

Presented to
The Library
of the
University of Toronto
by
Mrs. M.L. Davies

Digitized by the Internet Archive
in 2011 with funding from
University of Toronto

<http://www.archive.org/details/journals08soci>

~~Chem. & Phys~~
~~S~~

THE JOURNAL

OF THE

Society of Chemical Industry.

VOL. VIII.—1889.

390763
1.4.41

LONDON:

EYRE AND SPOTTISWOODE, HER MAJESTY'S PRINTERS,
EAST HARDING STREET, FLEET STREET, E.C.

TP
/ 500
v. 5
cop. 2

Journal of the Society of Chemical Industry.

INDEX OF VOL. VIII.—1889.

INDEX OF AUTHORS' NAMES.

	PAGE		PAGE
Abakanowicz, B. A., and Arsonval, A. d'. Electric batteries.....	402	Andreoli, E. M. H. Sodium Hypochlorite	865
Abbe. Refractive Index Apparatus.....	614	Bleaching Paper Pulp by Electricity.....	721
Abbot and Trimble. Solid Hydrocarbons in the Vegetable Kingdom	124	Andrews, A. Varnish for Iron.....	291
Abbott. Vulcanising India-rubber.....	376	Andria, M. N. d'. Ammonia Salts.....	284
Abegg, W. A. Quicksilver in Russia.....	657	Purification of Hydrochloric Acid.....	45
Abel, Sir F. A. Gum-cotton.....	518	Treatment of Acid Liquors from Galvanising Works.....	52
Flashing Point of Petroleum.....	734	Treatment of Scrap Tin.....	53
Abel, W. J. Discussion on Technical Education.....	348	Amab, J. Lubricating Compound.....	467
Abell, W. P. Centrifugals for Sugar.....	107	Annaudale, J. H. Paper Manufacture.....	634
Abenius. Piperazine.....	576	Appleton, D. See Hopkinson.....	604
Acheson, E. G. Generation of Electricity by Heat.....	901	Appleyard, J. R. See Knecht.....	457
Acland, T. D. Superphosphates as Manure.....	315	Archbutt, L. Olive Oil.....	685
<i>Action Ges. f. Anil. Fab.</i> Brown Colouring Matters.....	538	Arche, A. Separation of Lead from Silver.....	190
Homologues of Primulines.....	980	Archer, J. B. Gas Manufacture.....	872
Naphthol disulphonic Acid.....	280, 281	Water Oil Gas.....	51
<i>Actienes f. Chem. Ind. Rheinau.</i> Retenequinone Colours.....	279	Archleb, J. Alcoholic Fermentation.....	300
Adair, T. Butter Manufacture.....	409	Aria, C. D. Papier Maché.....	565
Adametz, T. Endosperm of Barley.....	290	Armstrong, H. E. Cinchona Alkaloids.....	160
Adams, P. H. and O. T. X. Treatment of Ores.....	989	Discussion on Technical Education.....	331
Adant, G. Slab Sugar Manufacture.....	810	Naphthol Sulpho Acids.....	277
Addis, Y. H. Mexican Pottery Glaze.....	707	Armstrong and Ackworth. Action of Cupric Nitrate.....	858
Adrian, L. A. Evaporator for Extracts (illus.).....	184	Armstrong and Fielden. Artificial Boracol.....	476
Pharmaceutical Extracts.....	210	Arnaut, M. Strophantus Globre.....	211
Adrian, M. Alcohol and Water Tannins.....	184	Tauhinin.....	1008
Agricola. Manufacture of Steel.....	787	Arnold, D. J., and Coryell, H. B. Dry Galvanic Battery.....	865
Aguiar. Naphthylene diamines.....	278	Arnoux. Anagris betida.....	413
Ahrens, P. B. Mandragora Alkaloids.....	814	Aronstein, L., and Holleman, A. F. Stilbene.....	114
Mandragorin.....	915	Arsonval, A. d'. See Abakanowicz.....	402
Aikman, C. M. Discussion on Technical Education.....	246	Artmann. Creolin.....	274
Aikman, D. Treatment of Pent.....	382	Arzeno. See Cella.....	63
Alberger, J. L. and others. Salt Manufacture (illus.).....	885	Asboth, A. v. Estimation of Starch.....	574
Albert, H., Fellner C., and Ziegler, C. Pyrites Furnace.....	119	Starch Determination.....	428
Alexander, F. H. Secondary Batteries.....	805	Asboth, H. von. Pyridine in Amyl Alcohol.....	734
Alla, L. See Aubin.....	309, 574	Ascough, J. Antiseptic Washing Compound.....	391
Allan, D. See Bishop.....	177	Ashley, E. A. Scouring Soap.....	467
Allan, J. See MacIvor.....	552	Ashley, H. M. Bottle Machine.....	780
Allen. Clarke's Soap Test.....	256	Ashwell, J. R. Discussion on Technical Education.....	317
Allen, A. H. Condenser Support (illus.).....	82	Askew, C. B., and Pumpelly, J. K. Secondary Batteries.....	804
Discussion on Action of Water on Lead.....	251	Assumpção, C. A. d., and Dias, E. T. Treatment of Coal.....	873
Discussion on Borax Lake.....	857	Atherley, R. L., and Sarti, A. E. Gold Extraction.....	804
Paraffin Wax.....	463	Atkins, C. H. Treatment of Paper Pulp (illus.).....	209
Allen, G. W., and Bowers, H. J. A. Purification of Water.....	271	Atkins, G. J. Treatment of Gold Ore.....	200
Allen, H. Effect of Rolling and Drawing on Steel.....	51	Atorburg. Naphthylene diamines.....	278
Allihn, F. Zero Points of Thermometers.....	886	Aubin, E., and Alla, L. Nitrogen Determination.....	309, 574
Alliott, J. See Newlands.....	128	Auer. Chlorate of Potash.....	168
Althausse, M., and Thruss, G. Absorption Spectra of Organic Compounds.....	1012	Auer, H. See Bolton.....	706
Absorption Spectra of Naphthylamine Derivatives.....	367	See Wylie.....	884
Amthor, C. Maltose.....	57	Ange, A. Soda Alum.....	706
Anderson. Cotarnine.....	59	Ange, E. Alumina Salts.....	393
Vulcanised India rubber.....	376	Ausserwinkler, L. Tests for Fats.....	159
Anderson, P. E., and Hodzson, S. Treatment of Wool.....	282	Avenarius, R. Preservative Paint.....	163
Anderson, I. M. T. and A. Explosives.....	818	Averell, J. D. Gas Manufacture.....	534
Andés, L. E. Disinfectant Varnish.....	553	Avery, R. B. Gas Generators.....	272
Andiran, A. J. J. d'. See Durand.....	581		
André. Action of Magnesium Chloride on Lead Oxide.....	794		
Nitric Acid in Plants.....	405		
André, G. Ammonia-Chlorides of Mercury.....	915, 916		
See Berthelot.....	56		
		<i>Edcock and Wilson Company.</i> Bagasse Furnaces.....	910
		Bach. Testing Carbolic Powder.....	1013
		Bach, O. Testing Machine Oils.....	999

	PAGE		PAGE
Bache-Wuz, H. and C., and Drewsen, V. B. Cellulose.....	814	Beechi. Test for Cotton-Seed Oil	63
<i>Badische Anilin- u. Soda Fabrik.</i> Alizarin Black.....	772	Test for Lard.....	644
Colouring Matters	770, 771, 772	Testing Lard	31
Liquid Chlorine (illus.)	777	Beckett, G. H. Production of Ammonia.....	507
Methylene Blue	557	Beckwith, J. H. See Howe.....	35
Naphthalene Dyes (Rosinduline).....	877	Bequerel, E. Phosphorescent Sulphides.....	117
Nitroso-Compounds	280	Bédard, V. See Hervieux, G.....	624
Rhodamines	389	Bedson. Discussion on Technical Education	312
Baessler. Cultivation of Potatoes	205	Bedson, P. P. Aluminium from Cryolite.....	985
Baeyer and Bloem. Dihydroxyquinoline	769	Salt Stalactites.....	98
Baeyer and Fritsch. Sinalbin Derivative	915	Breman, J. S. See Johnson, M.....	713
Baeyer. See Claisen.....	556	Beer, F. Composition for Moulding.....	621
Bailey. Discussion on Calorific Value of Coal	527	Behrend, P. and Kast, H. Titration of Gases.....	136
Discussion on Technical Education.....	398	Beilby. Distillation of Shale	102
Bailey, G. H. Sulphur in Coal	360	Beilby and McArthur. Distillation of Paraffin.....	166
Bailey, M., and Warner, J. Plates for Secondary Batteries...	201	Boilestein and Jawein. Electrolytic Analysis.....	257
Bailey, T. L. Sulphur in Coal.....	361	Boilestein and Kahlberg. Nitronaphthylamine	386
Bailhaeche. Nitric Acid Determination.....	820	Boilestein. Test for Beef Stearin	31
Bairds, Messrs. Ammonia from Blast Furnaces.....	787	Belitzki. Gelatin Emulsion	725
Baker, H. M. Magnesium Chloride	191	Bell, J. F. Water Gas	605
Ball, E. J., and Brough, E. H. Amalgamation of Ores (illus.)	287	Bell, Sir L. Gaseous Fuel.....	761, 863
Ball, E. J., and Wincham, A. Influence of Copper on Steel ..	516	Iron smelting.....	890
Ball, E. J. See Roberts-Austen	808	Iron and Steel Industry	782
Balls, M. Reduction of Tartaric Acid	474	Vote of Thanks to President.....	510
Balp and Broglio. Tertiary Amyl Nitrite	1003	Bell, R. Ammonia from Shale.....	102
Bamberger, E. Fichtelite.....	383	Paraffin Oil.....	100
Bamberger, E., and Bortd, F. Tetrahydronaphthylamine ..	387	Bell, W. Sodium Sulphate in the Fixing Bath	725
Bander, F. Sugar refining.....	128	Bellingrodt, P. Basic Bismuth Nitrate.....	210
Banz. Impurities in Alcohols	324	Bender, F. α -Naphthol Sulphonic Acids	609
Bang and Ruffin. Purification of Spirit (illus.).....	412	Benedikt. Detection of Mineral Oils.....	735
Bannister, J. W. Dyeing Fabrics.....	190	Turkey Red Oil	573
Bannist, M. C. Pumps for Gases	111	Turkey Red	188
Barbe. Vinegar Manufacture	393	Benedikt and Cantor, M. Determination of Glycerol.....	574
Barber-Starkey, W. J. S. Electric Batteries.....	714	Estimation of Glycerol	60
Barbezat and Obregia. Sulphur Determination.....	967	Benedikt, R., and Grussner, A. Analysis of Ethereal Oils ..	925
Barbier, J. Electrical Accumulators	51	Benedikt, R., and Grussner, H. Determination of Methoxyl (illus.)	735
Barlet, G. Exalgine	567	Benedikt, R., and Hazura, K. Composition of Solid Fats.....	897
See Dujardin-Beaumetz.....	412	Benedikt and Zsigmondy. Estimation of Glycerin.....	6
Barker, H. Gluten Manufacture.....	633	Benewitz, C. Potato Spirit.....	559
Barnsiddle, W. Desiccating Blood, &c.....	294	Bennett, J. D. Aluminium.....	800
Barret. Electrical Properties of Silicon Steel.....	796	Benneth. Opal Glass	195
Barth. See Hasiwetz.....	174	Bennard. See De la Roche	32
Barth, L., and Herzig, G. Hermaria.....	815	Bérard, G. H. Treatment of Peat Fibre.....	539
Bartlett, C. H. Balances.....	604	Berend, O. A. Filter (illus.)	379
Bartlett, F. L. Lead Pigments	808	Bergé, A. H. J. Saccharification	633
The Leadville Sulphurets	836	Berger. Naphtholsulphonic Acids.....	384
Treatment of Ores	989	Bergh, W. Centrifugal Separators	530
Bartlett, J. M. See Jordan, W. A.....	629	Bergmann. See Fresenius.....	261
Bass. See Ellenberger.....	113	Berkovits, M. See Reisz.....	802
Batchelor, T. C. See Butterfield.....	1009	Bernard, C. Influence of Carbonic Oxide on Germination....	554
Bateman, F. W. M. Marking Transparent Soap	807	Bernheim. Buetrin in Grain	590
Batho. Steel Furnace.....	546	Bernreuther, K., and Kumpfmiller, W. Maceration of Barley.	301
Baubigny, H. Action of Sulphuretted Hydrogen on Zinc Salts	216	Bernthsen, A. Methylene Blue	152
Separation of Zinc from Nickel	307	Hydrazone of Acridylaldehyde	596
Separation of Zinc and Cobalt	179	Berthelot. Action of Acids on Thiosulphates.....	619
Baubigny, M. Separation of Cobalt and Nickel.....	62	Alexandrin Blue.....	113
Bauer, E. Saccharification of Starch	561	Benzene in Coal Gas.....	221
Bauer, P. T. Coke Ovens.....	10	Combustion.....	181
Bauer, R. W. Sugar from Laminaria	106	Congress of Chemistry.....	656
Bauer, T. von. Coke Ovens	873	Dinitrobenzene.....	283
Baurmeister, A. See Fleiner.....	462	Fixation of Nitrogen by Soil.....	626
Baum. See Schaffer.....	609	Gas Analysis	64
Baumann, A. Weight of N ₂ O, per cent. of NO	125	Heat developed by Solution of Hydrochloric Acid Gas in Water.....	861
Baumann and Gersons. Guanidine	131	Nitric Acid in Plants.....	405
Baumann. Boric Acid in Plants	569	Raffinose.....	993
Baumann, G. Boric Acid in Vines.....	130	The Thionine Series.....	541
Baumann, A. Refining Sugar	510	Berthelot and André, G. Nitrogen in Soils.....	56
Baur, A. Musk Substitute	1004	Berthelot. Prussian Blue	758
Baxter, R. S., and MacDonald, G. D. Cotton Seed Cake.....	631	Bertoni. Amylo-nitrous Ether	1003
Bayer. Croceine Sulphonic Acid	276	Bertram, A. N. Treatment of Noxious Fumes.....	814
Bayer, F. & Co. Blue Azo-Dyes	41	Bertram, J., and Gildemeister, E. Betel Oil	816
Printing Azo-Colours	12	Bertschinger, A. Sand Filters at Zurich	998
Bayley and Lomas. Titration of Webbon Mud.....	968	Berzelius. Action of Sulphuretted Hydrogen on Zinc Salts	216
Baynes, J., and others. Composition for Ships' Bottoms.....	808	Lamp	61
Bazin, E. Production of Cold	759	Selenium.....	658
Beach, W. H. Receiver for Volatile Liquids	1009	Sulphuric Acid Process.....	105
Beau, W. See Lefmann, H.....	480, 561	Bessemer, H. Malleable Iron	787
Beau, E. Insecticide.....	111	Besson. Cupokt.....	395
Beardmore, T. Valves for Regenerative Furnaces.....	767	Beswick, S. E. Varnish for Harness.....	716
Beardsley, M. W. See Pearce.....	174	Bevan, E. J. Discussion on Applications of Oxygen	86
Beauffy, M. H., and Cartwright, J. Non-Alcoholic Beverage ..	295	See Cross.....	5, 252
Beaumont, E. A. B. Treatment of Beer, &c.....	995	Beveridge, J. Smoke-consuming Furnace.....	39
Beaurepaire, M. Durane.....	187	Bewlay, H. See Lloyd, G. H.....	767
Bechamp, A. Milk.....	58	Beythien, A., and Tollens, B. Raffinates.....	557
		Bibbins, T. L. See Wilson, R. P.....	465
		Biehler, J. See Reisz.....	802

	PAGE		PAGE
Bichon, Cupola.....	395	Boussingault, Nitric Acid in Rain.....	627
Bickford, Fuse.....	417	Oxygen.....	82
Bickford and Co. Fuse Igniter.....	818	Bowen, E. Tin Plate Liquors.....	193
Bidet, A. Influence of Thiophen on Benzene Derivatives.....	383	Bowen, O., Tomkins, A. S., and Cobdellick, J. Charcoal Manu- facture.....	61
Biedermann, E., and Harvey, E. W. Regenerative Furnace.....	765	Bower, H. Facilitating Chemical Reactions.....	972
Billault, E. A. Coating Metals with Sulphide of Silver.....	188	Bowers, H. J. A. See Allen.....	271
Billings, P. See Letalle, A. E.....	477	Bowick, Purification of Spirit (illus.).....	443
Binder, P. See Noetting, E.....	188	Bowley, J. J. Soap.....	714
Binnis, F. J., and Paris, R. J. Composition for Ships' Bottoms.....	291	Bowman, Discussion on Technical Education.....	347
Bison and Grandtits, Zinc extraction.....	545	Bowman, F. H. Structure of Wool.....	18
Birhans, F. Solid Nitrogen Trioxide.....	726	Bowman, R. D. Mantles for Incandescent Lamps.....	973
Birrell, H. A. Treatment of Ground Malt.....	966	Bowry, Urechitine.....	111
Bischof, G. Discussion on Explosives.....	524	Box, Dissipation of Heat.....	855
Bischoff, C. A. Piperazines and Hydrated Diazines.....	976	Boyer, S. S., and Steele, P. P. Treatment of Fibre.....	303
Quinoline Derivatives.....	769	Boyd, W. See Campbell, A.....	534, 703, 983
Bischoff, C. A., and Nastvogel, O. Acipiperazines.....	977, 978	Boyon, E. von. Higher Aromatic Hydrocarbons.....	974
Bishop, G. T. Soap Manufacture.....	991	Residual Paraffin.....	273
Bishop, F., and Allan, D. Washing Photographs.....	477	Bradburn, J. A. Caustic Soda.....	797
Bishop and Engé, L. Cotton-Seed Oil in Lard.....	63	Bradford, Separation of Zinc and Manganese.....	62
Black, W., and Remoldson, W. L. Antiseptic.....	131	Bramhall, Cupola.....	393
Blackmore, H. S. Sodium Manufacture.....	122	Branwell and Hughes, Cyanogen.....	758
Blair, A. A. Analysis of Iron.....	496	Brand, A. Electrolytic Separation of Metals.....	1011
Blair, F. A. Dye Vats, &c.....	982	Brandenburg, P. Pure Grape Sugar.....	470
Blakely, W. Funnels.....	808	Brands, W. Creosote.....	422
Blancaneaux, H. B. de. Cutter for India-rubber Trees.....	808	Branson, F. W. Triple Bunsen Burner (illus.).....	957
Blass, E. See Fox, S.....	873	Brasier, E. Fibrous Sheets or Slabs.....	513
Blenkinsop, W. E. H., and Lyte, F. M. Lead Salts.....	777	Treatment of Fibres.....	634
Blechnmann, The Bunsen Lamp.....	180	Braylants, Influence of Saccharine on Digestion.....	813
Blöem, See Baeyer.....	769	Brazier, E., and Thompson, J. Tin-plating.....	801
Blomstrand, Swedish Copper Mines.....	658	Breden, A. See Koffler.....	400
Bloxam, Sodium Flumo.....	179	Bredig, See Will.....	59
Blum, L. Carbon in Iron.....	922	Bredt, P. Slag as a Manure.....	125
Magnesia Determination.....	922	Brein, F. Solubility of Wool.....	458
Manganese Determination.....	922	Triphenylpararosaniline.....	455
Sulphur in Coal.....	361	Turkey-red Oil.....	573
Blumenthal, See Randohr.....	191	Brenner, G. N. Treatment of Sewage.....	411
Boa, Discussion on the Work of the Sections.....	969	Brémont, Desiccation of Gas.....	949
Boake, A., and Roberts, G. A. Treatment of Paper Pulp.....	565	Brentini, P. Removing Paint.....	716
Boake, A., and others, Sodium Meta-sulphite.....	119	Brevort, H. L. See Roberts, J. L.....	623
Boas Bonsson, See Nötting.....	422	Breyer, J. Raffinose in Raw Sugar.....	616
Bobrownicki, A. Treatment of Refuse.....	1090	Breze, J. H. Condensers.....	271
Boeard, Cupola Blast.....	391	Briem, H. Sugar Beet.....	628
Boek, J. Sugar Candy.....	632	Brighthouse, G. See Davies.....	269
Boddé, H. Distinction of Resorcinol.....	734	Brin, A. Oxygen Manufacture.....	46, 411
Bode, F. Lead for Vitriol Chambers.....	774	Oxygen.....	694
Specific Heat of Sulphuric Acid.....	543	Brin, L. Q. Aluminium Alloy and Plating.....	199
Boehm, See Engler.....	106	Aluminium Bronze.....	339
Boehring, Eseridine.....	1061	Aluminium Plating, &c.....	548
Boessneck, P. Valuation of Argol.....	420	Aluminium Plating.....	897
Bohlig and Hoyne, Magnesium Chloride.....	191	Iron Alloys.....	897
Böhlin, Curarine.....	476	Brin's Oxygen Company, Aeration of Liquids.....	759
Bohm, W. D. Expulsion of Gases from Solutions.....	399	Ageing Wines, &c.....	812
Filtration (illus.).....	271	Purification of Gas.....	381
Bohme, Cement.....	782	Visit to Works of.....	517
Influence of Frost on Cement.....	393	Brin's Oxygen Company and Goble, P. B. W. Carbonated Oxygen Water.....	301
Magnesia in Cements.....	59	Brisset, M. V. Purification of Fats.....	624
Silver Gray Dye.....	981	Bristol, L. Electrical Accumulators.....	623
Böhringer u. Sohn, Cocaine.....	1004	Britton, J. B. Chromium Determination.....	421
Bolley, Allotropic Lead.....	52	Brocklehurst, G. Evaporating Pans.....	107
Bolton, Micro-organisms in Water.....	911	Broglio, See Balp.....	1003
Bolton, G. H., and Bullough, T. A. Treatment of Lime Mud.....	779	Bromeis, Fichtelite.....	582
Bolton, G. H., and others, Permanganates and Chlorates.....	706	Brönner, β -Naphthylaminesulphonic Acid.....	699
Bolton, G. H., and Wyde, J. R. Multiple Effect Evaporation.....	884	Naphthol Sulpho Acids.....	276
Bombelon, E. Mercuro- β -Naphthol.....	1093	Brook, E. Gas Producers.....	581
Mercury- β -Naphthol Acetate.....	596	Brook, E., and Wilson, A. Gas Producer.....	533
Bondonneau, M., and Foré, G. Sugar from Starch.....	295	Brook, R. G. See Johnson, J.....	539
Boniza and Negrita, Lantamine.....	477	Brooke, Simpson, and Spiller, Primuline.....	389
Bonnard, J. B. G. Decoration of Glass, &c.....	196	Brotherhood, C. Oil Gas.....	873
Photographing in Colours.....	414	Brough, B. H. See Ball.....	287
Bonne, C. R. Treatment of Brewers' Worts.....	812	Brown, A. P. Mercury Oleate.....	567
See St. George.....	54	Brown, H. T., and Morris, G. H. Molecular Weights of the Carbohydrates.....	717
Borbély, Puddling Furnace.....	894	Amylodextrin.....	746
Bordt, F. See Bamberger.....	387	Brown, J. Campbell, Discussion on Technical Education.....	357
Borgmann, E., and Fresenius, W. Pure Sherry Wines.....	56	Report on Technical Education.....	359
Borland and Reid, Carbo-dynamite.....	522	Discussion on Electrolytic Analysis.....	262
Börnstein, E. Detection of Saccharin.....	216	Discussion on Chlorate of Potash.....	172
Borntrager, H. Examination of Spirit.....	64	Brown, W. Dyeing, Scouring, &c.....	704
Borsche, G., and Bruijes, F. Chloride of Magnesium.....	392	See Lemox.....	997
Bottlinger, C. Carbonyl Sulphide.....	283	Bruch, L. Dyewoods and Extracts.....	612
Bottomley, Steel for Magnets.....	796	Brühl, J. W. Air Bath for Flask (illus.).....	134
Bouchard, Beta-Naphthol.....	176	Determination of Fat.....	573
Bouchardat, G., and Lafont, J. Conversion of Terpine into a Mentane.....	131	Fractional Distillation in Vacuo (illus.).....	134
Boult, W. S. Oil-testing Machine (illus.).....	647	Laurene and Mentane.....	635
Bourguet, E. Sugar in Mushroom.....	495	Brulle, R. Determination of Sulphur in Coal (illus.).....	219
		Reactions of Oils with Nitrate of Silver.....	924
		Sulphur in Coal.....	364

	PAGE		PAGE
Brügger, H. <i>See</i> Salomon	814	Carpenter, W. Lamb. Discussion on Technical Education	333, 340
Brünjes, F. <i>See</i> Borsche, G.	392	Carr, I. Dinsmore Process of Gas Manufacture	960
Brunner, H. Discussion on Chlorate of Potash	172	Carre, E. Refrigerator	378
Test for Caustic Alkalies	920	Carter-Bell, J. Discussion on Yorkshire Grease	92
Brunner, J. C. A. Purification of Glycerin	807	Estimation of Iron in Water	175
Burton, J., and Griffiths, L. Artificial Stone	129	Cartwright, J. <i>See</i> Beaudry, M. H.	395
Brush Electric Light Company. Visit to Works of	517	Carver, H. <i>See</i> Walker	189
Brustlein, Silicon Steel	800	<i>Casamajor Filter Company</i> . Cleansing Filtering Media	407
Brylants. Saccharine	59	Cassella, L., and Co. Azo-Dyes	980
Bryan, St. G. T. C. Slag for Pavements, &c.	622	Beta-naphtholmonosulphonic Acid	275
Bryan, Denkin, and Co. Value of Fuels	362	Nitroso Colours	280
Buch, C. von. Incandescence Mantles	272	Thiodiarynes	608, 771
Buchka, K. Meta-nitrotoluene	388	Castell, J. Manganese Oxalate as a Drier	714
Buchka and Erk. Monobromobrazilin	709	Oxalate of Manganese	123
Buchner. Cadmium Sulphide	807	Castle, T. <i>See</i> Fawcett	462
Budrin, P. Manurial Experiments	905	Cawley, G. Discussion on Technical Education	310
Budweis, F. G. Mannures for Sugar Beet	905	Cazenave, P. Camphotropenol	815
Buquet, H. Testing Cement	621	Impurities in Alcohols	924
Buisine, A., and P. Acids in Suint	55	Cazenave, P., and Hugouenq, L. Red Sandal Wood	59
Suint	23	Cella, D., and Arzeno. Acetanilide	63
Bujard, A., and Waldbauer, G. Adulteration of Lard	480	Cerast. Therapeutic Action of Picric Acid	476
Bulk. Reduction of Rosaniline	456	Cesaro, W. Ammonia-Soda Process	460
Bull, J. C. Zinc Alloys	200	Chabry, L. Diffusion	776
Bullock, C. Manganese	622	Chambers, C. <i>See</i> Ponton, A. C.	432, 622
Bullough, T. A. <i>See</i> Bolton, G. H.	779	Champion. Lanuginic Acid	457
Bunge, N. Gas Analysis	922	Champt. Glucose from Jerusalem Artichokes	294
Bunsen. Estimation of Manganese (illus.)	307	Chance, A. M., and J. F. Treatment of Alkali Waste	119
Flame	180	Sulphuretted Hydrogen Manufacture	46
Gas Analysis	922	Treatment of Sodium Sulphide	118
Solubility of Oxygen in Water	726, 727	Chandler, H. H. Welding Copper	802
Bunsen and Playfair. Cyanogen from Blast Furnace	768	Chapman, A. Vacuum Evaporator	124
Bunte. Gas Analysis	136	Chapman, H. M. Percussion Caps	919
Burbridge. Vulcanised India-rubber	376	Chapman, L. <i>See</i> Ellice-Clark	46, 396
Burch. Sunlight	183	Chapman. Action of Acids on Yeast	471
Burch, G. J. E.M.F. of Copper	858	Chappel, H. <i>See</i> Lockwood	802
Burg. Picene	273	Chardonnet-Hilaire de. Treatment of Pyroxilin	474
Burghardt. Oxidation of India-rubber	173	Charpentier, P. Assay of Fine Gold	639
Vulcanised India-rubber	376	Chatelier. Solubility of Cuprous Chloride	883
Burghardt, C. A. Pure Zinc	804	Chatelier, H. le. Portland Cement	513
Reduction of Zinc Oxide	803	Chattfield, R. E. Ammonia Sesquicarbonate	284
Reduction of Zinc Oxides	551	Carbonate of Ammonia	392
Burkhard, G. Raffinose	296	Chattaway, W. Condenser Support (illus.)	82
Burnell, G. and A. Cleansing Wool	29	Chevrel, Dyewoods	613
Burns, T. Treatment of Skins	773	Sulphur in Wool	458
Burrows, W. A. Treatment of Leather Waste	809	Wool	22
Butterfield, J. C., and Batchelor, T. C. Cartridges	1009	Chevrel, M. E. Obituary	268
Buttner, A., and Meyer, C. Dyer for Pulps	867	Chimney, W. M., and Tarbutt, P. Hydrocarbon Lamp	39
		Chittenden. Pancreatic Juice	630
Caillot, J. India-rubber Goods	992	Chotzen, M., and Silbermann, O. Antiseptic Fabric	1001
Calabrese, L. H. Purification of Zinc	898	Christek. Fermentation	300
Calvert, Grace. Sulphur in Coal	334	Frothy Fermentation	559
Calvert, J. Chinese Method of Extracting Opium	916	Christophe, A. T. Rectification of Alcohol	719
Cameron, H. F. & Co. <i>See</i> Harris	805	Christopher, G., and Leftwich, R. W. Extract of Tea	997
Campbell, A., and Boyd, W. Chlorine Manufacture	706, 983	Christy, T. Technical Instruction in Germany	858
Treatment of Coal Gas	534	Chrontschoff, P. Reciprocal Displacement of Acids	900
Campbell, J. H. Ammonia Engines	531	Church, B. E. <i>See</i> Dewrance	808
Candlot. Portland Cement	543	Cianician, G., and Silber, P. Apol	305, 1007
Cannizaro. Saponin-oxime	721, 1003	Methylpyrrolines	974
Canon, M. Acetic Acid	513, 779	Cianician and Weidel. Dimethylpyrrolone	975
Cantor, M. <i>See</i> Bone-lik	60	Classen. Abnormal Beetroot	557
Cap, n. A. J. Treatment of Sewage	131	Claisen and Baeyer. Tartrazines	536
Carallo, V., and Caruso Pecosaro. Caffeine	1003	Clapp, E. H. <i>See</i> Gaunt	868
Carew, H. G., and Potts, P. B. Hollow Bricks	622	Clark. Fichtelite	382
Carey, E. Discussion on Chlorate of Potash	15	Clark, D. <i>See</i> Noakes	568
Discussion on Technical Education	172	Clark, H. Paint Mill	760
Discussion on Treatment of Black Ash	356	Clark, J. Discussion on Technical Education	345
Carious. Aqueous Ammonia	390	Clark, L. Eikonogen	958
Specific Gravity of Solutions of Ammonia	512	Clark, W. Gas Manufacture	768
Carl. Electro-Magnetic Explosive	40	Clark, W. G. Coating Metals	802
Carles, P. Caustic Action of Carbolic Acid	507	Clarke, F. W. Distribution of Boron	569
Carleton, G. E. Limelight	102	Classen. Electrolytic Analysis	257
Carlisle, F., and Hoffman, C. E. Absorber for Gases	119	Lane Determination	821
Carlsson. Iron Manufacture	545	Classen, A., and Schelle, R. Analysis by Electrolysis	137
Carnelly. Iron Determination	175	Claude. Consumption of Spirit in France	441
Melting Point of Aluminium	464	Claus. Naphthol Sulpho Acids	277
Carnot, A. Analysis by means of Hydrogen Peroxide	138	Claus, A. Dihydroxynaphthalene	535
Ammonio-Colalitic Salts	923	Claus, A., and Dreher, A. Metacresol	768
Estimation of Mercury, Silver, and Thallium	923	Claus, A., and Fabrian, W. Carvacrolsulphonic Acid	816
Estimation of Manganese	246	Claus, C. F. Carbonates of Ammonia	779
Lithium Determination	478	Claus, W. H. <i>See</i> Thompson, W. G.	538
Peroxides of Cobalt and Nickel	630	Clayton, H. F., and Holdroyd, G. H. Filter (illus.)	111
Caro, H. Naphthol Yellow	537	Clemon. Magnesium Chloride	191
Sulphonated Rosaniline	275	Clerc. Beet Analysis	1014
Caro and Kern. Benzyl-Violet	40	Clerget. Estimation of Sugar	569
		Clerk, Dugald. Combustion	181
		Clermont, P. de. Saccharine	473

	PAGE		PAGE
Clery, A. See Waxin.....	51	Dahl, Dehydrothioluidine.....	685
Cleve, P. T. Amidonaphthalene-sulphonic Acids.....	116	Naphthylaminesulphonic Acid.....	535
α -Nitronaphthalene.....	116	β -naphthylaminesulphonic Acid.....	620
Cleve and Forsling. Naphthylamine-sulphonic Acids.....	585	Sulphoated Beta-naphthylamine.....	276
Cliffe, J. Asphalt for Roofs.....	51	Thioluidine.....	12
Cluss, A. Natural Cements.....	708	Dahl, C. F. Paper Pulp.....	811
Coates, I. M. Anti-incrustator for Boilers.....	972	Dahl, H. G. Sterilising Milk (illus.).....	130
Cobeldick, J. See Bowen.....	61	Dahl and Co. Chromogen.....	389
Cochrane, C. Iron Smelting with Lime as Flux.....	890	Diamidodibenzylbenzidine.....	702
Coghlan, J. Natural Gas near Sydney.....	112	Diamidodibenzylbenzidine Colours.....	611
Cohn, Spontaneous Combustion in Hay.....	935	Naphthylaminesulphonic Acid.....	385
Cohn, W. Report on Manure Manufacture.....	141	Dahmen, H. R. von. Hydrocarbon Soap.....	991
Coleman, J. Diffusion.....	776	Dale, J. Obituary.....	528
Coleman, J. B. Discussion on Technical Education.....	349	Dale and Schorlemmer. Pararosaniline.....	435
Coleman, J. H. See Cummins.....	898	Dalican. Solidifying Points of Fats.....	12
Coleman, J. J. Refrigeration.....	169	Dalton. Aqueous Ammonia.....	309
Collé, C. See Lalousse.....	466	Dambmann, C. F. W. See Glaser, C.....	127
Collett, H. See Sawrey.....	272	Daniels, W. H. Antiseptic Compound.....	1001
Colson, A. Colours from Benzidine Tetrabenzyl Ether.....	451	Antiseptic.....	411
Combemale. See Mairat.....	728	Danielson, L. G. Paper Manufacture.....	634
Combes, A. Action of Diamines on Diacetones.....	976	Darby. Iron Smelting.....	783
Comstock. Cinchona Alkaloids.....	475	Darby, J. H. Ingot Steel.....	549
See Remsen.....	958	Open-Hearth Steel.....	546
Conacher, A., and Williams, O. L. Ice Manufacture.....	269	Darlington, F. A. See MacIvor.....	752
Conant, G. A. Laundry Blue.....	704	Daudenart, L. G. G. Hydrated Phosphates.....	118
Conrad, W. Methylene Blue.....	153	Maznesia from Sea Water.....	401
Constable, W. E. and Joseph J. Artificial Stone.....	51	Davies, E. A. Galvanising Iron.....	898
Cookson, N. C. Coating Iron with Antimony.....	464	Davies, J. Boiler Furnace.....	873
Cooper, C. F. See Hermite.....	289	Davies, W. H., and Brighouse, G. Phenol Vapour as a Curative.....	209
Cooper, C. W. Treatment of Hides.....	553	Davies, Bros. and Co. Galvanising Iron.....	898
Cooper, L. See Langner, J. von.....	696, 873	Davis, C. B., and Riddell, E. H. Filter.....	868
Coppola, F. Santonin-oxime.....	724, 1094	Davis, G. E. Ammonia Still (illus.).....	884
Couillon. Estimation of Methane.....	571	Discussion on Bisulphide of Carbon.....	47
Cornet, V., and Jones, A. Salt Manufacture.....	780	Discussion on Committees of Chambers of Commerce.....	961
Cornish, T. S. Defecators.....	298	Discussion on Technical Education.....	340
Cornwell, A. Galvanic Batteries.....	623	Refrigeration.....	959
Correns, E. Grids for Electric Accumulators.....	805	Report of Alkali Works.....	169
Cort. Malleable Iron.....	783	Softening Water.....	565
Coryell, H. B. See Arnold.....	805	Davis, G. E., and Duxbury, P. Paper Making.....	565
Cosh, W. M. Gas Generator.....	531	Davy. Aqueous Ammonia.....	390
Cosslett, R. Anti-incrustator for Boilers.....	971	Magnesium Chloride.....	191
Coulon, M. Estimation of Wood Cellulose.....	574	Davy, Sir H. Rate of Ignition.....	181
Coupe, G. E. See Hornsby.....	129	Dawson, D. Indigo Dyeing.....	611
Courtaud. See Pozzi.....	566	Day, D. T. Mineral Resources of the United States.....	589
Cousinier. Ferment in Ungermated Grain.....	560	Deacon, H. W., and Hurter, F. Chlorine.....	119, 779
Cowan. Visit to Sugar Refinery of.....	516	Debray. Allotropic Metals.....	52
Cowles. Aluminium Furnace (illus.).....	478	Debray, P. See Durand-Claye.....	48
Electric Furnace.....	900	Debrierre. Viburnum.....	477
Reduction of Oxides.....	136	De Chardonnet. Artificial Silk (illus.).....	539
Cramer. Micro-Organisms in Water.....	911	Decoudun, J. Photographer's Photometer.....	725
Crampton, C. A. Boric Acid in Plants.....	569	Deighton, W. Gas Producers.....	768
Specific Gravities of Fats and Oils.....	555	Deiss. Extraction of Oil from Seeds.....	25
Specific Gravity of Lard.....	643	Dekien, L. Treatment of Flax.....	702
Crawford, M. Oil Press.....	290	Delachanal. See Vincent.....	295, 296
Crawshaw, D. Cooling Lubricating Oils.....	714	Delacharlony, P. M. Destruction of Moss and Action of Ferrous Sulphate.....	205
Creydt. Estimation of Sugar.....	560	De la Roche and Berard. Specific Heat of Water.....	32
Crompton, R. E. B. Electrical Furnaces.....	901	De la Rue, Warren. Obituary.....	293
Crompton, S. Sugar in Mortar.....	196	Deblaurier. Coloured Glasses in Photography.....	918
Cronquist, A. W. Behaviour of Explosives under Pressure.....	969	De Luyes. Compound of Orcinol and Sodium Chloride.....	611
Crookes, Odling, and Tidy. Action of Water on Lead.....	243	Delf, F. D. Retort Stand.....	425
Croselmir. Zinc Process.....	286	Denigès, M. Acetanilide.....	307
Cross, E. D. Galvanic Batteries.....	103	Reaction of Copper Salts.....	420
Cross, C. F. Action of Nitric Acid on Lignin.....	858	Deninger, A. Nitrophenols.....	538
Discussion on Technical Education.....	329	Dennstedt, M. Dimethylpyrrolines.....	975
Cross, C. F., and Bevan, E. J. Economy of Pure Caustic Soda.....	252	Dennstedt, M., and Lehne, A. Methylpyrrolines.....	974
Estimation of Glycerin.....	5	Desèsquelle, M. Camphor Phenols.....	636
Crossley, J. Disinfectant Soap.....	715	Deshayes. Properties of Steel.....	800
Sulphur in Coal.....	361	Desprez, F. See Violette, C.....	292
Crowder. Absorption in the Gay-Lussac Tower.....	9	Dessaignes. Apocorbie Acid.....	294
Cummins, G. W., and Coleman, J. H. Annealing Metals.....	898	Destremx, L. Destruction of Moss.....	245
Cundill. Explosives.....	920	Devarda, A. Action of Superphosphate on Nitrate.....	75
Cunliffe, R. Carboniser.....	579	Deveril, H., and Gallagher, W. Photographic Negatives.....	918
Curci, A. Anisic Acid.....	566	Devile, E. Ste. Claire. Aluminium.....	677
Currie, S. C. C. Indicator in Charging Secondary Batteries.....	289	Oil of Elemi.....	657
Curtius, P. Hydrazine Compounds.....	1004		
Cuthbertson, Sir J. N. Discussion on Technical Education.....	543	Paris Gasworks' Data.....	871
		Studies of Coal Gas.....	972
		Temperature of Flame.....	179
		Deville and Debray. Osmium.....	710
		Dewey, F. F. Cuprous Oxide in Metallic Copper.....	151
		De Wilde, P., and Reyher, A. Conversion of Oleic into Stearic Acid.....	466
		Dewrance, J., and Church, B. E. Cementing Asbestos.....	808
		Diana, A. Paper Manufacture.....	301
		Dias, E. S. See Assumpção.....	873
		Dick, R. Waterproof Sheetin.....	808
		Diehl, W. Ammonium Salts in Carnallite.....	983
Dacomo. Filicic Acid.....	412		
Dagger, J. H. J. Cowles' Aluminium Furnace (illus.).....	677		
Daguin, J. B. Soda Manufacture.....	193		
Sulphuric Acid Manufacture.....	193		

	PAGE		PAGE
Dieterich, E. Examination of Soap.....	423	Ebermayer, E. Absence of Nitrates in Forest Trees.....	292
Malt Extract.....	424	Ebert and Merz. Naphthalenedisulphonic Acid.....	385
Dietrich, T. Determination of Fat in Milk.....	823	Ebert, L. <i>See</i> Hoffmann.....	206
Indian Wheat.....	203	Eckhardt, H. Chromium Alloys.....	801
Dietzsch, C. Kiln for Carbonic Acid.....	284	Eckmann, F. L. Impurities in Spirit.....	310
Digby, E. J. T. Crucibles.....	621	Eder. Photographic Developers.....	817
Dimitry, C. P. Indelible Ink.....	43	Edison, T. A. Treatment of Ores.....	988
Dinsmore, J. H. R. Gas Manufacture.....	272, 351, 873, 960	Edmunds, H. Storage Batteries.....	401
Distler. Pyridine.....	113	Edwards, W. Treatment of Waste Waters.....	474
Dittler. Naphthylenediamines.....	278	Egasse, M. Urechit's Suberecta.....	411
Dittmar, W. Analyses of Tea.....	634	Eger, F. Fast Yellow.....	388
Discussion on Paraffin Manufacture.....	110	Egger, E. Extract in Wines.....	924
Discussion on Technical Education.....	344	Free Acid in Alum Cake.....	479
<i>See</i> Roscoe.....	862	Eggertz, C. G. Humus.....	104
Divers and Kwakita. Oxygen in Chontelone.....	175	Humus Substances in Soils.....	293
Divis, J. V. Hydrometers.....	761	Eggmann, A. <i>See</i> Jericka.....	472
Divis, J. V. Hydrometers.....	761	Ehrenwerth, J. von. Double Shaft Furnace.....	873
D'Humy, P. R. de F. Galvanic Batteries.....	401	Elhring, E. Basic Bismuth Salicylate.....	304
Dobbie. Discussion on Technical Education.....	332	Ehrlich, E. Oxidation of β -Naphthol.....	456
Dobbin. Sodium Hydrate in the Carbonate.....	820	Eichler, C. H. Paint.....	204
Doetsch, H. Copper Extraction.....	801	Eichorn. Zinc Furnace.....	546
Dommergues, G. Detection of Colours on Wool.....	216	Eidam, E. Adulteration of Linseed Meal.....	301
Donald, W. J. A. Chromates.....	391	Einhorn, A. Anhydro-cocaine.....	634
Donet, v. <i>See</i> Reymann.....	124	Cocaine.....	305
Donelson, E. V. Treatment of Rice.....	301	Ecgonine.....	914
Donkin, R. Amalgamation of Gold Ores.....	547	Einhorn, A., and Klein, O. Cocaine.....	131, 132
Dopping-Hepenstal, L. I. Connexion for Battery Plates.....	623	Elbers, A. D. Blast-furnace Slag.....	623
Doremus, C. A. Removal of Salts from Solutions.....	885	Defects of Wrought Iron.....	657
Doring, E. Waterproofing Fabrics.....	107	Elbs, K., and Hoermann, O. Diphenoltrichloroethane.....	876
Dossios. Coal Tar.....	954	Elder, H. M. Eikonogen.....	958
Dott, D. B. Uniform Weights.....	969	Ellenberger and Bass. Escrine-Pilocarpine.....	413
Doty, H. H. Treatment of Rhea Fibre.....	773	Ellie-Clark, E. B. Sulphuric Anhydride.....	119
Doughty, W. H. <i>See</i> Baynes, J.....	808	Ellie-Clark, E. B., and Chapman, L. Oxygen from the Air.....	46, 306
Douleron, A., and Meerbeek, E. van. Treatment of Fabrics.....	282	Elliott, J. Gas Producer.....	696
Doulton, Sir H. Visit to Works of.....	510	<i>See</i> Hicks.....	467
Dove, E. J. <i>See</i> Wailes.....	291	Ellis, F. Copper Alloy.....	802
Dowds, S., and Greenwood, W. Painters' Filling.....	204	Ellis, G. E. R. Cyanide Method of Copper Determination.....	686
Downton, H. G. Apparatus for Aerating.....	111	Hydrocarbon Furnace for Assaying (illus.).....	958
Dowson, J. E. Water Gas.....	869	Ellis, O. J. <i>See</i> Marcet.....	271
Dowson, J. E. and A. Scrubber for Gas.....	873	Elmore, F. E. and A. S. Electro-deposition.....	803
Doyère. Mercury Trough.....	922	Ellosser, S. Battery Solution.....	804
Drake, J. A. Filter Presses.....	449	Engel, L. <i>See</i> Bishop.....	63
Drake, J. A., and Muirhead, R. Filter Presses.....	186	Engel, F. Explosives.....	818
Dralle, C. <i>See</i> Schall, C.....	639	Engel, R. Solubility of Salts.....	883
Dratz, C. and H. Dyeing or Painting Fabrics.....	703	Engler and Boehm. Determination of Paraffin.....	106
Drechsel, E. Decomposition of Casein.....	813	Engler, C., and Kauer, A. Action of Acetone on Amidophenol.....	384
Dreher, A. <i>See</i> Claus, A.....	708	Engler, C., and Seidner, S. Heating Fats under Pressure.....	607
Drechsle, H. Gas Analysis.....	570	Ensor, A. R. Preservation of Seaweed.....	468
Dreschfeld. Pyridine.....	476, 722	Erban, F. <i>See</i> Schmidt.....	308
Dreser. Nicotine Bitartrate.....	723	Erebern. Bullion Assay.....	699
Drewsen, V. B. <i>See</i> Bache-Wug.....	814	Erickmann. <i>See</i> Weiss.....	291
Dreyfus, C. Primaline Derivatives.....	117	Erdmann, H. Progress in the Colour Industries.....	389
Dry, J. R. Treatment of Fibre.....	457	Erpf. <i>See</i> Greiner.....	394
Hubois, C. Treatment of Spent Gas Purifying Materials.....	696	Erwig, E., and Koenigs, W. Pentacetyl Dextrose.....	718
Ducrotet. Polarising Pyrometer.....	214	Pentacetyl Galactose.....	904
Dudley. Iron Smelting.....	783	Trimethyltinide.....	723
Dufrené. Cupola.....	395	Eschellmann, G. Chlorine from Magnesium Chloride.....	190
Duisberg, C. <i>See</i> Pflitzinger.....	384	Magnesium Chloride.....	391
Dujardin-Beaumez and Bardet, G. Exalgine.....	112	Sulphuric Acid Process.....	167
Dumas. Nitrogen Determination.....	920	<i>See</i> Mond, L.....	696
Red Lead.....	498	Eschka. Sulphur in Coal.....	361
Dunham. Accumulators.....	201	Esoy, J. V. Sodium Nitrate.....	619
Duncan, J. M. Evaporation of Brine (illus.).....	380	Sodium Sulphide.....	619
Duncan, L. Electrodes for Secondary Batteries.....	901	Cyanogen Compounds from Spent Oxide.....	881
Dunn. Discussion on Technical Education.....	342	Estcourt. Discussion on Technical Education.....	349
Dunn, W. H., jun. Salt Stalactites.....	98	European Water Gas Company. Gas Generator.....	533
Dupetit, G. <i>See</i> Gayon, U.....	560	Evans, W. Blast Furnaces.....	287
Dupré. Estimation of Oxygen in Water.....	729	Evershed, F. Discussion on Technical Education.....	335
Explosives.....	520	Evard. Dilatation of Metals.....	800
Report on Explosives.....	419	Ewart, J. Protection of Iron Surfaces.....	490
Durand, L., Huguenin, and Co., Composite Indigo Dye.....	282	Ewer and Pick. Amidotriphenylcarbinols.....	455
Indophenol Indigo Vat.....	189	Naphthylene Diamines.....	278
Durand, J. C. L., and others. Gallocyanines.....	981	Eykman. Chavicol.....	816
Durand, L. Reduction of Carbinols.....	156		
Durand-Claye and Debray, P. Action of Sea Water on Cement.....	48		
Dury. <i>See</i> Monnet.....	275		
Duxbury, P. <i>See</i> Davis, G. E.....	565		
Dwight, G. S. <i>See</i> Lowe, T. S. C.....	533		
Dyeckerhoff, R. Influence of Magnesia on Cement.....	781		
		Fahnejehn, O. Incandescent Lamps.....	533
Eames, H. H. Treatment of Iron Ores.....	290	Gas Burner.....	605
Eastman, J. H. Anti-fouling Liquor for Iron.....	715	Fahriou, W. Old Mortars.....	49
Ebell. Opal Glass.....	195	<i>See</i> Claus, A.....	816
		Falk. β -ethyl- α -stilbazoline.....	636
		Fankhauser, E. O. Mordant.....	283
		Faraday. Influence of Aluminium on Steel.....	683
		<i>Farbenfabrik vorm. Brönnner.</i> Sulpho-Acid Colours.....	709

	PAGE		PAGE
<i>Farbenfabriken vorm. F. Bayer and Co. Azo-Dyestuffs.</i>	771, 772	Foster, F. Carbonic Acid Generator.....	983
Diethylmercaptol.....	610	Foster, H. Le Neve. Valves for Regenerative Furnaces (illus.)	98
A New Sulphuric.....	980	Application of Disinfectants.....	720
<i>Farbwerke vorm. Meister, Lucius, and Brüning. Green</i>		Foster, W. Dimsore Gas.....	961
Colouring Matters.....	701, 980	Discussion on Action of Water on Lead.....	230
Indulines.....	878	Foster, W. G. Crucible Furnace.....	884
Rhodamine.....	537	Foth, G. Effect of Carbon Dioxide on Yeast.....	653
Farsky, F. Crab-Apple Wino.....	120	Fould-Dupont, Cast Steel.....	799
Manurial Experiments with Slag.....	126	Foulis, W. Discussion on Flame.....	267
Flare, C. A. Aluminium Chloride.....	283	Discussion on Technical Education.....	316
Fawcett, T. C., and Castle, T. Cement.....	462	Foulis, W., and Liversedge, A. J. Purification of Gas.....	381
Fawcitt, C. A. Vulcanisation of India-rubber (illus.).....	368	Foulsham, H. C. Soap Powder.....	625, 807
Feit, W. Kaliborite.....	882	Fouque, F. Alexandria Blue.....	143
Thallium Determination.....	571	Egyptian Blue.....	200
Field, W., and Knorre, G. von. Silicon Copper.....	898	Fox, S. Discussion on Gaseous Fuel.....	870
Feldmann, A. Metals of the Alkaline Earths.....	465	Fox, S., and Blass, E. Imparting an Odour to Water Gas.....	873
Feldon, G. J. Pasting Paper, &c.....	721	Fox and Wanklyn. Estimation of Glycerin.....	6
Fell, A. G. Lead Pigments.....	201	Fragner, K. Imperialine (an Alkaloid).....	132, 566
Fellner, C. See Albert, H.....	119	France, G. T. Discussion on Technical Education.....	341
Fellner, J. C., and Ziegler, C. Travelling Platforms for Ovens	531	France, J. R. Manufacture of Celluloid (illus.).....	303
Fenner, G. H. Moulds for Naphthalene.....	875	Printing Pyroxyline Collars, &c.....	303
Ferguson, J. See Jardine, J.....	797	Francis, A., and Manbré, E. Combustion of Fuel.....	767
Fergusson, H. A. Spent Battery Liquors.....	201	Francis, E. Discussion on Technical Education.....	319
Fernce, J. Boiler Furnace.....	872	Francis, P. See Gomez, J. G.....	1010
Ferrini. Dissipation of Heat.....	866	Frank, B. Micro-Organisms in Water.....	911
Fichett, P. A., and Nodon, A. Secondary Batteries.....	289	Nitrates in Soils.....	306, 420
Field, T. See Lennox.....	997	Frank, G. Compressed Fuel.....	531
Field, W. D. Varnish.....	204	Frankel, C. Disinfecting Properties of Creosote.....	912
Field, W. E. See Johnson, M.....	713	Frankel, L. K. See Smith, E. F.....	639
Fielden. See Armstrong.....	476	Frankland, E. Chemistry of Secondary Batteries.....	899
Fiege, A. Treatment of Vegetable Fibres.....	539	Luminosity of Flame.....	182
Finkener. Gas in Rolled Iron Tubes (illus.).....	398	Micro-Organisms in Water.....	911
Separation of Copper from Antimony.....	733	Frankland, P. F. Action of Water on Lead.....	241
Solidifying Points of Fats.....	423	Frankland, P. F., and Frew, W. Action of Water on Lead	
Finsler. Turkey-Red Oil.....	573	(illus.).....	247
Firbas, R. Bases in Potato Shoots.....	816	Free, R., and Pierce, H. J. Thermometers.....	868
Fischbach, J. H. See Leroux.....	204	Freitag, A. Vacuum Pans.....	449
Fischer. Triphenylacetic Acid.....	877	Frémy. Metacetone.....	273
Fischer, B. Iodoform.....	210	French, A. Alloy of Tin, Lead, and Copper.....	26
Fischer, E. Acids of the Sugar Group.....	994	See Wilson.....	112
Hydrazine of Mesoxalic Acid.....	556	Fresenius. Analysis of Tartar.....	216
Orthonitrobenzylchloride Derivatives.....	772	Determination of Sulphur in Pyrites.....	967
Osaones.....	296, 718	Sulphur in Pyrites.....	819
Fischer, E., and Hirschberger, J. Mannose.....	297, 558	Testing Machine Oils.....	960
Fischer, E., and Laycock, W. J. Metacetone.....	274	Fresenius, H. Arsenic in Calcium Phosphate.....	62
Fischer, E., and Meyer, T. Milk Sugar.....	297	Fresenius, W. Phosphoric Acid in Wines.....	65
Oxidation of Maltose.....	994	Fresenius and Bergmann. Electrolytic Analysis.....	261
Fischer, E., and Passmore, F. Acrose from Formaldehyde.....	296	Fresenius, R., and Hintz, B. Estimation of Arsenic.....	62
Fischer, E., and Tafel, J. Synthesis of Sugars.....	296	Analysis of Cryolite.....	572
Fischer, F. Efficiency of Fire-places.....	531	Fresenius, W. See Bergmann.....	56
Smoke.....	450	Fresnel, L. Ammonia-Soda Process.....	460
Fischer, O. Harmine.....	112	Freund, M. Hydrastine.....	412, 637
Morphine.....	475	Freund, M., and Lachmann, S. Hydrastine.....	1006
Fischer, O., and Wacker, L. Action of Nitroso-bases on		Frew, W. Action of Water on Lead.....	245
Phenylhydrazine.....	387	See Frankland, P. F.....	247
Fischli, M. Turkey-Red Dyeing.....	188	Frick, G., and P. Drying Fruit (illus.).....	562
Fish, W. C. Electric Welding.....	899	Fricke, E. Artificial Coffee.....	910
Fisher, T. Varnish.....	201	Congo Coffee.....	473
Fittie. Isotropic Acids.....	305	Frisch, L. Beer Manufacture.....	906
Prehnitene.....	114	Frist, R. P. Linings for Bleaching Kells.....	541
Flachat and others. Iron Smelting.....	890	Friswell, E. J. Discussion on Technical Education.....	331
Flanagan, W. L. See Wilson, R. P.....	105	Fritsch. See Baeyer.....	915
Flannery, J. Water Gas.....	451	Fritsche. Allotropic Tin.....	52
Fleck, H. Examination of Potable Waters.....	998	Frohde. Reagent for Alkaloids.....	132
Nitrogen in Coke.....	596	Fruchling, J. See Noeltz.....	187
Fleiner, A., and others. Cement.....	192	Fruchling, R. Fat Extractor (illus.).....	568
Fleitmann. Cobalt and Nickel.....	711	Frühling and Ursé. Copper in Wine.....	206
Fleitmann, T. Volatility of Iron.....	285	Frühling, R. Red Lead.....	203
Fletcher, A. E. Discussion on Gas Analysis.....	1	Fuchs, F. Determination of Carbon Dioxide (illus.).....	736
Fletcher, G., and Mathey, C. A. Vacuum Pans.....	471	Fudakowsky. Pentactyl Galactose.....	994
Fletcher, T. High Temperatures.....	85	Fulton, H. B. Treatment of Quartzose Ores.....	987
Flückiger, F. A. Acetanilide.....	64	Fune, H., and Co. Petroleum Trade.....	840
Fluge. Disinfection of the Air.....	911		
Foerster, O. Estimation of Nitrates.....	924	Gaillot. Application of Ferrous Sulphate to Land.....	554
Purification of Lithium.....	924	Gallagher, W. See Deveril.....	918
Follenius. Cadmium Sulphide.....	807	Galland, G. Composite Indigo Vat.....	618
Forel. See Nöbling.....	115	Galletty. Paraffin Wax.....	163
Forel, S. See Witt.....	274	Gallois. See Hardy.....	413
Forét, G. See Boudonmeau.....	295	Gallon, W. Clay for Puddle.....	50
Forrest, R. W. See MacArthur.....	800	Gamberini. Mercury Phenates.....	1003
Forrest, W. See MacArthur.....	809	Gamble, D. Chlorine (illus.).....	776
Forsling. See Cleve.....	585	Ganther, F. Tannin Determination.....	1015
Forsling, S. Naphthylaminesulphonic Acid.....	387, 535	Garden, W. Refrigerator.....	759
β -Bromonaphthalenesulphonic Acids.....	620		
Forster, O. Estimation of Mustard Oil.....	220		
Nitrogen Determination (illus.).....	220		
Forster, W. G. Sodium Manufacture (illus.).....	543, 712		

	PAGE		PAGE
Gardner, Cerium Oxalate.....	394	Goggs, L. H., and Irvine, T. T. Bronzing.....	403
Garrison, F. L. Bessemer Steel Processes.....	984	Gohring, C. F. Hydrogen Peroxide.....	652
Gärtner, Water for Drinking.....	678	Purification of Effluent Water.....	508
Gas Patents Syndicate. Fuel Gas Burners.....	635	Goldenberg, Analysis of Tartar.....	216
Gascard, See Reymann.....	124	Analysis of Tartarates.....	734
Gaseous and Liquid Fuel Supply Company. Gaseous Fuel.....	695	Valuation of Argol.....	420
Gasquet, B. E., and Gaudin, H. E. Filter.....	297	Gomez, J. G., and Franco, P. Vesta Matches.....	1010
Gassner, C. Galvanic Batteries.....	711	Gonty, E., and F. B. See Grunhut.....	592
Gassner, C., jun. Electrical Dry Elements.....	122	Gooch, W. D., and others. Porous Artificial Stone.....	393
Gastine. Honey Fermentation.....	540	Gopplesroder, F. Capillary Analysis.....	569
Gastine, G. Fermentation of Honey.....	955	Gore, Allotropic Antimony.....	52
Gatellier, E., and L'Hôte, L. Gluten in Wheat.....	627	Gergen, A. Oxides of Manganese.....	541, 774
Gatheral, G. Treatment of Copper Precipitate.....	818	Action of Air on Manganese Carbonate.....	620
Gattermann, L. Silicon and Boron.....	285	Gorz, A. Dry Assay of Silver.....	137
Thiolutidine.....	275	Goshish, <i>o</i> -nitrosulphanilic Acid.....	116
See Piltzinger, W.....	668	Gossage, F. H., and Mathieson, T. T. Sodium Sulphide.....	119
Gattermann, L., and Wichmann, G. Aldehyde Blue.....	384	Gossage, W., and Sons. Treatment of Black Ash.....	353
Gauz, M., and Mossner, I. Waterproofing Solution.....	625	Goubert. Aurous Bromide.....	1062
Gaudin, H. E. See Gasquet.....	297	Gouvy, M. A., jun. Cupolas (illus.).....	394
Gaunt, T., and Clapp, E. H. Evaporator.....	88	Grabe, Tetrahydronaphthalene.....	387
Gautier, A. Carbon Oxy-sulphide.....	118	Grabe, C. Euxanthone.....	609
Manganese Steel.....	791	Grache and Glaser. Carbazol and Nitric Acid.....	569
Gautier, A., and Hallopeau, L. Metallic Sulphides.....	889	Reaction for Nitrates.....	138
Gawaldowsky, A. Powder for Decolourising.....	557	Graeff, F. Ferment of Rennet.....	267
Gay-Lussac. Cyanogen.....	758	Gractzel. Magnesium Extraction.....	900
Gayon, U., and Dupetit, G. Aldehydes in Spirit.....	560	Graham. Allotropic Palladium.....	52
Gebek, L. Azo-compounds of Salicylic Acid.....	609	Magnesium Chloride.....	191
Gehrenbeck, C. Simultaneous Determination of Hydrogen and Nitrogen.....	759	Granger, F. S. Discussion on Technical Education.....	349
Geigy, J. R. Azoxy-compound Colouring Matters.....	701, 702	Grant, J., and Co. Peat Paraffin.....	697
Polychrome.....	359	Grauvall and Valser. Commercial Oleic Acid.....	425
Geigy, J. R., and Co. Violet Dye.....	981	Commercial Olein.....	641
Geissler, E. Tobacco Extract.....	325	Grass, J., and others. Saccharine Liquors for Breeding.....	207
Gellmann and Remy. Naphthylendiamines.....	278	Grave, L. Preparation for Cleansing.....	203
Gent, W. T. See Morris.....	468	Gravelin, A. Eburite.....	625
Genzlen, T., and Wegener, A. Filters.....	766	Gray, T. H. Treatment of Mineral Oils.....	467
Gerard. Tulipine.....	560	Graydon, J. W. High Explosives.....	61
Gerbel, W. Effervescing Wines.....	497	Great Western Aluminium Company. Aluminium Alloys.....	989
Milk Powder.....	497	Greaves, H. T. See Baynes, J.....	808
Gergens. See Baumann.....	131	Gredit, P. Fusing Points of Slags.....	987
Gerziejenko. Adonidin.....	1003	Green. Dehydrothiolutidine.....	608
Gerhardi. Cupola.....	394	Green, A. G. Naphthylamine Sulpho Acid.....	878
Gerichten, V. Morphine.....	475	Primuline.....	42, 583, 980
Gerland. Discussion on Dyewood Extracts.....	397	Sulphonated Beta-naphthylamine.....	276
Gerlozy, S. von. Disinfection of Excreta.....	942	Green, H. Anomalous Liquor.....	193
German Society of Apothecaries. Purity of Medicines.....	567	Greene, W. H. See Hooker, S. C.....	723
Geuther. Action of Silver Oxide on Sodium Thio-sulphate.....	705	Greenway, A. G. Iron Manufacture.....	803
Giannetti, C. Peat Litter Manure.....	997	Greenwood, A. Press for Gunpowder.....	61
Giesel, F. Cinnamylacetone.....	1007	Greenwood, J. Chlorine Manufacture.....	779
See Liebermann.....	131	Gold Extraction.....	801
Giffard, P. Cartridges for Blasting.....	919	Greenwood, W. See Downs.....	204
Gilbert, J. H. See Lawes.....	495	Greiner and Erpf. Cupola (illus.).....	394
Gildemeister, E. See Bertram.....	816	Greshof. Bitter Principle in Hops.....	129
Giles, W. B., and others. Sulphites.....	254	Grete, A. Preservation of Green Fodder.....	409
Giles, W. B. See Boake, A.....	119	Gridley, W., and Pike, F. B. Isinglassine.....	473
Gillam, E. E. Antiseptic Soap.....	714	Griess. Amidonaphtholsulphonie Acid.....	958
Gilles, D. Annealing Furnace for Glass.....	393	Naphthol Sulpho Acids.....	276
Gilman, C. C. Porous Earthenware.....	751	Naphthylendiamines.....	278
Ginsberg. Isapiol.....	1007	Griess, J. P. Azo-Dyes.....	41
Gintl, W. Testing Olive Oil.....	116	Griffith, A. B. Application of Ferrous Sulphate to Land.....	554
Girard. Inosite Methyl Ether.....	174	Griffiths, L. See Branton.....	120
Girard, A. Development of the Potato.....	625	Grimbert, L. See Jungfleisch.....	295
Potato Culture.....	472	Grimshaw. Discussion on Technical Education.....	339
Girard, C., and Roques, X. Examination of Alcohol.....	219	Grimshaw, H. Discussion on Committees of Chambers of Commerce.....	964
Giraud, H. Dimethylaniline Compound.....	877	Discussion on Yorkshire Grease.....	92
Giunti, M. Estimation of Nitrates in Soils.....	572	Grimshaw, R. Applications of Cotton-Seed Oil.....	431
Gladstone, J. H. Discussion on Technical Education.....	328	Grindley, W. H., and Hensley, W. S. Pyrometers.....	623
Gladstone and Hibbert. Oxygen in Caoutchouc.....	175	Groezer, L. Extract of Hops.....	719
Glaser. See Grabe.....	118	Groer, M. Determination of Neutral Fat.....	220
Glaser, C., and Dambmann, C. F. W. Treatment of Phosphates.....	127	Rancidity of Fats.....	202
Glesson, A. Refrigerator (illus.).....	694	Grosclaude, J. Slag Cement.....	888
Glew, F. H. Porous Surfaces for Absorption.....	393	Gross, H. Cotton Dyeing.....	460
Gmelin. Cupola.....	394	Grossiel, A. See Matevitch.....	209
Gnauck. Hyoscyanine.....	1002	Grossman. Discussion on Committees of Chambers of Commerce.....	965
Gobin, A. Cements of Isere.....	887	Groth, L. A. Electric Tanning.....	914, 518
Goble, P. B. W. See Brin.....	301	Grouven. Organic Analysis.....	192
Aeration of Liquids.....	750	Grove. Gas Battery.....	509
Godeffroy, R. Estimation of Wood Cellulose.....	574	Grubbaum, H. O. A. E. Solidified Petroleum.....	112
Godeffroy. Purification of Alcohol.....	559	Gruenberg, H. Specific Gravity of Ammonia.....	390
Godeffroy, M. L. Impurities in Spirit.....	509	Specific Gravity of Solutions of Ammonia.....	541
Godfrey, S. McColey. Alloys.....	549	Gruener. Gas Sampling.....	176
Goebel, H. Commercial Caustic Soda.....	725	Iron Smelting.....	890
Goedicke, E. Puddling in Gas Furnaces.....	894	Gruener, M. Bessemer Process.....	787
Goeldner, M. Colour Reaction of Cocaine.....	1413	Grunhut, J., and Gonty, E., and F. B. Waterproofing Com- position.....	992
		Grunwald, H. Determination of Glycerol.....	480
		Estimation of Glycerol.....	378

	PAGE		PAGE
Grüssner, A., and Hazura, R. Unsaturated Fatty Acids.....	806	Haslam, T. J., jun. Storage Batteries.....	466
Grüssner, A. <i>See</i> Benedikt.....	925	Hausenschild, H. <i>See</i> Flemer.....	462
<i>See</i> Hazura.....	202, 807	Haufl, J. Antiseptic.....	202
Grüssner, H. <i>See</i> Benedikt, R.....	735	Freeing Skins from Lime.....	202
Guignet, C. E. Copper Compounds with Sugars.....	925	Removal of Lime from Skins.....	809
Parchment Paper.....	1001	Treatment of Hides with Cresotinic Acid.....	121
Prussian Blue.....	277	Haupt, L. M. Permeability of Cements.....	856
Guignet, C. E., and Macne, L. Re- <i>Et</i> Glass for Church Windows.....	886	Hausdorfer, A. Diphendylisopiperazine.....	978
Gulshambroff, M. Petroleum Trade.....	829	Hausmann, S. Sulphuric Acid Process.....	106
Gunning, J. W. Nitrogen Determination.....	823	Havenham, C. H. T. Extraction of Lead and Silver.....	197
Gutensohn, A., and James, J. M. Pickling Iron.....	201	Lead Extraction.....	897
Guthrie, H. Treatment of Sewage (illus.).....	564	Hawke, J. Blotting Paper.....	411
Guttler, H. Charcoal Furnace.....	60	Hawke, J. L. Discussion on Alkali and Sulphur Process.....	15
Guttman, Pyroline.....	722	Purification of Black Ash (illus.).....	351
Guttman, O. Explosives.....	60, 817	Hawtin, F. C. <i>See</i> Hart, H.....	91
Gutzzeit, H. Solid Hydrocarbons in the Vegetable Kingdom.....	124	Hayduck, M. Hops.....	129
		Hayter. Instability of Cements.....	50
		Hazura, K. Examination of Oils.....	611
		Fatty Acids of Drying Oils.....	806
		<i>See</i> Benedikt, R.....	807
		<i>See</i> Grüssner.....	806
		Hazura, K., and Grüssner, A. Non-drying Oils.....	807
		Olive Oil.....	202
		Head, J. Water-Gas.....	869
		Head, J., and Poulf, P. Siemens Furnace (illus.).....	764
		Head, J. Concentration of Antimony Ore.....	399
		Heaton and Hargreaves. Treatment of Slag.....	623
		Hecht, Clays from Maderen.....	981
		Heckel, E., and Schlagdenhauffen, F. Juice of <i>Bassia latifolia</i>	124
		Heller, A. Gluconic Acid.....	558
		Helm, O. Butter Analysis.....	822
		Determination of Glycerol.....	676
		Estimation of Glycerin.....	4
		Heiden, E. Slag compared with Bone-Meal.....	125
		Heilmann, G. C. <i>See</i> Grass.....	207
		Heil, H. B. Methylfurfural.....	973, 974
		Heintz. Butter Analysis.....	823
		Heinzelmann, R. Spirit from Wheat.....	550
		Wheat and Wheat Malt.....	298
		Heinzerling and Schmid. Magnesium Chloride.....	191
		Held, A. <i>See</i> Haller.....	411
		Hell, C. Fichteichte.....	382
		Hell, C., and Roekenbach, T. Aniline By-products.....	386
		Hell, C., and Twerdonkoff, S. Oil from <i>Cyperus esculentus</i>	714
		Hellson, W. L. F. Dry Galvanic Batteries.....	804
		Hellwell, T. W. Prevention of Rust on Iron.....	715
		Hellriegel. Fixation of Nitrogen by Soil.....	627
		Leguminosae.....	355
		Helm, E. Discussion on Committees of Chambers of Commerce.....	965
		Hemilian. Triphenylmethane Derivative.....	877
		Hemming and Dyar. Ammonia-Soda Process.....	460
		Hempel, W. Decomposition of Food (illus.).....	996
		Gas Analysis (illus.).....	570
		Henderson. Distillation of Paraffin (illus.).....	108
		Retort for Shale (illus.).....	100
		Henderson, G. G. Discussion on Technical Education.....	345
		Hengst, C. F. Smokeless Gunpowder.....	478
		Henriquez. Oxidation of α -Naphthol.....	456
		Hensley, W. S. <i>See</i> Grindley, W. H.....	623
		Hepworth, J. H. Dyeing Cloth, &c.....	878
		Herard, F. Amorphous Bismuth.....	285
		Herauld. Aluminium Bronze.....	288
		Herbertz. Cupola.....	304
		Herditschka. Cupola.....	305
		Herrmann, G. Mustard-Seed Oil.....	484
		Hernite, E., and Others. Plates for Voltaic Batteries.....	280
		Hervult. Electric Crucible.....	900
		Herrick. Electrolytic Analysis.....	257
		Hertkorn, J. Withdrawal of Liquid from Extraction Apparatus.....	920
		Hervieu, G., and Bedard, V. Axle Grease.....	624
		Herzberg, W. Black Spots on Cellulose.....	702
		Hertzfeld, A. Beet-root Sugar.....	632, 633
		Examination of Sugar.....	557
		Raffinose and Invert Sugar.....	904
		<i>See</i> Meissl. Estimation of Invert Sugar.....	1014
		Herzig, G. <i>See</i> Barth.....	815
		Herzig, J. Quercetin.....	770
		Hess. Thio Colouring Matters.....	698
		Hesse, J. Determination of Carbonic Acid.....	156
		Hygryn.....	567
		Morphine.....	475
		Quinine Compounds.....	721
		Hesse, O. Coca Bases.....	556
		Hesse and Jobst. Methylene-Ether of Dimroentechol.....	1005
		Hennann, K. Ultramarine.....	715
		Heydon, F. von (Nachfolger). Paraoxybenzoic Acid.....	917
		Heyerdahl. Fish Oils.....	54

	PAGE		PAGE
Heyl, G. E. Secondary Batteries.....	624	Horn, F. M. Black Wax for Polishing.....	961
Heyne. <i>See</i> Bohlige.....	191	Hornby, J., and Coupe, G. E. Extraction of Gold.....	199
Heys, M. H. Lime Manufacture.....	120	Horstmann. Sulphuric Acid.....	775
Hibbert. <i>See</i> Gladstone.....	175	Horwitz, A. Analysis of Wool Oils.....	220
Hicks, J. J. Specific Gravity Apparatus (illus.).....	310	Houdrat. Oenobarometer.....	561
Hicks, T. H. Secondary Batteries.....	624	Hovgaard, G. W. Distilling Sea Water.....	760
Hicks, W. G. Proportional Meter.....	694	Howard, D. Discussion on Action of Water on Lead.....	230
Hicks, W. T., and Elliott, J. Lubricating Composition.....	467	Discussion on Applications of Oxygen.....	85
Hilger. Estimation of Theine.....	822	Discussion on Borax Lake.....	857
Hill, H. Seasoning Casks.....	995	Discussion on Estimation of Glycerin.....	8
Miller. Estimation of Invert Sugar.....	1014	Discussion on Explosives.....	523
Hillischer, H. T. Regulator for Gas-holders.....	767	Discussion on Technical Education.....	325
Hilton. Salt in Australia.....	118	Howarth, R. Drying Granular Substances.....	970
Himly, E. Prevention of Fritting in Photography.....	917	Howatson, A. Purification of Water.....	563
Hinsberg, O. Naphthylendiamine.....	388	Howe. Metallurgy of Steel.....	791
Hintz, E. <i>See</i> Presenius, R.....	62, 572	Howe, C., and Beckwith, J. H. Still for Water.....	33
Hipwell, E., and Hofmann, B. B. Enamels.....	808	Howell, M. A., jun. Soft Back Steel.....	989
Hirn. Luminosity of Flame.....	182	Howleroft, T. C. Funnel (illus.).....	648
Hirsch, R. Formation of Aniline Blue.....	187	Hübl. Iodine Test for Oils.....	31
Theory of Dyeing.....	388	Resins.....	308
Hirschberger, J. Mannonic Acid.....	994	Hübner and Sticker. Chloral-methane.....	722
<i>See</i> Fischer, E.....	297, 558	Hucks, W. Centrifugal Separators.....	694
Hirshfield, J. Treatment of Excreta.....	209	Treatment of Worts.....	497
Hitchcock, R. Japanese Lacquer Ware.....	902	Hufner, G. Absorption of Gases by Vulcanised Caoutchouc.....	55
Hitchcock-Spencer, W. Treatment of China Grass.....	634	Hughes, H. A. Extracting Sugar Juice.....	718
Hitzemann, C., and Tollens, B. Hexyl Iodide from Sorbite.....	558	Hugouenq, L. <i>See</i> Cazeneuve.....	59
Hlasiwetz. Morin.....	618	Huguenin, D. E. <i>See</i> Durand.....	282, 981
Hlasiwetz and Barth. India-rubber.....	174	Huhal, M., and Lantenschlager, J. M. and F. Electric Ther- mometers.....	402
Hlasiwetz and Habermann. Decomposition of Casein.....	843	Hume, W. Discussion on Paraffin Manufacture.....	110
Hobbs, T. F. <i>See</i> Temple, W. J.....	621	Humes, J. J. R. Carburetter for Gas, &c.....	381
Hobson, A. H. Treatment of Bones.....	292	Hummel. Moisture in Wool.....	21
Hobson, A. H., and Rooker, C. H. Purification of Water.....	186	Humphreys, D. Galvanic Batteries.....	122
Hock. Opal Glass.....	195	Hurlicke, H. A. Zinc extraction.....	802
Holmes, S. <i>See</i> Anderson.....	282	Hunt, H. E. <i>See</i> Thompson.....	379
Hoeppner, C. Electrolytic Metals.....	401	Hunt, R. Cotton-Seed Oil.....	203
Hoermann, O. <i>See</i> Elbs, K.....	876	Hunter, J. Treatment of Shell Fish.....	1001
Hoffmann. Coke Oven.....	450	Huntington. Centrifugal Roller Mill.....	196
Hoffmann, C., and Ebert, L. Treatment of Beer Wort.....	266	Huppe. Micro-Organisms in Water.....	911
Hoffmann, C. E. <i>See</i> Carlisle, F.....	449	Huppe, F. Well Water Supply (illus.).....	208
Hoffmann, M., and Tittelbach, R. Estimation of Theine.....	822	Hurst, G. H. Theory of Dyeing.....	389
Hoffmann, M., and Weinberg, A. Azo-Colours.....	709	Yorkshire Grease.....	90
Hoffmann, O. Naphthol Green B.....	958	Hurter, F. Condensation of Hydrochloric Acid.....	861
Hoffmann, R. Ultramarine.....	715	Discussion on Alkali and Sulphur Process.....	14
Hoffmeister, A. Behaviour of Lubricating Oils at Low Tem- peratures.....	423	Discussion on Chlorate of Potash.....	172
Hofmann, A. W. α -Coniceine.....	636	Discussion on Sulphuric Acid Process.....	167
Decay of India-rubber.....	175	Discussion on Technical Education.....	335
Diphenylpiperazine.....	976	Discussion on Treatment of Black Ash.....	857
Eupittonic Acid.....	455	<i>See</i> Deacon.....	119, 779
Leucaniline.....	456	Hurter, H. Aerating Beer, &c.....	719
Hofmann, B. B. <i>See</i> Hipwell.....	808	Husberg, N. G. K. Fat in Milk.....	928
Hofmann, F. Determining Free Fatty Acids.....	54	Hutchinson, A. H. Discussion on Estimation of Glycerin.....	9
Hogg, T. W. Volatilisation of Lead Oxide.....	681	Hutchinson, C. C. <i>See</i> Johnson.....	270
Hohenhausen. Specific Gravity of Benzenes.....	950	Hutchinson, H. Gas Generator.....	112
Hohnel, F. von. Examination of Paper.....	564	Treatment of Gold Ores.....	287
Holde. Detection of Mineral Oils in Fatty Oils.....	735	Hutton, D. Calcining Gold Ores.....	200
Flashing Point of Mineral Oil (illus.).....	731	Hyde, G. W. Permeability of Cement.....	886
Test for Rosin.....	572		
Holdfleiss. Slags as Manure.....	904		
Holdroyd, G. H. <i>See</i> Clayton.....	111		
Holgate. Ferro-Manganese.....	790	Ibringer. Cupola.....	396
Holgate, J. E. Discussion on Sulphur in Coal.....	365	Ihl, A. Action of Phenols on Cinnamic Aldehyde.....	640
Hollman, A. P. <i>See</i> Aronstein.....	114	Carbohydrate Reactions.....	914
Hollies, M. B., and Warner, J. Secondary Batteries.....	901	Colour Reactions of Ethereal Oils.....	421
Hohn, J. C., and Poulson, S. V. Wild Yeasts.....	471	Colour Reactions of Wood.....	1012
Holroyd, J., and Wilson, A. Gas-fired Kilns.....	285	Immerheiser, C. Naphthylaminesulphonic Acid.....	385
Homann. Quercite.....	406	Immer, M. Storage Batteries.....	496
Honzka. <i>See</i> Baeyer.....	769	Imperatori, L. Cast Steel.....	549
Honiz. Fermentation.....	560	Imshenetzky, A. Electric Batteries.....	402
Honiz, M. Determination of Indizotin (illus.).....	640	Ireland. Cupola.....	394
Honnay, F. Artificial Fuel.....	878	Irvine. Discussion on Vulcanised India-rubber.....	877
Hooker, S. C. Nitrates in Natural Water.....	138, 569	Distillation of Shale.....	102
Nitric Acid Reaction.....	1010	Irvine, R. Carbon Particles in Smoke.....	377
Reactions of Carbazol and Pyrrol.....	138	Discussion on the Work of the Sections.....	969
Hooker, S. C., and Green, W. H. Lapacholic Acid.....	723	Irvine, T. T. <i>See</i> Goggs.....	403
Hooker, W., and Murray, D. Incandescant Gas Burners.....	273	Isbert. Phosphoric Acid Determination.....	573
Hooper. Himalayan Polyphyllin.....	725	Issleib. Bitter Principle in Hops.....	129
Hooper, D. <i>See</i> Lawson.....	916	Istrati, M. Action of Sulphuric Acid compared with Selenic Acid.....	876
Hoper. Purification of Alcohol.....	559	Romanian Rock Salt.....	774
Hopkinson, E., and Appleton, D. Circulation of Liquid in Dye Baths, &c.....	604	Itallie, L. van. Carboic Acid Reaction.....	422
Hoppe-Seyler, F. Humus.....	404	Hyocyanine.....	220
Horbaczewski. Decomposition of Apaminoids.....	813	Macassar Oil.....	722
Hornmann. <i>See</i> Liebermann.....	770		
Horn, A. Saccharometers.....	406		

	PAGE		PAGE
Jackson, R. Soda Drums	392	Kelly, J. E. Bronzed Fabrics, &c.	204
Jacobson, Sulphonated Rosanilines	275	Kellner, Treatment of Lupinus	555
Thio-Colouring Matters	608	Kempton, G. R. B. Blue Laundry Soap	715
Jacobsen, O. Adjacent Metaxyleneol	111	Laundry Blue	704
Ethylbenzenes	113	Kendall, H. D. Essence (Colour)	702
Jacobson, H. Vegetable Fats	123	Kereff, Naphthylenediamines	278
Jager, E., and Kruss, G. Carbonic Acid Determination	479	Kerr, B. Influence of Sulphur in Zinc Smelting	986
Jagger, B. Treatment of Sewage	209	Kerr, See Caro	40
Jahn, Saccharification of Starch	561	Kerner, Estimation of Quinine	587
Jahns, Arsenic in Glycerin	639	Kerr, J. Printing on Fabrics	540
Jahns, E. Alkaloids of Arca Nut	210	Kerr, J. Guthrie, Blasting Gelatin and Bellite	213
Myrtle Oil	721	Kershaw, Discussion on Technical Education	337
Jaksch, von. Thalline Salts	566	Kertész, A. Composite Indigo Vat	618
James, J. M. See Gutensohn	201	Indophenol Indigo Vat	539
Janin, L. Treatment of Silver Ores	120	Key, Natural Gas near Sydney	112
Jannsch, P., and Richards, T. W. Sulphur Determination ..	849	Kjeldahl, Nitrogen Determination	139, 480, 571, 823, 920, 921
Japp and Klingemann. Benzene-azo-propionic Acid	536	Saccharification	811
Jardine, J., and Ferguson, J. Valves for Regenerative Furnaces	767	Kiderlen, E., and others. Brewing	130
Jardine, J. See MacDonal, T.	780	Kiel, H., and Stollenhoff, R. Starch Manufacture	293
Jarvis, G. A. Sodium Manufacture	209	Kiel, W. Vulcanised Plastic Compounds	204
Jannez, G. Carburetted Air Gas	606	Kien, L. de. Treatment of Fibre	773
Jawein. See Bülstein	267	Kilgour, G. Sorter for Minerals (illus.)	465
Jensch, E. Solubility of Thomas phosphates	904	Kiliani, Inulin	717
Jensen, J. L. Smut in Oats	469	Kiliani, H. Galactose-carboxylic Acid	406
Jerika, A. G., and Eggmann, A. Clarifying Beer	472	Kiliani, H., and Scheibler, C. Quercite	406
Jeyes, J. Soap	167	Sorbitose	206
Jiinsky, W. Ammonia from Coke Ovens	382	King, C. F. Bessemer Process	730
Coke Ovens (illus.)	450	Kinklein, Fr. See Muller, W. v.	635
Jobst. See Hesse	1006	Kingsland, W. Secondary Batteries	201
Jodlbauer, Nitrogen Determination	920	Kinzelett, C. T. Antiseptics	1060
Joffre, J. Resistance of Dyed Fibres to Light	878	Discussion on Applications of Oxygen	86
Johnson, E. Carbonised Deodorant	473	"Schuler"	256
Composition for Cleaning	203	Kintner, C. I. See Paget, L.	768
Johnson and Matthey. Platinum Refining	710	Kirchmann, W. Removal of Bases from Denaturated Spirit ..	471
Johnson, P. Precipitation of Copper as Sulphocyanide in Assaying	603	Kirkman, H. J. Treatment of Galvanising Skimmings	713
Johnson, J., and Brook, R. G. Lids for Iron Drums	530	Utilisation of Galvanisers' Pickle	400
Johnson, M., and others. Amalgamation of Gold, Ore	713	Waste Pickle from Galvanising	548
Johnson, S. H. Discussion on Applications of Oxygen	85	Kissling, R. Estimation of Sodium Carbonate	820
Johnson, S. H., and Hutchinson, C. C. Filter Presses	270	Kitchen, W. H. A. and J. G. A. Explosive	818
Johnstone, A. Detection of Antimony	215	Kitchon. Discussion on Technical Education	349
Jolles, A. Use of Potassium Manganate in Analysis	819	Kitto, C. W. See Thompson	370
Joly, J. Meldometer	306	Klaproth, Uranium	658
Jones, Test for Cotton-Seed Oil	31	Klauder, C. L. Scouring Yarn	190
Jones, A. See Cornet, V.	780	Klein, O. See Einhorn	132
Jones, C. Treatment of Steel	549	Kleiner, Aluminium Extraction	900
Jones, J. Shale or Coal Retorts	697	Klingemann. See Japp	536
Jones, W. N. Discussion on Treatment of Black Ash	558	Kluger, Diamidostilbene	114
Jordan, S. French Iron and Steel	797	Klobukow, N. v. Cadmium Sulphide	807
Jordan, T. R. Amalgamator	200	Electrolytic Apparatus (illus.)	818
Jordan, W. A., and others. Digestibility of Fodders	629	Knapp, Slag with Cement	708
Jorissen, Free Acid in Alum Cake	479	Knapp, F. Mineral Tanning	992
Joseph, J. See Constable	51	Turbid Glass	393
Joule, Allotropic Iron	52	Kuechlt, Dyeing	388
Joy, W. Cement	120	Wool	21
Judell, M. W. See Singer, L.	21, 618, 773	Kuecht, E., and Appleyard, J. R. Properties of Wool	457
Jukna, Condurangin	413	Knerr. See Smith	257
Julian, H. F. Treatment of Gold Ores	711	Knight. Discussion on Electrolytic Analysis	262
Jullien, Puddling Furnace	895	Knoffler, Sulphuric Acid Determination	195
Junce, A. Extraction of Silver from Lead	198	Kuerr, Boric Acid in Plants	569
Jungfleisch, E., and Grünbert, L. Invert Sugar	295	Dimethylpyrrolone	975
Jurisch, K. W. Magnesium Chloride	791	Kuerr, L. Morphine	305, 476, 636
Treatment of Waste Copper Liquors	285	Syntheses in the Oxazine Series	1004
Just, J. A. Chlorine Manufacture (illus.)	46	Knoore, G. von. See Feld, W.	898
Justice, P. M. Explosive	818	Kunblauch, O. Estimation of Ferrocyanogen	732
		Kobbe, Sulphonol	131
Kahn, E. Benzanthide	476	Kobbe, F. Lithium Salts	731
Kallah, F. V. Toluylene Orange	540	Kobert, R. Condurangin	413
Kolle and Co. Diamidotolan	389	Creatine	131, 477
Sulphonated Rosaniline	275	Koch, Wood Sugar	557
Kaupmann, Etching Glass	629	Koechlin, Chrome Mordant	982
Kaunimikow, Quercite	406	Koechlin, H. Artificial Silk	611
Kassner, G. Plumbates	885	Composite Indigo Vat	618
Kast, H. See Behrend	136	St. Denis Red	703
Kauer, A. See Engler	384	Koenigs, Cinchona Alkaloids	475
Kwakita. See Divers	475	Koenigs, W. See Erwir, E.	718, 723, 904
Kedde, A. Thermometers	813	Koller, F. W., and Breden, A. Coating Metals with Zinc	400
Keep. Alloys of Iron and Silicon	790	Koller, H. Free Carbon in Coal Tar	40
Keep, W. J. Aluminium and Iron Alloy	683	Kollmann, A. See Kiderlen	130
Keilber, A. Sulphide of Zinc	408	Kohn, C. A. Base Isomerism with Quinine	959
Kelbe, R. tene	974	Kohn, C. A., and Woodgate, J. Quantitative Analysis by Electrolysis (illus.)	256
		Kohn, O. See Smelting	274
		Kolbe, C. Salts	817
		Cresolcarboxylic Acid	156
		Koller. See Leyser	458
		Koni, Cost of Principal Nutrients	1020

	PAGE		PAGE
König, H. Santonin	566	Landriu, E. Analysis of Cinchonas	610
König, J. Artificial Coffee	910	Lane, H. Meter	381
Koninek, L. L. de. Carbon in Iron	622	Lang J. Water Gas	186
Testing Reagents	215	Lang, W. Removal of Pyridine from Denaturised Spirit	471
Konigh. See Muter	1013	Langbeck and Ritsert. Wool Fat	22
Konther, Magnesium Chloride	191	Langbeck, H. W. Washing Wool	991
Kookooy, W. P. Compounds for Batteries	402	Langberg, O. Gaseous Fuel	872
Charging Secondary Batteries	289	Lange, Acidity of Cell Juice of Plants	628
Galvanic Batteries	902	Lange, H. Antimony Salts for Cotton	188
Koert, W. Iron Manufacture	515	Lange, M. Gas Blowpipe (illus.)	568
Kopp, C. Starch Gum	139	Lange, O. Estimation of Nitrogen and Phosphoric Acid	139
Kopp, E. Resorcinol Green	703	Langen, H. Thickening of Tar in the Hydraulic Main	450
Korschelt, O. Lanolin	290	Langer, C. Gas Battery	509
Soap Mould	552	See Mond	550, 767, 790
Korschelt. Japanese Lacquer	903	Lanker, J. von, and Cooper, L. Water Gas (illus.)	696, 873
Kostanecki, S. v. Colouring Matters	698	Langfarth. Land	123
Nitrosophthoresorcinol	697	Lantenschlager, J. M. and F. See Huhl	402
Köttstorfer. Resins	308	Lagore, Cochineal in Foodstuffs	821
Kovort, W. Extraction of Zinc	545	Lapeyrière, I. Coffee Substitute	997
Kowalewsky, N. Action of Ozone on Guaiacum Resin	480	Laplace. Disinfecting Power of Phenol	912
Kramer, E. Mucic Fermentation	811	Lascelles-Scott, W. Discussion on Technical Education	330
Krauch, C. Testing Chemical Reagents	822	Laska, W. Hydrometer (illus.)	726
Krauss, G. Tannin	993	Laubheimer. See Will	915
Krömel, A. Ethereal Oils	925	Lauber, E. Tests for Fats	139
Red Lead	250	Laubheimer, J. See Salomonson	111
Kretschmar, M. Resin Compounds for Preserving Wood	285	Lauer. Friction Cap	417
Krensler. Nitrates in Soils	306, 420	Friction Detonator	817
Krey. Distillation under Pressure	697	Laufenauer. Rubidium	658
Kriger, Cupola (illus.)	394	Lauth. Porcelain Glaze	983
Krohn, C. α -Naphtholhidiazobenzene	116	Lawes, Sir J. B. History of a Grass Field	554
Krüger, B. Micro-Organism in Water	911	Rotamsted Experiments	829
Kruis. Saccharification of Starch	561	Lawes, Sir J. B. and Gilbert, J. H. Nitrogen of Vegetation	405
Krupp. Cupola	396	Nitric Acid in Rain	627
Krüss. Gnomium	711	Lawrence. Cupola	394
Krüss, G. Nickel and Cobalt	261	Lawrence, R. S. Treatment of Explosives	818
Nickel Coating	518	Lawson. Naphthylendiamines	278
See Althaus	387	Lawson, M. A., and Hooper, D. Indian Quinine	916
See Jager, E.	479	Lawson, W. T. Compound for Washing	263
Krüss, G., and Schmidt, F. W. Cobalt and Nickel	397, 889	Laycock, W. J. See Fischer	274
Krutwig, J. Electrolytic Analysis	287	Lazenby, G. Muffles for Glass	621
Kudelka, P. German and Russian Beet	205	Leather, J. W. Fat Extractor (illus.)	81
Kühlberg. See Beilstein	386	Reflux Condenser (illus.)	81
Kühmann. Cyanogen	758	Lebedeff, N. Extraction of Metals	802
Kühn, W. Pasteurisation of Beer, &c.	391, 719	Le Boulenger. Chronograph	60
Kumpfmiller, W. See Bernreuther	391	Lechartier. Instability of Cements	50
Kundráť, F. Reaction of Vanado Sulphuric Acid on Glucosides	421	Le Chatelier. Photographic Measurement of Expansion	638
Kunheim and Co. Treatment of Spent Oxide	881	See Mallard	60, 181
Kupelwieser, P. Gaseous Fuel	763	Le Chatelier, A. Influence of Temperature on Steel	710
Water Gas	870	Le Chatelier, H. Solubility of Salts	391, 541
Kupferschläuer. Testing Ammonia	25	Leclanche, M. Depolarisers for Batteries	289
Kuriatow. Oil of Olibanum	635	Leclercq, A. Nickel Determination	421
Kusnezoff, W. Purification of Gas	767	Lee, C. T. Moulded Articles	781
Kuthe. Experiments on Sugar Beet	908	Leenhof, J. W. van. See Kiderlen	130
Kynaston, J. W. Discussion on Technical Education	337	Leffmann, H., and Beam, W. Organic Nitrogen in Water	480
		Preservation of Diastase	561
		Leftwich, R. W. See Christopher	997
		Legier. Estimation of Glycerin	5
		Lehmann. Creatine	131
		Lehne, A. See Demstedt	974
		Leipen, R. Caffeine	815
		Le Las, W., and Robin, A. Moist Air for Furnace Fires	381
		Leilmann, E. Affinity Values of Organic Compounds	1012
		Conicine	636
		Leilmann, E., and Schleich, C. Para-diamidodiphenylpiperazine	699
		Lemp, H. Connecting Carbon Filaments	805
		Lenzowsky, A. W. de Leuse. Treatment of Manganese Ore	199
		Lennard, F. Distillation of Tar	585
		Lennox, A. B., and others. Bread Fermentations	997
		Leinsen and Souclay. Potassium Antimony Oxalate	189
		Leutz. Zinc Furnace	545
		Lenz. Sodium Silver Thiosulphate	705
		Specific Gravity of Glycerin	8
		Lenz, O. Maltose	298
		Maltose Syrup	633
		Leonhardt and Co. Colouring Matters	770
		Mikado Brown	389
		p-nitrotoluenesulphonic Acid Colours	41
		Lepin. Pyridine	476
		Leploy, H. Organic Acids in Beet Plant	681
		Leprevost-Bourzerel, O., and Pierron, E. Extracting Tin from Scraps	460
		Lersch, Z. See Nietzki	116
		Lerner, J. C. Acid from Hops	129
		Hop-growing Soils	126
		Lercux, C. J., and Fischbach, J. H. Painting on Metal Plates	294
La Cie. Indle. Raoul Pictet. Refrigerator	886		
Ladiche. Test for Cotton-Seed Oil	63		
Lach, B. Ozokerite	696		
Lachmann, S. See Freund	1006		
Lacroix, C. See Ostermann	200		
Ladd, E. F. Estimation of Starch	295		
Ladenburg. β -ethyl- α -stilbazoline	656		
Choline	637		
Naphthylendiamines	278		
Synthesis of Active Conine	723		
Ladenburg, A. Atropine and Hyoscyamine	59		
Ladenburg, A., and Oelschlägel, C. Pseudo-Ephedrine	724		
Ladureau, A. Soils of Algeria	205		
Lafont, J. See Bouchard	131		
La Harpe, C., and Reverdin, P. Carbon Monoxide in the Air	396		
Lahousse, H., and Co., and Collé, C. Electric Batteries	668		
Lainer, A. Etching Glass	629		
Photographic Gold Salts	212		
Stains in Gelatin Negatives	637		
Lake. Discussion on Yorkshire Grease	92		
Lalande de. Hydrosulphite Vat	618		
Lallemant. Mercure-Thymol	1003		
Laming, R. Regenerative Furnace	764		
Lamm, C. Bellite	212		
Protecting Explosives	726		
Lamy, F. Gallen Conversion Colours	43		
Landmann, E. Bichromate Cells	803		
Landolt. Electrical Estimation of Salts in Sugar	994		

	PAGE		PAGE
Le Roy, G. A. Nitriles	383	Look, M. van. Anti-incrustator for Boilers	971
Leshie, J. Automatic Filter	972	Loomis, B. Water-Gas	869
Purification of Alcoholic Liquids	812	Lord, H. F. Compound for Welding Metals	898
Letalle, A. E., and Billing, F. Coloured Photographs	477	Lord, J. S. <i>See</i> Spencer	380
Lethby, Effect of Pressure on Luminosity	183	Lorenz, Discrimination of Phosphoric Acids	819
Leuckart, Thiophenols	187	Fluorine in Phosphates	569
Lewick, H. Tanning	202	Valuation of Argol	420
Levinstein, I. Committees of Chambers of Commerce	962	Lorenz, N. v. Analysis of Tartrates	734
Lanolin	25	Mineral Phosphates in Bone Meal	347
Nitrosomethyl Colours	11	Lorrain, G. Treatment of Sugar Solutions	810
Leyoir, C. Electrolytic Estimation of Metals	62	Lorrain, J. G. Filters	530
Lévy, A. Depositing Metals on Iron	987	Lortzing, C. Purification of Sewage	473
Deposition of Metals	551	Losekann, G. Formaldehyde	876
Lewin, Kava Resin	304	Lovibond, Discussion on Technical Education	342
Lewis, G. T. Lead Pigments	204	Lowe, C. Treatment of Coal Gas Tars	953
Lewkowitch, J. Determination of Glycerol	574	Loewe, C. <i>See</i> Spilker	778
Treatment of Fats	239	Lowe, J. Red Lead	468
Leybold, Gas Analysis	570	Sugar of Lead	462
Leybold, W. <i>See</i> Moldenhauer	421	Low, T. S. C., and Dwight, G. S. Gas Generator	553
Leyer and Koller. Solubility of Wool	458	Lowe, W. F. Assaying at the Chester Assay Office (illus.)	687
L'Homme, E. Bronze Alloy	712	Lowenthal, Estimation of Tannin	1015
L'Hôte, L. Nitrogen Determination	574	Lucas, Phenanthrene Perhydride	451
<i>See</i> Gätellier, E.	627	Lucion, R. Ammonia-Soda Process	450
Liardet, W. L. Explosives	1010	Action of Chlorine on Carbon Dioxide	306
Liddon, J. <i>See</i> Pearson	320	Luekow, Copper Determination	256
Lidstone, F. B. <i>See</i> Gooch	336	Lugo, O. Secondary Batteries	402
Liebermann, Cocca Alkaloids	1094	Lundberg, A. Lead Linings to Boilers (illus.)	304
γ-isatropic Acid	556	Lundholm, C. O. Dynamite	818
Naphthylendiamines	278	Lunge, Coal Tar	949
Liebermann, C. Cinnamylsuccine	132	Condensation of Gases	864
Cocca Bases and Hyacin	507	Gas Analysis	3
Isatropic Acids	555	Sulphur in Pyrites	819
Liebermann, C., and Giesel, F. Cocaine	131, 433	Lunge and Naef. Sulphuric Acid Manufacture	283
Liebermann and Hermann. Xanthorhammin	770	Sulphuric Acid Process	165
Liebermann, C., and Spiegl, L. Chrysene Hydrides	274	Lunge and Smith. Aqueous Ammonia	380
Perhydrides of Hydrocarbons	151	Lunge, G. Efficiency of Fireplaces	531
Lieber, Extract of Meat	131	Estimation of Sulphur in Pyrites	966
Liebmann, Naphtholsulphonic Acid	600	Nitrogen Determination	139
Liebmann, A. S. Pyridine	476	Sulphur Determination	572
Liebreich, Butyl Chloral Hydrate	475	Sulphuric Acid (illus.)	774
Pyridine	476	Utilisation of Heat of Pyrites Burner Gases (illus.)	879
γ-isatropylsuccine	556	Lunge, G., and Wiernik, T. Specific Gravity of Solutions of Ammonia	541
Lieventhal, E. Mercury Benzate	722	Lunt, J. <i>See</i> Roscoe	729
Lightfoot, T. B. Refrigeration	189	Lupke, R. The Potash in Plants	404
Lillie, S. M. Evaporating Apparatus (illus.)	38	Luther, Cement Grinder	889
Limpach, L. Amidoparacresylmethyl Ether	452	Lutwyche, W. Translucent Enamel	781
Xylidines	281	Lyte, F. M. Lead Paints	124
Lindet, L. Action of Maltose	811	<i>See</i> Blenkinsop	777
Estimation of Saccharose and Raffinose	909		
Saccharification by Diastase	470		
Lindinger, E. Cotton Velvet Dyeing	9-1		
Lindley, Discussion on Technical Education	347		
Lindner, P. Examination of Yeast	400		
Linford, Action of Hydrochloric Acid on Glass	707		
Linosier, G. Influence of Carbonic Oxide on Germination	554		
Lintner, Determination of Starch	128		
Diastase	107		
Estimation of Starch	574		
Lintner, C. J. Brewing	56		
Ferment of Wheat	594		
Lintner, P. Fermentation	56		
Lippitt, H. F. Dyeing Yarns in Cops	282		
Lippmann, American Vacuum Apparatus	405		
Beet Analysis	1011		
Beetroot Sugar	632		
Coloured Glasses in Photography	148		
Raffinose	154		
Raffinose in Beet Sugar	54		
Lippmann, E. O. von. Beet-root Ash	201		
Sugar Refining	903		
Lipscombe, F. R. Purification of Water	563		
Lisle, E. A. de. Vegetable Black for Decolourising	578		
List, Sweet Wines	75		
List, K. Test for Nitrobenzene	113		
Lixeyne, G. D. Eikonozon	958		
Liversidge, A. J. <i>See</i> Foulis	384		
Ljubawin, Dextrin	394		
Lloyd, A. L. <i>See</i> Lloyd, G. H.	767		
Lloyd, F. J. Discussion on Technical Education	320		
Lloyd, G. H., and others. Water-Gas	767		
Lockwood, A. W., and Chappell, H. Treatment of Gold Ore	802		
Lodge, Condensation of Lead Fumes	377		
Loew, J. Liquid Fuel	521		
Loew, O. Carbohydrates from Formaldehyde	27		
Lohmann, H. Behaviour of Explosives	119		
Lomas. <i>See</i> Bayley	968		
Louden, J. A. Peat Paper, Millboards, &c.	844		
		MacArthur, Cement	621
		McArthur. <i>See</i> Beilby	106
		MacArthur, J. S., and Forrest. Extraction of Gold, &c.	800
		McCallum, J. M. Soap Powder	123
		McCay, Le Roy W. Removal of Arsenic from Chamber Acid	704
		McDonald, A. <i>See</i> Rigby, J. S.	622
		McDonald, E. J. Indigo Manufacture	981
		McDougall, T., and Jardine, J. Incineration of Spent Alkalis	780
		MacDougall, G. D. <i>See</i> Baxter, R. S.	634
		McDougall, A. Gas Manufacture	272
		McDougall, I. S., and J. T. Solutions of Sulphurous Acid (illus.)	391
		McDougall, I. S., and others. Lead-lined Boilers	449
		McDougall, J. T. <i>See</i> McDougall, I. S.	449
		McEvoy, C. A. Fuse	120
		McEwan, P. Discussion on Technical Instruction	860
		McGee, W. T. American Petroleum	829
		McIlwaine, A. W. Cattle Food	719
		MacIvor, R. W. E. New Zealand Petroleum	39
		MacIvor, R. W. E., and others. White Lead	552
		MacIvor, R. W. E. Onions in Australia	294
		Mackay, Refrigerator	168
		Mackay, M. Fusible Cement	59
		McKay, J. B. Dyeing Yarns	117
		McKellar, W. G. Titration of Weldon Mud	968
		MacLachlan, J. Gas Analysis (illus.)	4
		McLaren, P. Iron Liquor	780
		McLeod, R., and White, C. K. Coffee Substitute	409
		MacNium, G. L. Insecticide	810
		Maclean, J. Discussion on Technical Education	329
		Incandescence Mantles	451
		Treatment of Esparto Grass	878
		Treatment of Fibre	411

	PAGE		PAGE
Madden, O. E. and A. F. Battery Plates	289	Mays, T. J. Creatine	476
Magne, L. <i>See</i> Guignet	886	Mears. Chlorination of Gold Ores	805
Mahla, F. Potassium Ferrocyanide Compound	283	Meerbecck, E. van. <i>See</i> Douleron	282
Mahnet. Methacetic	722	Mehner, C. H. Dry Galvanic Cells	289, 714
Maiche, L. Battery Liquid	714	Meincke. Precipitation of Iron	819
Maiden, J. H. Sandarach	901	Meissl. Phosphoric Acid Determination	573
Maignen, P. A. Filters	186	Meissl, E. Manurial Experiments	557
Filtration	379	Meissl and Herzfeld. Estimation of Invert Sugar	1014
Maignot, E., and Sabates, J. Treatment of Sugar Juice	811	Meissner. Aqueous Ammonia	390
Main, W. Secondary Batteries	624	Meister, Lucius, and Bruning. Sulphonated Rosaniline	275
Mairet and Combemale. Chloral-urethane	723	Meldola, R. Discussion on Technical Education	333
Maissen, P. <i>See</i> Pogzi, T.	628	Eikonogen (Photographic Developer)	958
Majert, W. Methylene Blue	453	Naphthyl Sulpho Acids	276
Madin. Oxidation of Rhamnose	718	Separation of Shades of Violet	535
Mallard and Le Châtelier. Combustion	181	Meldola and Moritz. Nitrogen in Sulphuric Acid	139
Heat of Explosion	60	Mellmann. Phosphor Copper	286
Mallet, P. A., and Pagniez, T. A. Ammonia Still	162	Mendel. Cannabine Tannate	565
Mallmann. Intensifying by means of Hydroquinone	725	Mendeleeff. Periodic Law of Atomicity	52
Maltby-Newton, C. Galvanic Batteries	714	Mendeleeff, D. Caucasian Petroleum Industry	753
Maly, R. Relation of Gelatin to Albumen	468	Memmel, E. <i>See</i> Merck	414
Manbré, A. <i>See</i> Shears	812	Merck. Basic Bismuth Salicylate	304
Manbré, E. Manufacture of Alcohol and Vinegar	300	Egonine	637
<i>See</i> Francis, A.	767	Pseudo-ephedrine	304
Manbré Saccharine Co. Visit to Works of	512	Pyroline	476
Mandelin. Reagent for Alkaloids	132	Merck, E. Mercury Phenate	722
Mandleberg, G. C., and Rothband, H. L. India-rubber		Narcaine	567
Garments	902	Merck, L., and Memmel, E. Mercury Phenols	414
Manet, G. and C. Electrical Fuses	466	Meresole. Secondary Battery	624
Mangin, L. Pectous Substances in Plants	1013	Mérimee, L. Ammonia-Soda Process	460
Manhes, P. Treatment of Nickel and Cobalt	988	Mering. Phlorizin	413
Mann, F. Sulphonated Rosaniline	275	Mering, J. von. Amylenehydrate	1002
Mannesmann. Rolled Iron Tubes	398	Merrill, L. H. <i>See</i> Jordan, W. A.	620
Mannesmann, R. Fire-proof Columns	622	Merry. Australian Wattle as a Tanning Material	903
Maquenne. Faccosol	974	Merz, J. Extraction of Fat	991
Inosite	406	Merz. <i>See</i> Ebert	385
Maquenne, M. Formic Acid	210	Merz and Ris. Tetrahydroquinoxaline	412
Marcano, V. Fermentation of Cane Juice	561	Merz and Weith. Thiotoindine	383
<i>See</i> Muntz, A.	627	Messinger, J. Estimation of Acetone	138
Marcet, A., and Ellis, O. J. Refrigerator (illus.)	271	Mestern, R. <i>See</i> Shedlock, J. J.	624
Marek, v. d. Alkaloid in Coca Leaves	574	Mesure and Nouel. Pyrometric Telescope	800
Marchal, C. <i>See</i> Sentex	199	Mesure. <i>See</i> Nouel	214
Mareschal. Battery Zincs	803	Mémier. Sorbite	206
Marguerite-Delacharlonny, P. Use of Ferrous Sulphate in		Mémier, S. Chrome Iron	196
Agriculture	554	Meyer, C. <i>See</i> Buttner	867
Marguerite and Sourdeval. Production of Ammonia	506	Meyer, E. Treatment of Molasses	128
Marignac. Specific Heat of Sulphuric Acid	543	Meyer, F. Waterproof Roofing Material	894
Markel, C. Production of Ammonia	507	Meyer, J. <i>See</i> Fischer, E.	904
Markel, K. Gas Analysis	570	Meyer, J. E. P. Ozone	1001
Marker. Citrate Solution	139	Meyer, L. Heat of Combustion of Gases	450
Marmont, S. Preservation of Food	562	Nitration	275
Marneff, G. de. Fertilisation of Subsoil	628	Nitrogen Pentoxide	283
Marpmann, G. Hydroxylamine as an Antiseptic	634	Meyer, R. Soap Meal	552
Marquard, F. Insulating Composition	902	Tartrazines and Azo-Dyes	536
Martin, P. Steel	787	Meyer, R., and Oppelt, O. Fluorescein	116
Martinand. Fermentation of Milk	633	Meyer, S. Paradioxybenzol	457
Martindale. Action of Osmic Acid on Glass	707	Meyer, T. <i>See</i> Fischer, E.	297
Marinotti, F. Nitrogen Determination	920	Meyer, V., and Stadler, O. Reaction of Pyrrol	138
Martius, C. A. Mixed Azo-Colours	701	Michaelson, W. Painting on Glass, &c.	403
Marx, J. Treatment of Lignors	288	Miehell, W., and Picard, S. Extraction of Oil from Waste	991
Maseazzini. <i>See</i> Parodi	257	Middleton, R. Preparing Materials for Smelting	987
Mason (U. S. Consul). Essential Oils	722	Midgley, T., and Nye, W. B. Galvanising	713
Matcovitch, P., and Grossich, A. Antiseptic Paper for Wounds,		Miles. Insect Flower Growing in California	658
&c.	200	Miller, W. A. Decay of India-rubber	175
Mather. Discussion on Technical Education	312	Millan. Test for Lard	645
Mather, W. Treatment of Textile Materials	460	Test for Cotton-Seed Oil	31
Mather and Platt. Ager for Printed Goods	510	Millon. Mercury Ammonium Compound	211
Mathey, C. A. <i>See</i> Fletcher	471	Mills, E. J. Discussion on Technical Education	344
Mathieson, N., and Co. Ammonia from Black Ash	355	Flame	179
Mathieson, T. T. <i>See</i> Gossage	119	Mills, E. J., and Hamilton, J. J. Dyeing with Mixed Colours	263
Mathieson, T. T., and Hawliczek, J. Treatment of Black Ash		Mills and Smith. Nickel and Cobalt Sulphates	265
(illus.)	351	Milne, J. M. Discussion on Technical Education	346
Matrol, J. B. <i>See</i> Rivage, J.	553	Miniewicz. Urechites	477
Mattauch, M. Conversion Colours	43	Mitchell, J. L. Condensation of Smoke	377
Matthews. Vulcanised India-rubber	576	Mitchell, W. A., and Hagemann, O. C. Purification of Oils	624
Matthey. Separation of Gold and Silver from Bismuth	286	Mitscherlich. Wood Cloth	388
Matthiessen. Alloys	121	Mittelmeier, H. <i>See</i> Scheibler, C.	718
Allotropic States of Metals	52	Miura. Ephedrine Hydrochloride	304
Matz, P. Effect of Drying on Malt and Beer	290	Moerk, F. X. Californian Olive Oil	467
Mawson and Swan. Gas Sampler (illus.)	176	Mohr. Magnesia Determination	922
Maxim, H. S. Carburetted Gas	767	Mohau. Methylene Blue	453
Explosives	918, 919	Moissan. Allotropic Metals	52
Mayer. <i>See</i> Tollens	717	Mol, P. Artificial Wool	188
Mayer, A. Mineral Value of Sea Coast Products	809	Moldenhauer, C., and Leybold, W. Testing Gas Residues	421
Mays, J. Creatine	131	Mollisch, H. The Nitrogenous Salts in Plants	405
		Moller, K. Freeing Air from Germs	472

	PAGE		PAGE
Molyneux, C., and Wood, J. M. Round Chimney Shafts	692	Native Guano Company. Visit to Works of (illus.)	516
Molyneux, P. Paint	124	Naudin, L. Purification of Alcohol	559
Mond, L. Address at Eighth Annual Meeting	505	Naumann, Coal Tar	954
Ammonia Manufacture (illus.)	507	Naupert, A. Douglasball Carnallite	704
Nitrogen from the Air	758	Naylor, Nitrous Vitriol	706
Mond, L., and Eschelman, G. Inert Gases	696	Nebel, B. Photometer Disc	420
Mond, L., and Langer, C. Gas Batteries (illus.)	550	Negruta. See Boniza	477
Gas Battery	990	Negro, M. Filters	691
Hydrogen	767	Neilson, Hot Blast	783
Mongoldier, Acetate of Camphor	1008	Nellensteyn, G. D. Extraction of Perfumes (illus.)	133
Monnet and Dury. Sulphonated Rosaniline	275	Nencki, Cresol Salicylates	565
Montague, F. C. Report on Technical Education	339	Nencki, H. Salicylates of Cresol	805
Montgomery, A. W. Treatment of Sisal Hemp	611	Nencki, M. Leuco-Malachite Green	535
Moore, F. Treatment of Yarn, &c.	878	Purity of Reagents	822
Moore, T. Electrolysis of Pyrophosphates	1011	Salols	817
Electrolytic Analysis	257	Nesbit, Chloral-Ammonium	413
Moorthamers, L. Electrical Dry Piles	901	Nessler, Wine	129
Moravsek, J. Top-Dressing Beets with Chili Saltpetre	908	Nittl, Testing Olive Oil	139
Morawski, T. Determination of Glycerol	424	Netto, Extraction of Aluminium	985
Test for Rosin	572	Netto, C. Aluminium	517
Morel, D. R. J. J. G. Water Supply to Mash Tuns	996	Aluminium Manufacture	198
Morfit, C. Paper Manufacture	634	Sodium Manufacture	122
Rosin Liquor for Paper Makers	1001	Neumann, G. Acid Salts of Mercury	815
Morcan, A. Digestibility of Food Stuffs	628	Electrolytic Analysis	257
Moritz. See Meldola	139	Separation of Zinc and Manganese	62
Morland, J., and J. C. Treatment of Skins and Furs	117	Neu-Stassfurt, Magnesium Chloride	191
Morris, D. China Grass	655	Neville and Winter, Naphthol Sulpho Acid	279
Morris, G. H. See Brown, H. T.	716, 717	Newlands, Periodic Law of Atomicity	52
Morris, R. Filters	111	Newlands, B. E. R. Absorption in the Gay-Lussac Tower	16
Morris, R., and Gent, W. T. Varnish	168	Discussion on Applications of Oxygen	80
Mosely, B. L. See Ponton, A. C.	462, 622	Discussion on Purification of Spirit	444
Moss. Discussion on Borax Lake	857	Drying Sugar, &c.	810
Moss, J. Discussion on Technical Instruction	860	Newlands, B. E. R., and Allott, J. Filter	128
Mössner, I. See Gangl, M.	625	Nicholl, W. A. Filters	111
Mothay-Temier, du. Production of Ammonia	506	Nicholson, Sulphonation of Rosaniline	275
Mühlhauser, O. Benzyl-Violet	40	Nicholson, T. Gas Producers	695
Rosanilines	455	Nickel, E. Colour Reactions of Organic Compounds	821
Rosaniline Sulpho Acids	275	Oil of Cloves Reaction	573
Synthesis of Rosanilines	536, 610	Nicoll, D. Waterproof Fabrics	291
Muir, M. M. P. Action of Water on Lead	217	Nietzki, Aniline Blue	157
Muirhead, R. See Drake	186	Theory of Dyeing	388
Filtration of Sewage	208	Nietzki, R., and Lerch, Z. Orthonitroaniline Sulphonic Acid	116
Mulder. Estimation of Theine	822	Nietzki, R., and Müller, E. Tetramidobenzene	385
Red Lead	468	Nietzki, R., and Zübelen, J. Nitration of Naphthionic Acid	386
Mulhausen. Methylamidine	1005	Nilson, L. F. Butter Analysis	822
Muller, C. E. T. Purification of Alcohol	812	Nond, J. See Trickett	199
Muller, E. Magnesia Puddle for Steel Furnaces	799	Noakes, H. G., and others. Medicated Chocolate	568
See Nietzki	385	Nobel, A. Explosives	61, 214, 420, 725
Müller, F. C. G. Experiments with Explosives	918	Explosives and Safety Fuses	133
Müller, H. Safety Fuse	420	Fuses for Shells	918
Müller, J. A. Preservation of Food	562	Nitroglycerin	518
Müller, Max. Determination of Oxygen in Water (illus.)	925	Nodon, A. See Fichet	289
Müller, P. See Nathansohn	978	Noelting, E. Indophenol Indigo Vat	189, 539, 618
Müller, W. v., and Kinklein, Fr. Coumarin Derivatives	635	Naphthol Sulpho-Acids	276
Muller-Jacobs, A. The Resinate Colours	770	Substantive Cotton Dyes	703
Mullings, T. J. Cleansing Wool	25	See Witt	274
Muntz, A., and Marceno, V. Nitro-Deposits	627	Noelting, E., and Binder, F. Turkey-red	188
Murjahn, E. Minerals for Paper Making	625	Noelting, E., and Fraehling, J. Paraxyloquinoline	187
Murray. Oxygen Manufacture	694	Noelting, E., and Kohn, O. Xyldine Sulpho-Acids	274
Murray, D. See Hooker	273	Noelting and Boas Boasson. Determination of Monomethyl- aniline	422
See Prout, G.	987, 988	Nolting, E., and Pick, B. Adjacent Metaxyldine	115
Mushet, R. F. Manganese Steel	787	Nolting, E., and Forel	115
Muspratt. Prussiate of Potash	758	Nolting, E., and Stricker, T. Azoxylenes	114
Muspratt, E. K. Discussion on Technical Education	336	Noordlinger, H. Free Fatty Acids in Fats	806
Mussenbrock. Alloys	121	Norman, G., and R. A. Grinding Mill	379
Musset, F. Nitrates in Water	420	Normandy. Double-distilling Condenser	760
Nitrous Acid in Water	569	Noroy, C. F. Z. Dyeing	878
Muter and Koningsh. Testing Carbolic Powder	1013	Norris, Cupola	594
Mycock, W. Dyeing	282	Norris, R. Sensitive Collodion Films	414
Mylius. Hydroxyquinone	699	Nond. See Mesuré	800
Reaction for Bile	479	Nond and Mesuré	214
Mylius, F. Alkali in Glass	306	Noyer, A. Amido-saccharine	476
Iodide of Starch	205	Nye, W. B. See Midgley, T.	713
Mylius and Foerster. Action of Water on Glass	708		
Nagai. Ephedrine	504, 724	Oates, E. Compound for Removing Varnish	552
Nägeli, W. Amylodextrin	716	Obach. Sodium Amalgam	121
Nahnsen, G. Aluminium Extraction	804	Obenetter, E. Gelatin Photographic Plates	725
Nangle, W. C. Paint for Iron, &c.	808	Obregia. See Barbezat	507
Nastvogel, O. Homologues of Diphenylpicazipiperazine	977	O'Brien, J., and Weaver, S. J. Purifying Feed Water	971
See Bischoff	977	O'Brien, L. Metallic Sulphates	707
Nathansohn, M., and Müller, P. Tetramethyldiamidobenzene- phenone	978	Oehler. Methylene Blue	453
		Ochsenius, C. Boracite from Doughstall	704

	PAGE		PAGE
Odling. <i>See</i> Crookes.....	243	Pechiney and Weldon. Magnesium Chloride.....	191
Oehler, K. Azo-Dyes.....	456	Peck, O. B. Desulphurisation of Ores.....	400
Diaz-Colours.....	538	Separation of Ores, &c.....	868
Ethylene Blue.....	389	Treatment of Slag.....	201
Fast Pink G.....	981	Pellat, H. Battery Potentials.....	550
Oelschlägel, C. <i>See</i> Ladenburg, A.....	724	Pellet. Estimation of Sugar.....	1013
Oetzmann, F. A. Electro-plating.....	901	Pelouze. Nitric Acid Determination.....	820
Olime, O. <i>See</i> Grass.....	207	Sulphur Determination.....	572
Oldham, W. Developing Photographs.....	918	Pensky. Flashing Point of Petroleum.....	734
Oliphant, W. Liquid Purification.....	58	Pentecost, S. J. Discussion on Technical Education.....	350
Olivier, P. A. <i>See</i> Seargrave.....	272	Penzbold. Pyridine.....	413
Onufrowicz. β -naphtholsulphide.....	187	Percy. Flame.....	179
Oppelt, O. <i>See</i> Meyer.....	116	Percy, John. Obituary.....	448
Ordonneau. Aldehydes in Spirit from Molasses.....	471	Perino. Treatment of Copper Pyrites.....	292
Ort. A. Nitro-Cellulose Solutions.....	204	Perkin. Coumarin Derivatives.....	635
Orsat. Gas Analysis (illus.).....	3	Naphthylenediamines.....	278
Osmond. Malleable Steel.....	800	Perkin, A. G. and W. H., jun. Anthraquinone Derivatives.....	112
Ost. Testing Ammonia.....	25	Perkins, L. "Arkots" Refrigerator (illus.).....	378
Ostberg, P. Mitis Iron Castings.....	681	Peroncel. Bisulphide of Carbon (illus.).....	94
Ostermann, H., and Lacroix, C. Non-magnetic Alloy.....	200	Persoz, J. Action of Ammonia on Corallin.....	453
Ostermann, H., and Prip, A. Non-magnetic Alloy.....	199	Wool.....	23
O'Sullivan, Dextrins.....	717	Petermann-Gembloux. Jerusalem Artichokes.....	293
Saccharification.....	471, 811	Peters, C. <i>See</i> Will, W.....	719
Oudemans. Examination of Oils.....	807	Peters, E. D. Nickel and Steel Alloys.....	819
		Peters, W. Adulterations in Vegetable Oils.....	6
Paddock. Pneumatic Jigs for Ores.....	399	Petrie, J. and F. W. Treatment of Wool.....	28
Padé, L. Sodium Bicarbonate in Milk.....	1013	Petrowsitch, M. Lime in Tanning Materials.....	299
Page, G. S. Liquefied Ammonia.....	462	Syrian Vermouth Wine.....	911
Paget, L. Battery Excitant.....	289	Pettekofer. Determination of Carbonic Acid.....	13
Secondary Batteries.....	402	Reaction for Bile.....	47
Paget, L. and Kintner, C. I. Incandescent Gas Burners.....	768	Pettersen. Air Pyrometer (illus.).....	21
Paczyn, T. A. <i>See</i> Mallet.....	462	Pettersen, O., and Sonden, K. Absorption of Atmospheric Gases by Water (illus.).....	62
Palladin, W. Albuminoids in Plants.....	628	Pfaundler, Morin.....	719
Palmaer, W. α -Nitronaphthalene.....	116	Pfeifer, F. Sulphurous Acid in Beer.....	98
Palmer. Logwood Extract.....	616	Pfitzinger, W., and Duisberg, C. Naphtholsulphonic Acid.....	36
Pamphlett, W. F. Still for Sea Water.....	38	Pfitzinger, W., and Gattermann, L. Primuline.....	60
Paquelin. Thermo-cauter.....	1009	Philipp, J. Ultramarine.....	71
Parcus. Testing Sugar Solutions.....	632	Philippart, C. Purification of Alcohols.....	995, 99
Paris, R. J. <i>See</i> Binus.....	291	Phillips, R. E. Purification of Sewage.....	36
Parker, T., and Robinson, A. E. Chlorine Manufacture.....	778	Piat, C. A. Crucible Furnaces.....	46
Chlorine and Phosphorus Manufacture.....	983	Picard, S. <i>See</i> Michell.....	96
Iodine Manufacture.....	817	Pick, B. <i>See</i> Nötting.....	11
Parkes. Extraction of Silver.....	198	Pick, <i>See</i> Ewer.....	278, 43
Treatment of Gold and Silver Ores.....	286	Piefke, C. Water Filtration.....	95
Parkes, A. Extraction of Gold and Silver.....	198	Pieper, H. Secondary Batteries.....	71
Parnell, E. H., and Simpson, J. Treatment of Calcium Sulphide.....	193	Pierce, H. J. <i>See</i> Free.....	86
Parnell and Simpson. Alkali and Sulphur Process.....	11	Pierron, E. <i>See</i> Leprevost-Bourgerel.....	46
Parnell, E. W. Discussion on Treatment of Black Ash.....	358	Pietzka. Puddling Furnace.....	81
Parnell, E. W., and Simpson, J. Sulphuretted Hydrogen.....	284	Pike. Analysis of Iron Ore.....	48
Parodi and Mascazzini. Electrolytic Analysis.....	257	Pike, F. B. <i>See</i> Gridley, W.....	47
Parsons. Purification of Spirit.....	442	Pintsch. Zinc Furnace.....	5
Parsons, C. C. Ammoniacal Cleansing Compound.....	403	Piria. Naphthionic Acid.....	70
Parsons, H. de. Influence of Sugar on Cement.....	545	Planchon. Determination of Glycerol.....	49
Parsons, P. M. Alloys.....	713	Estimation of Glycerol.....	39
Partridge, E. A. Paraffin in Crude Petroleum.....	535	Planté, Gaston. Obituary.....	5
Passmore, F. <i>See</i> Fischer, E.....	296	Plath, G. β -ethyl- α -stilbazoline.....	6
Paternó, E. Filicic Acid.....	412	Playfair, L. Allotropic States of Metals.....	5
Lapachic Acid.....	723	Pochl, A. Preservation of Food.....	5
Paterson, D. "Antimony Salt".....	612	Pozzi, T., and Maisson, P. Value of Phosphates.....	6
Paterson, E. J. <i>See</i> Hermitte, E.....	289	Pohl. Melting Points of Fats.....	9
Patrick, Major Allan Poyntz. Petroleum in the Canadian North-West.....	697	Poiré, P. Photographic Developers.....	4
Patrick, J. A. <i>See</i> Robertson, J.....	621	Poirrier, A. F., and Rosenstiel, D. A. Diamidobenzil.....	3
Patterson, T. L. Discussion on Technical Education.....	345	Pollard, I. Washing, &c. Factories.....	8
Pattinson. Extraction of Silver.....	198	Pollock, J. Purifying Feed Water.....	6
Pattinson and Stead. Influence of Arsenic on Steel.....	677	Pollok, J. H. Refractory Gold Ores.....	4
Pattinson, J. Discussion on Technical Education.....	341	Pomeranz, C. Methystien.....	3
Examination of Lard.....	30	Ponthier, H. Consumption of Energy in Electro-Metallurgy.....	402, 6
Nitrous Vitriol.....	706	Ponton, A. C., and others. Artificial Stone.....	7
Pattinson, J. and H. S. Chilean Manganese Ores.....	676	Popovici, M. Determination of Nicotine.....	2
Pauer. <i>See</i> Stadel.....	536	Porcelain Dental Art Co. Hydrocarbon Muffle.....	2
Paul, E. Heating Feed Water.....	970	Porion. Evaporator.....	7
Paul, G. <i>See</i> MacIvor.....	552	Porret. Prussian Blue.....	7
Pavely, H. A. Waste Glass.....	781	Porter, H. H. Influence of Sugar on Cement.....	6
Payen. Action of Diastase on Dextrin.....	470	Potts, F. B. <i>See</i> Carew, H. G.....	7

	PAGE		PAGE
Price, Puddling Furnace	894	Reiss, R. Seminose	406, 558
Price J. Press for Sewage Sludge	563	Reisz, D. J., and others. Nickel Alloy	802
Prime, W. C. Mexican Pottery Glaze	707	Reitmar, O. Burette Tap (illus.)	821
Prior, Cannabine Tannate	565	Line Determination in Slag	821
Prip, A. See Ostermann	199	Remmery. See Valtou	799
Proctor, B. S. Discussion on Technical Education	342	Rempel, R. Standard Solutions of Ammonia	820
Proskauer, B. Nitrous Acid in Water	559	Remsen and Comstock. Sulphophthalic Acid	958
Prost, E. See Spring, W.	460	Renard. Batteries for Balloons	53
Prout, G., and Murray, D. Coating Iron with Metals	987, 988	Rennoldson, W. L. See Black	131
Prudhomme. Dinitrosorosecinol	189	Renny. See Gellmann	278
Pruvier. Queroué	406	Rétif, J. Bag Filters	972
Puech, P. Treatment of Skins	553	Reuter. Action of Chloral Hydrate on Glass	707
Pullar, R. D. Discussion on Technical Education	345	Reuter, A. The Three Xylenes	874
Pumpelly, J. K. See Askew	804	Reverdin. Beta-naphthol	476
Punshon, R. See Story	196	Naphthol-sulpho Acids	276
Punshon, R., and Vizer, R. R. Cartridge for Blasting	214	Reverdin, F., and Harpe, C. de la. Determination of Mono-	
Puplett, H., and Riez, J. L. Refrigerator	970	methylaniline	429
		Estimation of Lime in Soils	735
Quaglio. Zinc Furnace	545	Reverdin, F. See La Harpe	506
Quantin, H. Determination of Sulphates	216	Rey. Sulphur Determination	968
Quasthoff. Manure for Beets	557	Reychler, A. Artificial Diastase	407
Queeness, Le Brun, and Desmoutis. Platinum Refining	710	Saccharification by Diastase	470
Queenessen, T. L. J. Artificial Fuel	767	See De Wilde	466
Quesneville, Gustave-Augustin. Obituary	867	Reynann and others. Potatoes	124
		Reynier, E. N. Secondary Batteries	901
R. B. G. Paraphenylene Blue	189	Reynolds, J. E. Thioam Disinfectants	1000
Rademann, O. Carbolic Acid	151	Reynolds, R. Solubility of Glass Bottles	707
Radinet. Fluid Batteries	803	Rheinck, H. Iron Determination	175
Ramdohr. Magnesium Chloride	191	Rhodes, G. W. Tanning	292
Rammelsberg, C. Mercury Ammonium Compounds	211	Richards, T. W. See Jannasch	819, 967
Ramage, A. S. Treatment of Scrap Tin	52	Richardson, J. T. H. Hardened Glass	621
Ramsay, W. Nitrogen Trioxide	644	Richmond, H. D. Ash in Crude Glycerin	7
Ramsay and Williams. Estimation of Oxygen in Water	729	Richter, G. Drying Potatoes, &c.	409
Ramsay and Young. Dissociation of Ammonia	102	Richter, V. v. Chromogenic Carbinols	117
Ransome, J. W. Artificial Stone	782	Rickmann and Thompson. Ammonia Manufacture	507
Raoult. Carbohydrates	717	Riddell, E. H. See Davis, C. B.	868
Nitrogen Trioxide	644	Ridol, S. Nitrates in Water	1010
Rapand, N. F. E. Artificial Leather	469	Rizand. Zinc Furnace	515
Raschig. Sulphuric Acid Process	164	Rizby, J. S. Cement	462, 620
Rasine, M. Indicator for Carbon Monoxide	949	Rizby, J. S., and McDonald, A. Cement	622
Rateau, A. Ozokerite	768	Riez, J. L. See Puplett	970
Rathbone, A. Heater and Cooler	379	Rizoud. Azulin	455
Raty. Slag Drier	889	Riley. Cupola (illus.)	395
Raulin, J. Manurial Value of Phosphates	292	Riley, E. Bessemer Converter Lining	788
Phosphates as Manures	810	Riley, J. Alloys of Nickel and Steel	547
Rave, C. Treatment of Acid Tars	112	Nickel and Steel Alloy	896
Razzia. See Zeechini	910	Rillieux. Evaporation	32
Rawes, F. B. Sulphur Manufacture	119	Ripper. Boric Acid in Wines	120
Rawson, C. Action of Water on Lead	251	Ris. See Merz	412
Discussion on Yorkshire Grease	92	Rising. Boric Acid in Plants	569
Lead in Water	611, 638	Ritsert. See Langbeek	22
Rawson, P. L., and White, W. Electrical Batteries	288	Ritthausen. Vism	724
Ray, F. E. Automatic Evaporation Regulator (illus.)	927	Rittmeyer, R. Preservation of Wool	285
Raynaud, H. See Suilliot	210, 477	Rivage, J., and Matroil, J. B. Tanning	553
Readman, J. Phosphorus Manufacture	884	Robert. Bessemer Steel Process	986
Readman, J. B. Prussiate of Potash	757	Roberts-Austen, W. C. Allotropic Forms of Metals	52
Réaumur. Alloys	121	Alloys	120
Rebnflatt. Piperazine	976	Bullion Assay	689
Recker, H. Dyeing Cotton Yarn	982	Roberts-Austen, W. C., and others. Iron Alloys	898
Redemann, H. M., and Tilford, R. J. Refined Steel	401	Roberts F. G. A. See Bonke, A.	119, 565
Redwood, L. I. Specific Gravity of Paraffin Wax	162	See Giles	284
Reeb. See Schlegelhaufen	413	Roberts, J. L., and Brevoort, H. L. Galvanic Batteries	623
Reich, S., and Co. Metallic Surface on Glass	984	Robertson, J., and Patrick, J. A. Cement	621
Reichert. Electrical Estimation of Salts in Sugar	994	Robertson, R. A. See Watson, W. R.	530
Reiherl, C. Reaction for Proteids	822	Discussion on Multiple-Effect Evaporation	35
Reichling, R. Condensation of Vapours	869	Roberval. Balance	604
Reid, W. F. Discussion on Estimation of Glycerin	8	Robin, A. See Le Las	381
Reid, W. T. Generation of Electricity by Nitrocellulose	69	Robinson, A. E. See Parker, T.	778, 817, 983
Reid. See Borland	522	Robinson, T. See Hargreaves	118
Rein. Japanese Lacquer	903	Robottom, A. Discussion on Borax Lake	857
Reinhardt, C. Chromium Determination	421	Roekenbach, T. See Hell	286
Sodium Hypophosphite as a Reducer	572	Rocques, X. See Girard	219
Chromium Determination	572	Roege. Estimation of Fusel Oil	559
Copper Determination	572	Roesing, R. Distilled Lead	711
Reinke, O. The Malt of 1888	298	Roeske, H. Filters	863
Reinsch, P. F. Pyrofusine	476	Roessler. Extraction of Silver	198
Reiset, J. Putrefaction	554, 627	Treatment of Silver	286
		Roessler, S. Purification of Spirit	442
		Rössler, K. Dry Assay of Silver	137
		Rogers, F. W. See Temple, W. J.	621
		Rogers, L. H. Joining Sheet Metal	802
		Robert, F. P., and M. L. Treatment of Cloth	281
		Rohn, S., and Wichmann, H. Filtration of Beer	56
		Röhrig. Sodium Potassium Sulphites	705
		Rolland, C. Manurial Experiments	810

	PAGE		PAGE
Romiquières, F. T. Manufacture of Alkaline Hydrates	779	Saunders, T. S. Soap	290
Rommier, A. Communicating Banquet to Wine	995	Sannier, A. <i>See</i> Sentex	199
Rooke, W. Photographic Bath	568	Savalle, Spirit Still	412
Rooker, C. H. <i>See</i> Hobson	186	Sawrey, J. S., and Collett, H. Filtration	272
Roozeboom, B. Solubility of Salts	391, 511	Sayers, J. Explosive	1009
Roques, H. Natural Brandy	560	Schadeck, Mercury Phenate	1003
Roscoe, Sir H. E. Aluminium	163	Schadler, Uenhuba Fat	202
Metropolitan Main Drainage	409	Schaeffer, Naphtholsulphonic Acid	958
Roscoe and Dittmar. Aqueous Hydrochloric Acid	862	Schäffer, Beta-naphthol-beta-monosulphonic Acid	276
Roscoe, Sir H. E., and Lunt, J. Estimation of Oxygen in Water (illus.)	729	Naphthol-Sulpho Acid	279
Rosenberg, Micro-Organisms in Water	911	Schaffer and Baum. Naphtholsulphonic Acid	609
Rosenlecher, R. Spirit Blow-pipe Lamp (illus.)	61	Schaffgotsch, Count. Red Glass	708
Rosenstiel and Noeltling. St. Denis Red	703	Schaffner. Zinc determination	922
Roser, W. Nareine	1004	Schall, C., and Dralle, C. Brazilin	699
Narcotine	59	Schanschiff, A. Galvanic Batteries	803
Ross, O. C. D. Waste from Electric Batteries	122	Scheele, Prussian Blue	758
Roth. Experiments on Oats	556	Scheerer, Blast Furnaces	785
Fuse Igniter	817	Scheibler, Arabinose	206
Roth, C. Methylene Blue	453	Scheibler, C. <i>See</i> Kiliani	206, 406
Rothband, H. L. <i>See</i> Mandleberg	992	Scheibler, C., and Mittelmeier, H. Melitose	718
Rotho, J. Tin Alloys for Soldering	711	Schelle, R. <i>See</i> Classen	137
Rothera, C. L. Discussion on Technical Education	346	Scheller, Reagent for Invert Sugar	1014
Rothwell, J. E. Treatment of Gold Ore	894	Schertel. Sulphuric Acid Process	168
Rottemund, E. de. Extraction of Gold, &c.	713	Schertel and Sorel. Sulphuric Acid	774
Roussau, B. Secondary Batteries	901	Schertel, A. Liquefaction of Lead	197
Roussin. Naphthazarin	42	Sulphuric Acid Manufacture	283
Roux, G. Theory of Lead Accumulators	899	Scheurer. Treatment of Cotton	254
Roux and Sarrau. Mechanical Equivalent of Explosives	519	Scheurer, A. Thioflavin	608
Rovello, A. Extraction of Copper	551	Schiff, Chloral-Ammonium	413
Row, O. M. Distillation of Sea Water (illus.)	276	Colour Reactions of Urea	1012
Rowan, Flame	267	Nitrogen Determination	736
Rowan, F. J. Evaporation by Multiple Effect (illus.)	32	Schiff, H. Reduction of Rosaniline	456
Flume	179	Schiffner. Cement	781
Rowan, T., and Hakeman, L. Distribution of Disinfectants (illus.)	1009	Schilling, E. Dowson Gas	532
Royer, C. L. Treatment of Hides	292	Schirm, J. W. C. C. Photographic Decoration of Materials	133
Ruault. Beta-Naphthol	476	Schlagdenhaufen, F. <i>See</i> Heckel	124
Rücker. Combustion	181	Schlagdenhaufen and Reeb. Coroullin	413
Rüdorff, F. Constitution of Solutions	43	Schleich, C. <i>See</i> Lellmann, E.	699
Electrolytic Estimation of Copper	62	Schlesinger, H. A. Substitute for India-rubber	992
Rueff, L. β -Dinaphthyl-p-phenylenediamine	452	Schlosing. Condensation of Gases	864
Ruelle. Rotary Drier	889	Schneider and Co. Copper Castings	656
Rudin. Freezing Spirit from Fusel Oil	559	Schneiderschitz, H. Cinchona Alkaloids	475
<i>See</i> Bang	442	Schoefer, A. Lime Kiln	622
Ruffle, J. Gas Analysis Apparatus (illus.)	3	Scheller, A. Hystazarin	387
Ruhemann, J. Nitrous Acid in Water	569	Schellkopf. α -naphtholdisulphonic Acid I	41
Rumpf, G. Gray Acetate of Lime (illus.)	1008	Naphtholsulphonic Acid	278
Rusag, K. Scheelite	63	Schoen, C. St. Denis Red	703
Russell. Action of Nitric Acid on Silver	858	Schöneweg, H. Explosives	61
Treatment of Silver Ores	120	Schoop, P. Electric Batteries	804
Rust, J. Vitreous Paving Material	782	Schorlemmer. Active Contin	723
Rutten, C. Peat for Surgical Application	720	<i>See</i> Dale	455
		Schorndorff, A. Estimation of Methane	571
		Schott. Cement	781
		Schott, O. Glass for Optical Purposes	780
		Schreib, H. Action of Calcium Carbonate on Ammonium Chloride	461
		Purification of Effluent Waters	301
		Starch Manufacture	127
		Schreib. Estimation of Starch	574
Saare. Moist Starches	909	Schroder. Caffeine with Hypnotics	1003
Salates, J. <i>See</i> Maigrot	811	Estimation of Tannin	1015
Sachoncl, J. Action of Char on Syrups	56	Schroeder. <i>See</i> Hanisch	546
Sachs. Beet Analysis	1014	Schlossing. Magnesium Chlorides	191, 391
Sadtler, S. P. Manufacture of Chloroform (illus.)	1008	Putrefaction	627
Saget, G. Chrome Mordant Process	982	Schlosing and Rolland. Ammonia-Soda Process	490
Sabli. Guaiacol	1002	Schlunk. Cocoa-Nut Butter	1029
Saint-Pierre, O. <i>See</i> Hauriot	877	Schmuck. Micro-Organisms in Water	911
Salot. Gas Pipette	922	Schmid. <i>See</i> Heinzerling	191
Salferd. Manurial Experiments	809	Schmidt. Cobalt and Nickel	711
Salferd, A. Supply of Nitrogen to Papilionaceæ	555	Schmidt, E. Ammonium Bromide	210
Salkowski. Acidity of Fats	806	Schmidt, F. A. Imitation Marble	781
Salkowski, H. Etheral Oil of White Mustard	915	Schmidt, F. W. <i>See</i> Kruss	307, 889
Salleron. Viscolorimeter	561	Schmidt, M. v., and Erban, F. Resins	308
Salomon, F., and Brünzger, H. Protection of Pulp Boilers	814	Schmidt, W. Condenser for Vapours	271
Salomonson, H. D., and Laubheimer, J. Crusher for Super-phosphates, &c.	111	Schmidt and Will. Hyocyanine	1002
Salvétat. Porcelain	983	Schmitt. Cresolcarboxylic Acid	456
Samck, J. Manurial Values of Nitrogen	556	Schnabel. Extraction of Silver	198
Sanio. Testing Astringent Matters	821	Schnabel, C. Deposition of Lead Fume	197
Sardas. Solanine	477	Schneider. Coke Oven	798
Sarrau. <i>See</i> Roux	519	Schneider, H. Copper and Steel Alloy	808
Sarti, A. E. <i>See</i> Atcherley	804	Steel and Nickel Alloys	801
Sartorius. Specific Gravity Balance	7	Schneider, R. Copper Pyrites	212
Satterlee, G. B. Cases for Batteries	803	Schneider, P., and A. Purification of Mercury	802
Saunders. Growth of Wheat	483	Schroeter, H. J. M. <i>See</i> Trimble	915
		Schrotter. Morphine	475

	PAGE		PAGE
Schückher, W. Smokeless Powder.....	818	Singer, I., and Judell, M. W. Cleansing Wool	618, 773
Schultz, Azoxylene.....	114	Singer and Judell. Cleansing Wool (illus.).....	24
Schultze and Hager. Wine Density Tables.....	924	Six-Scrive, E. Dyeing Skeins.....	283
Schultze, W. Action of Sunlight on Beer	56	Skoglund, J. W. Explosives.....	478
Schulz, H. Yeast Poisons.....	471	Skraup. Cinchona Alkaloids	960
Schulze, E. Betaine from <i>Vicia Sativa</i>	724	Thalline.....	566
Schulze, K. Production of the Benzenes.....	954	Skraup, Z. H. Cinchona Alkaloids	474
Schulze, W. Combination of Malt with Water.....	633	Skraup and Wiegmann. Morphine	413, 475
Schumacher-Kopp. Saccharine.....	473	Skraup, Z. H., and Würstl, J. Cinchona Alkaloids	815
Schumann, Cement.....	781	Slaiter, T. Evaporator (illus.).....	970
Schumann, A. Dextrin free from Sugar.....	295	Multiple Evaporator	759
Schunck. Discussion on Committees of Chambers of Commerce	964	Slater, J. Regenerative Furnace	764
Schuster, H. Hard Soap.....	991	Smee, W. F. Treatment of Spent Hops.....	813
Schützenberger. Allotropic Copper.....	52	Smith, Angus. Condensation of Hydrochloric Acid.....	863
Decomposition of Aluminoids.....	813	Smith. See Mills	263
Estimation of Oxygen in Water.....	729	Smith, A. and W. Triple Effect Evaporator (illus.)	33
Hydrosulphite Vat.....	618	Smith, E. Electrolytic Analysis.....	257
Treatment of Logwood.....	614	Smith, E. F., and Frankel, L. K. Separation of Cadmium and Zinc.....	639
Schwackhofen. Acidity of Dextrin.....	573	Smith, E. L. Electro-depositing Cells	289
Schwarz, Opal Glass.....	195	Smith, G. H. Treatment of Guns, &c.	553
Schwarz, P. W. See Stein.....	921	Smith, H. J. Steel Manufacture	801, 802
Schweber. Eseridine.....	1003	Smith, J. Waterproof Paint	808
<i>Schweizerische Metallurgische Gesellschaft</i> . Aluminium Alloys	122	Smith, J. P. See Sinclair	339
Schwicker, A. Sulphites and Thiosulphates.....	705	Smith and Knerr. Electrolytic Analysis	257
Seaulder, F. Metropolitan Sewage.....	440	Separation of Cadmium and Zinc	639
Seabrook, R. Paint for Ships' Bottoms.....	468	Smith, W. Mixer or Churn	379
Seacave, G., and Olivier, P. A. Carburetted Gas	272	Smith, Watson. Discussion on Bisulphide of Carbon.....	97
Seaton, T. L. Treatment of Impure Water.....	127	Discussion on Dyewood Extracts	367
Seaver, F. I. R. Manures	270	Discussion on Sulphur in Coal.....	364
Sebelien, J. Fat Determination.....	300	Discussion on Technical Education	336, 338
Seddon, W. See Lloyd, G. H.	767	Discussion on Technical Instruction	859
Seidner, S. See Engler.....	697	Naphthalene Obstructions in Pipes.....	919
Sellers, J. C. Cement.....	621	Variations in Products of Different Coals	919
Sels. Painting on Plaster.....	715	Wool (illus.).....	17
Senorans, E. Treatment of Faecal Matter	209	Smith, W. J. Permeability of Cement.....	886
Seutex, A., and others. Bronzo.....	199	Snedkor, C. T. Electric Insulator	805
Serrin, H. G. C. Battery Cells	714	Snelus, G. I. Converter Lining	788
Sestini and Tobler, O. Copper in Wine.....	296	Société Française des Alcools purs. Purification of Alcohol.....	57
Olive Oil Refuse.....	590	<i>Soc. Leblais, Piceni & Cie.</i> Bleaching and Dyeing.....	703
Seybold and Bernard. Coke Ovens.....	798	Soldani. Reagent for Invert Sugar.....	1014
Seyberlich. Pure Grape Sugar	496	Solomon, C. Dryer or Desiccator.....	694
Seyberlich and Traupedach. Pure Grape Sugar.....	479	Solson, G. Carbonising Rags, &c.	634
Seyfert. Sugar Refining.....	993	Soltien. Boric Acid in Plants	569
Seyfert, F. Iodide of Starch.....	295	Treatment of Lupins	555
Shackelton, R. Superheated Steam.....	379	Solvay. Carbonator for Soda.....	12
Shaedler. Palm Nut Oil.....	806	Solvay, E. Magnesium Chloride	191
Sharp, H. Discussion on Applications of Oxygen	85	Purification of Gases	973
Sharpe, G. H., and Turner, F. W. Cement	622	Sodium Bicarbonate (illus.).....	45
Shaw. Vulcanised India-rubber	376	Soumaraga, E. v. Reduction of Oxides	196
Shaw, C. H. Disinfectants	411	Sundén, K. See Pettersson, O.	726
Shaw, T. Testing Mine Gases.....	425	Sorauer, P. Decay of Potato Stems.....	205
Shenrer, A. See Bouke, A.	119	Sorel, E. Rectification of Alcohol	910
See Giles	284	Soret. Luminosity of Flames	182
Shears, J. Extraction of Metals	990	Sord, A. Gases occluded in Electrolytic Copper	990
Shears, J. C., and Manbré, A. Vinegar Manufacture	812	Sostegni, L. Surface Water of Soils	907
Shedlock, J. J., and Western, R. Thermo-electric Batteries.....	624	Souchay. See Lenssen	189
Shedlock, W. Treatment of Rice.....	911	Sourleval. See Margueritte.....	506
Shenton, J. P. Calorific Value of Coal	627	Southerton, R. See Stephan	518
Shorrock, J. H. Wood Pulp for Paper	914	Sowerby. Discussion on Technical Education	342
Sieckel. Beef Analysis.....	1014	Soxhlet. Determination of Maltose	573
Siddleley and Co. Refrigerator	169	Pure Grape Sugar	470
Sidot. Bisulphide of Carbon	96	Spence, E. F. Treatment of Rhea Fibre.....	702
Siebold, L. Dyewood Extracts	365	Spence, F. M. and D. D. Fire-resisting Material.....	394
Arsenic in Glycerin.....	726	Spence, J. M. and D. D. Fire-resisting Composition.....	621
Siemens. Cupola.....	395	Spencer. Vacuum Filter.....	446
Puddling Furnace	894	Spencer, S., and Lord, J. S. Pump for Acids, &c.	530
Torsion Galvanometer.....	137	Spiegel, L. See Liebermann	274, 451
Siemens, F. Flame	267	Spilker, W. Electrolysing Chlorides, &c.	53
Water Gas.....	870	Spilker, W., and Loewe, C. Electrolytic Manufacture of Soda	778
Siemens, W. Regenerative Furnace.....	98	Spiller. Oxidation of India-rubber	173
Siewert. Lapacholic Acid.....	723	Spiller, J. Eikonogen.....	958
Silber, P. See Ciancician	395	Spindler, W. Effluent Water	998
Silber. See Ciancician	974, 1007	Sprengel. Explosives	520
Silberman, O. See Chotzen.....	1001	Spring. Alloys.....	121
Sillar, C. Treatment of Sewage (illus.).....	516	Spring, W. Polymerisation of Metals	52
Simon, P. Plate Glass	543	New Acid of Tin.....	397
Simpson. Discussion on Alkali and Sulphur Process	16	Spring, W., and Prost, E. Decomposition of Chlorates.....	460
Simpson, J. See Parnell.....	193, 284	Springer. Puddling Furnace	894
Simpson, M. H. Extraction of Gold by means of Bromine.....	988	Sprung. Expansion of Air.....	215
Simpson, W. S. Explosive Shells	1009	Squibb, E. R. Crude Cocaine	1013
Sims, T. P. Cupel Machine.....	186	Squire, W. S. Purification of Alcohol (illus.).....	441
Sinclair, J., and Smith, J. P. Metallic Alloys.....	399	Purification of Spirit	472
Singer, I. Bisulphide of Carbon (illus.).....	93	Yeast	57
Discussion on Yorkshire Grease	93	Stachelhaus, H. Preserved Meat	208

	PAGE		PAGE
Stadel and Paner. Diamidobenzophenono.....	536	Summers, T. Cleaning Tin Plates.....	989
Stadler, O. <i>See</i> Meyer, V.....	138	Sutcliffe, E. and G. E. Dyeing Aniline Black.....	703
Stammer. Diffusion Sugar Process.....	558	Sutherland, D. A. Discussion on Paraffin Manufacture.....	109
Influence of Sugar on Cement.....	545	Swinborne, F. W. P. and L. P. Gelatin from Hide.....	473
Purification of Spirit.....	441	Syer, J. Silvering Glass.....	196
Sugar.....	632	Szilasi, J. Green Ultramarine.....	715
Stanford, E. C. C. Discussion on Technical Education....	313, 316		
Staub, A. Production of Ammonia.....	507		
Staute. Pinnoite.....	882		
Staveley, W. W. Alkaline Carbonates.....	45		
Examination of Carbolic Acid.....	1013		
Paraffins in Coal Tar Oils.....	974		
Stead. Discussion on Technical Education.....	342		
<i>See</i> Pattinson.....	677		
Stead, J. E. Aluminium Determination in Iron.....	965	Tacke, B. Nittrification.....	907
Gas Analysis (illus.).....	176	Tafel, J. <i>See</i> Fischer, E.....	296
Stead, W. H. Purification of Gums.....	206	Tagliabue, C. J. Thermometer.....	576
Stearns, De Witte. Hydrocarbon Gas.....	273	Tamm, A. Gas Analysis.....	570
Stebbing, J. H. Photographic Developers.....	817	Tanret, C. Ergosterin.....	132
Stebler, F. G. Growth of Hemp.....	125	Tarbutt, P. <i>See</i> Chinnery.....	39
Steedman, R. H. Cement from Alkali Mud.....	778	Tate, N. Discussion on Technical Education.....	336
Treatment of Kelp Salt.....	884	Tatlock, R. R. Discussion on Paraffin Manufacture.....	110
Steele, P. P. <i>See</i> Boyce.....	303	Discussion on Vulcanised India-rubber.....	376
Steen, T. S. Soap.....	624	Tauber, E. Pegannum Harmala.....	412
Steger. Zinc Furnace.....	515	Tauss, H. Action of Water on Wood at High Temperatures..	913
Steiger, L. Estimation of Galactose.....	925	Taylor, J. Soap.....	290
Steinmiz, R. Wood Fibre (illus.).....	209	Taylor, W. J. Gas Producer.....	534
Stein. Determination of Fat.....	573	Tebbutt Bros. Visit to Works of.....	518
Stein, W. M., and Schwarz, P. W. Estimation of Ammonia		Ted, F. L. Clarke's Soap Test.....	256
(illus.).....	921	Temple, W. J., and others. Decoration of Slate, &c.....	621
Steinach, H. Porous Surfaces for Metallic Deposits.....	289	Tenison-Woods, N. M. E. Extraction of Metals.....	980
Stefan, J. Inter-Diffusion of Acids and Bases.....	775	Terry, H. L. Discussion on Bisulphide of Carbon.....	97
Steffen. Sugar Refining.....	993	Resinous Constituents of Caoutchouc.....	173
Steffen, C. Refining Loaf Sugar.....	718	Tervet. Distillation of Shale.....	102
Sugar Refining.....	128	Tetmajer. Slag for Cement.....	888
White Sugar Manufacture.....	811	Thame, H. Secondary Batteries.....	54
Stempel, S., and Warendoff, N. Purification of Alcohol.....	562	Thatcher, C. F. Hops.....	627
Stenbok, M. Nickel Ores in the Ural.....	399	Thatcher, E. Brewers' Finings.....	207
Stenhouse. Fucusol.....	974	Thielsen, E. Condenser.....	759
Oil of Olibanum.....	635	Theodossieff, G. Tempering Steel.....	548
Stephan, J. A., and Southerton, R. Aluminium.....	548	Thiele, J. Generator for Gases (illus.).....	1010
Stephens, P. Baku Petroleum.....	697	Thies, A. Barrel Chlorination of Gold Ores.....	895
Stern, R. Influence of Ventilation on the Atmosphere.....	911	Thom, J. Ammonia-Soda Process.....	460
Stewart, D. R. Paraffin Oil (illus.).....	100	Thomas. Citric Acid in the Hydroquinone Developer.....	725
Stevenson. Discussion on Paraffin Manufacture.....	109	Thomas and Gilchrist. Steel Manufacture.....	783
Monobrom-Camphor.....	565	Thomas, J. G., and White, G. H.....	890
Stevenson, J. C. Vote of Thanks to President.....	510	Thompson. <i>See</i> Rickman.....	507
Stevenson, T. Discussion on Action of Water on Lead.....	250	Thompson, C. <i>See</i> Wright.....	980
Stewart, D. Centrifugal for Sugar, &c.....	811	Thompson, C. H. Secondary Batteries.....	289
St. George, A. F., and Bonne, C. R. Galvanic Batteries.....	54	Thompson, J. <i>See</i> Brazier.....	801
Stieker. <i>See</i> Hubner.....	722	Thompson, J. B. Sulphur from Sulphuretted Hydrogen.....	543
Stift, A. Influence of Saccharine on the Digestion.....	813	Thompson, L. Cyanogen.....	758
Stirling, R. Regenerative Furnace.....	764	Thompson, N. G. Electrical Battery.....	401
Stitt, C. A. Soap.....	467	Thompson, R. C. Recovery of Tin.....	801
Stockasa, J. Discrimination of Phosphoric Acids.....	819	Thompson, W. G., and Claus, W. H. Diazo-Colours.....	533
Stoddart, A. F. Copying Paper.....	58	Thompson, W. H., and others. Grinding Mill.....	379
Stoehr, C. Egonine.....	637	Thompson, W. P. Discussion on Technical Education.....	337
Stokes, F. W. S. Cement.....	622	Discussion on Treatment of Black Ash.....	358
Stokes, H. N. <i>See</i> Treadwell.....	64, 570	Thoms, G. Manurial Experiments with Rye.....	907
Stoklasa, G. Spent Animal Charcoal.....	573	Thomsen. Heat of Solution of P_2O_5	283
Fluorine in Phosphates.....	569	Wood-Caoutchouc.....	557
Solubility of Calcium Tetrahydrogen Phosphate.....	728	Thomsen, J. Phosphoric Acid.....	45
Stolba, F. Ash in Coke.....	64	Thomson. Vulcanised India-rubber.....	376
Stoltenhoff, R. <i>See</i> Kiel, H.....	298	Thomson, E. Electric Soldering.....	892
Stolze. Discolouration of Gelatin-Chloride Prints.....	918	Electric Welding.....	288, 899
Stone, R. Artificial Fuel.....	872	Mercurial Soap.....	123
Stone, R. H. Artificial Stone.....	782	Thomson, R. T. Valuation of Caustic Soda.....	252
Stood, A. Action of Salt Water on Vegetation.....	556	Thomson, W. Colorific Value of Coal.....	525
Effect of Salt on Vegetation.....	810	Decay of India-rubber.....	175
Storch. Test for Rosin.....	572	Discussion on Dyewood Extracts.....	367
Storek, F. Testing Olive Oil.....	139	Discussion on Technical Education.....	340
Storer. Natural Gas near Sydney.....	112	Thomson, W. Salifer.....	256
Storrar, J. M. Candle-making Machines.....	467	Thorington, J. Cocaine in Yellow Fever.....	916
Story, E., and Punshon, R. Glass Manufacture.....	196	Thorne, L. T. Applications of Oxygen.....	82
Strassmann. Injurious Effects of Fuel Oil.....	560	Thorne, W. Examination of Fats.....	902
Stricker, T. <i>See</i> Nolting.....	114	Thorpe. Discussion on Technical Education.....	333
Striegler. Soldani's Reagent.....	1014	The Bunsen Lamp.....	180
Strubell, A. Beet-root Nematoids.....	632	Thoulet, J. Solubility of Minerals in Sea Water.....	621
Stuart, T. W. Discussion on Technical Education.....	341	Thresh, O. M. Manganese Alloys.....	53
Stutzer. Artificial Digestion.....	630	Thresh. Action of Rain Water on Glass.....	767
Stutzer-Bonn. Slags as Manure.....	904	Thümmel, K. Ammonium Bromide.....	210, 436
Sugden, J. Building Material.....	622	Macassar Oil.....	722
Sugden, T. <i>See</i> McDougall, I. S.....	419	Oxychlorides of Mercury.....	916
Sulliot, H., and Raynaud, H. Iodine.....	477	Thurston, F. A. <i>See</i> Wilson, R. P.....	465
Iodoform.....	210	Thwaite, B. H. Gas Producers.....	451
Summerhill, J. Black Varnish on Iron.....	712	Solid Steel Castings.....	691

	PAGE		PAGE
Thyss. Sulphuric Acid	775	Valenta, E. Palm Nut Oil	806
Tibbits, J. B. Filaments for Incandescent Lamps	901	Ucuhuba Fat	202
Tidy. Testing Carbolic Powder	1013	Valentin, B. W. Brewing	297
<i>See Crookes.</i>	243	Valentine, S. G. Roasting Iron Ore	797
Tiedemann, F. Preserving Eggs	207	Valerius. Iron Smelting	890
Tilden. Oil of Sage	636	Valon, W. A. M. Purification of Gas	381
Tilford, R. J. <i>See Redemann.</i>	401	Valon, W. A. Application of Oxygen in Gas Manufacture	634
Tilghman. Magnesium Chloride	191	Purification of Gas by Oxygen	84
Timmis, J. A. Secondary Batteries	201	Valser. <i>See Granval.</i>	425, 641
Tittelbach, R. <i>See Hoffmann.</i>	822	Valton and Remaury. Lining for Steel Furnaces	759
Tobler, O. <i>See Sestini.</i>	206, 290	Van Alstein, A. J. Testing Lubricants	123
Tollens and Mayer. Molecular Weights of the Carbohydrates	717	Van Choate, S. F. Incandescent Electric Lamps	805
Tollens. <i>See Wellington.</i>	876	Preservation of Food	301
Tollens, B. <i>See Beythien, A.</i>	557	Vandermeirssche, C. Treatment of Fibre	773
<i>See Hitzemann, C.</i>	558	Van Niessen. Beet Analysis	1014
<i>See Washburn, J. H.</i>	557	Varin, P. Filters	868
<i>See Wheeler, H. J.</i>	557	Varley, P. H. <i>See Gooch.</i>	393
Tomé. Cement	782	Varley, S. A. Secondary Batteries	803
Tomkins, A. S. <i>See Bowen.</i>	61	Vars, H. A. B. H. de. Ozone Apparatus	624
Tonry. Poisonous Sardines	823	Vaubel. Action of Acids on Thiosulphate	882
Törning, H. G. von. Estimation of Glycerol	424	Vaubel, W. Action of Acids on Sodium Thiosulphate	704
Toth. Testing Carbolic Powder	1013	Vaughan, E. R. Fixing Tubes of Syphon Bottles	760
Toth, H. Photographic Developers	817	Vauquelin. Ammonia-Soda Process	400
Townsend, C. C. Malleable Iron Castings	499	Wool Swept	23
Townsend, W. Evaporation of Acids	780	Vautin, C. T. J. Extraction of Gold	800
Tram, N. J. Reduction of Silica by Magnesium	622	Vée, A. Pharmaceutical Extracts	916
Trampedach. <i>See Seyberlich.</i>	470	Vehries. Decolourising Paraffin Wax	55
Traube. Estimation of Fusel Oil	559	Veitch, G. Concentration of Sulphuric Acid	983
Traube, I. Defuselisation of Alcohol	995	Veley, V. H. Reaction between Copper and Nitric Acid	858
Freeing Spirit from Fusel Oil	559	Veldhuysen and Co. Coating Iron with Lead	548
Traube, M. Hydrogen Peroxide	881	Vereinigte Chem. Fab. Leopoldshall. Magnesium Chloride	191
Treadwell, E. P., and Stokes, H. N. Determination of Benzene in Gas	64	Vesterberg. Amyrin	635
Treadwell, E. P., and Stokes, H. N. Gas Analysis	570	Vibrans. Cultivation of Potatoes	204
Tree, J. W. Malt	207	Vicat. Action of Sulphate of Magnesia on Lime Salts	49
Trench, G. Explosives	1010	Cement	888
Trickett, F., and Nead, J. Extraction of Gold	199	Vicille. <i>See Bertheld.</i>	181
Trimble. Colorimetry	616	Vier. <i>See Tanneley.</i>	1044
<i>See Abbot.</i>	124	Vifquain. Cocaine in Yellow Fever	916
Trimble, H., and Schroeter, H. J. M. Oils of Winter Green and Birch	915	Vignon, L. Oxidation of Tin	120
Trommsdorff. Fichtelite	382	Proximate Analysis of Water	138
Trommsdorff, H. Vegetable Fats	123	Tin	62
Troost and Hautefeuille. Manganese Iron	830	Villiers, A. Action of Sulphurous Acid on Hyposulphites	478
Trotman, C. W. <i>See Temple, W. A.</i>	621	Vincent, C., and Delachanal. Sorbite	295, 296
Truman, Hanbury, and Buxton. Visit to Brewery of	515	Vincent, G. Vessel for Compressed Gases	760
Tschirch. Ucuhuba Fat	202	Viollette, C. Nitrogen Determination	309
Tucker, E. J. <i>See Noakes.</i>	568	Violette, C., and Desprez, F. Sugar Beet	292
Tummeley, E. Azo-Compounds from Salicyl-Derivatives	609	Vivian, Sir H. H. Copper and Nickel Alloys	801
Tummeley and Vier. Invert Sugar	994	Vixien. Estimation of Sugar	1013
Turnbull, C. H. Grids for Gas Purifiers	534	Vizer, R. R. <i>See Pinshon.</i>	214
Turnbull, J., jun. Boilers for Esparto Grass (illus.)	302	Vogel, A. Ammonia-Soda Process	460
Turnbull, R. Composition for Ships' Bottoms	553	Vogel, J. H. Prat Litter Manure	907
Turner. Iron and Silicon	788	Portuguese Wines	561
Turner, F. W. <i>See Sharpe, G. H.</i>	622	Vogelsang. Cannabine Tannate	565
Turner, T. Waste Galvanising Liquors	780	Vogt, A. Magnesium Chloride	191
Turner, W. H. Printing on Earthenware	781	Voigt, A. Action of Magnesium Chloride on Lead Oxide	704
Turpin, E. Explosives	61, 520	Influence of Sulphur in Zinc Smelting	986
Twerdomedoff, S. <i>See Hell, C.</i>	714	Zinc Determination	922
Twynam. Purification of Iron	549	Voisin. Cupola	394
Twynam, T. Alkaline Salts from Slag	399	Volz. Naphthol Sulpho Acids	277
Iron Manufacture	287	Von Schmidt, M. Purification of Oils	624
Tyer, E. Charging Secondary Batteries	804	Vortmann, G. Action of Acids on Thiosulphate	882
Voltaic Batteries	51, 122	Vosmaer, A. Chronic Chloride	569
Tylar, W. Washing Photographs	477	Sulphur Determination	724
Tyrer, T. Discussion on Technical Education	327	Voswinkel, A. Metadiethylbenzene	114
Discussion on Technical Instruction	869	Vries, de. Formulae of Carbohydrates	717
<i>See Fruhauf.</i>	206	Vrij, de. Estimation of Quinine	641
Udransky, L. v. Fusel Oil Determination	309	Vulpian. Lithium Silicylate	476
Ulzer, F. Resorcinoldisulphonic Acid	535	Vulpius. Conduragin	413
Ungerer, A. Continuous Extractor (illus.)	919	Vulpius, G. Acetanilide (Antifebrin)	63
Unglaub, R. O. Glycerin Rectifier (illus.)	715	Arsenic in Glycerin	639
Ure. Ammonia Tables	350	Terpin Hydrate	636
Ursié. <i>See Fruhauf.</i>	206	Test for Lanolin	822
		Waage. Estimation of Theine	822
		Wacker, L. <i>See Fischer, O.</i>	387
		Wachsmuth. Aqueous Ammonia	390
		Specific Gravity of Solutions of Ammonia	541
		Wagner. Manual Experiments	405
		Wagner (Darmstadt). Slag Fertiliser	909

	PAGE		PAGE
Wagner, P. Phosphoric Acid Determination.....	573	Wichmann, G. <i>See</i> Gattermann.....	384
Wagner, R. Potassium Antimony Oxalate.....	189	Wichmann, H. <i>See</i> Rohn.....	56
Wailles, E. F., and Dove, E. J. Paint for Iron.....	291	Widman, Oxazines.....	1004
Waldbaner, G. <i>See</i> Bujard, A.....	489	Widmark, C. J. Cement.....	782
Walker, J., and Carver, H. Printing Calico, &c.....	189	Wiegmann. <i>See</i> Skramp.....	413, 475
Walker, W. T. Purification of Coal Gas.....	112	Wiernik, T. <i>See</i> Lunge, G.....	541
Wall, F. J. <i>See</i> Wilson, R. P.....	465	Wieland, Electrolytic Analysis.....	257
Wallach, O. Terpenes and Ethereal Oils.....	635	Wildy, W. L. Discussion on Gaseous Fuel.....	869
Wallach and Otto. Pinol.....	959	Wiley, H. W. Lard Examination (illus.).....	641
Wallis, H. W. Carbonate of Soda.....	884	Sugar from Sorghum.....	631
Sodium Manufacture.....	801	Willarth. Fixation of Nitrogen by Soil.....	627
Tempering Steel.....	987	Wilhelmi, A. <i>See</i> Kiderleu.....	130
Walsh, E. Zinc Fumes.....	549	Wilke, O. H. von. Sea-Water Soap.....	203
Walter, V. Treatment of Vegetable Fibre.....	58	Will, W. Meconin.....	412
Walton, A. H. "Cut-Outs" for Electric Currents.....	289	Will and Bredig. Atropine.....	79
Wangenheim, Von. Moor Cultivation in Germany.....	469	Will and Landenheimer. Sinalbin Derivative.....	915
Wanklyn, J. A. Clarke's Soap Test.....	254	Will, W., and Peters, C. Oxidation of Rhamnose.....	718
Coal Tar.....	954	Will and Varrentrapp. Nitrogen Determination.....	920
Explosives.....	818	Williams, Opal Glass.....	195
<i>See</i> Fox.....	6	Williams, C. T. Phenylpropioni: Acid.....	305
Ward, T. Salt Deposits of Cheshire (illus.).....	629	Williams, E. S. Photographic Films.....	306
Warenzoff, N. <i>See</i> Stempel.....	552	Williams, H. <i>See</i> Alberger.....	885
Warner, I. <i>See</i> Bailey.....	201	Artificial Fuel.....	381
Warner, J. <i>See</i> Hollies.....	901	Williams, H. J. Ferro-Silicon.....	799
Warren. Platinum Silicide.....	789	Williams, John. Obituary.....	184
Warren, J. E. Filters.....	760	Williams, J. T. Block Fuel.....	272
Warren, T. T. P. B. Walnut Oil.....	466	Williams, M. Barytes Pigments.....	992
Wartha, V. Influence of Pressure on Flames.....	183	Williams, O. L. <i>See</i> Conacher.....	269
Washburn, J. H., and Tollens, B. Sugar from Maize.....	557	Williams, Preece, Bellite.....	212
Watson. Sulphur Determination.....	572	Williams, R. Discussion on Yorkshire Grease.....	92
Watson, W. R., and Robertson, R. A. Evaporator.....	539, 531	Resins.....	308
Watt, A. Treatment of Zinc.....	287	Testing Carbolic Powder.....	1013
Watt, G. Himalayan Podophyllin.....	724	Williams, R. G. Colouring Matters.....	457
Watts. Flame.....	180	Mixed Azo Colours.....	981
Waxin, C., and Clery, A. Artificial Stone.....	51	Orcinol Colour Derivatives.....	611
Weaver, S. J. <i>See</i> O'Brien.....	971	Phenylenediamine Colours.....	279
Weber, A. Coke Ovens.....	874	Tetrazo Colours.....	280, 251
Weber, H. G. Artificial Fuel.....	535	Williams, T. H. Nitrous Vitriol.....	705
Webster, W. Chalybeate Waters.....	289	Williams, W. J. Nitrogenous Fertilisers.....	294
Webster, W., jun. Treatment of Sewage.....	58, 208	Willot. Beetroot Nematoids.....	632
Weddell. English Bottle Glass.....	707	Wilson. Brazilian Paraffin.....	872
Wegener, A. <i>See</i> Gentzen, T.....	769	Discussion on Dyewood Extracts.....	366
Weidel. <i>See</i> Ciamician.....	975	Wilson, A. Gas Producer.....	381
Weigelt, C. Fish Manure.....	631	<i>See</i> Brook, E.....	533
Weinberg. Bromoxylensulphonic Acid.....	274	<i>See</i> Holroyd.....	285
Weinberg, A. <i>See</i> Hoffmann, M.....	709	Wilson, D., jun. Discussion on Technical Education.....	345
Weingartner, E. Detection of Dyes.....	216	Wilson, H. J., and J. W., and French, A. Scrubbing Gases.....	112
Weinreb. Opal Glass.....	194	Wilson, J. Zinc Sulphide.....	119
Weir, P. A. Opium Industry in the N. W. Provinces.....	446	Wilson, J. A. Caustic Alkali in Soap.....	478
Weirich, J. Treatment of Gold Ores.....	400	Wilson, R. P., and others. Steel Manufacture.....	465
Weisberg, J. Pectins of Sugar Beet.....	206	Wilson, T. Vulcanising Flasks.....	808
Weiss, G., and Erekmann, Amber.....	291	Windhausen, F. Refrigerator.....	269
Weiss, R. Acetic Acid.....	697	Windisch. Alcoholic Fermentation.....	509
Weissmann, G. Corrosion of Iron Water Mains.....	378	Fusel Oil in Brandy.....	560
Weith. <i>See</i> Merz.....	383	Impurities in Spirit.....	509
Weldon, W. Sodium Sulphide.....	619	Winham, A. Discussion on Applications of Oxygen.....	86
<i>See</i> Pechiney.....	191	<i>See</i> Ball.....	546
Wellington and Tollens. Anhydroformaldehyde-aniline.....	876	<i>See</i> Roberts-Austen.....	898
Wendling, F. Paint for Stone, &c.....	553	Winkelmann. Coal Tar.....	954
Wenger, A. F. Colour Mixers.....	280	Winkler, C. Artificial Cryolite.....	713
Werber, I. Acetic Acid.....	777	Gas Analysis (illus.).....	3, 64, 570
Werner. Azoxylene.....	114	Winkler, L. W. Solubility of Oxygen in Water (illus.).....	727
Wernike, A. <i>See</i> Kiderleu.....	130	Winskill, J., jun. Limekiln.....	462
Westman. Zinc Furnace.....	545	Wimlinger, C. L. D. Precipitated Phosphate.....	284
Westman, G. M. Gas Producer.....	273	Winter, T. Immersion Rollers for Dyeing.....	281
Treatment of Ores.....	287	Winter. <i>See</i> Neville.....	279
Westwood, W. H., and Wright, E. T.....	451	Wirth, J. Vulcanising Caoutchouc.....	625
Weyl, T. Action of Artificial Colours on the Animal Organism.....	410	Wislicenus. Stilbenes.....	114
Creolin.....	274	Witt, O. N. Amidonaphtholsulphonic Acid.....	958
Weyland Legal. Reagent for Aldehydes.....	573	Beta-naphthol Derivatives.....	276, 277
Wheatley, W. T. Cement for Cutlery.....	622	Detection of Dyes.....	216
Wheeler, H. J., and Tollens, B. Wood-Caoutchouc.....	557	Gold Mines of the Siebenburgen.....	286
Whitaker, T. Bradford Water.....	638	Naphtholsulphonic Acids.....	384
White, C. H. <i>See</i> McLeod, R.....	469	Photographic Developers.....	317
White, G. H. <i>See</i> Thomas.....	800	Progress in Colouring Matters.....	42
White, W. Chloride of Aluminium.....	706	Witt, O. N., and others. Paraxylidine.....	274
Sodium Manufacture.....	801	Wohler. Aluminium.....	677
<i>See</i> Rawson.....	288	Wohlwill, E. Disintegration of Anodes.....	288
Whitelaw, A. Discussion on Technical Education.....	344	Wolf, J. G. "Ossalith".....	622
Whiteley, L. Discussion on Technical Education.....	349	Wolff, A. Chili Saltpetre for Wheat.....	404
Whorgh. Sulphur Determination.....	726	Wollheim, H. Preserving Liquid.....	564
Whorgh, J. Air Pyrometer (illus.).....	214	Treatment of Sewage.....	563
Wichelhaus, H. Diamidobenzophenones.....	536	Wolniewicz, C. von. Utilisation of Tar Acid.....	874
Wichelhaus, v. <i>See</i> Reymann.....	124	Wolstenholme, T. Dye Tank for Yarns.....	389
		Wood, A. M. Broyant Compound.....	625
		Wood, C. Granulated Cement.....	888
		Wood, J. M. <i>See</i> Molyneux.....	692

	PAGE		PAGE
Wood, W. G. Gas Manufacture.....	768	Young and Beilby. Retort for Shale.....	102
Woodzate, J. See Kohn.....	256	Younger, W. Estimation of Chlorine and Hydrochloric Acid in Gases (illus.).....	88
Woodward. Prussian Blue.....	757	Yverl, A. Mercuric Chloride for Asiatic Cholera.....	58
Woodford, J. Treatment of Zinc Ores.....	465	Yvon. Acetanilide.....	63
Wotton, W. O. Paint for Ships' Bottoms.....	403		
Wright, C. A. Discussion on Estimation of Glycerin.....	9		
Iron Smelting.....	786		
Wright, C. R. A. Discussion on Applications of Oxygen.....	86		
Discussion on Technical Instruction.....	860		
Wright, C. R. A., and Thompson, C. Gas Battery (illus.).....	990		
Wright, E. T. See Westwood.....	451	Zeisel. Determination of Methoxyl.....	735
Wright, L. T. Distillation of Coal.....	950	Zalozecki. Char.....	108
Propagation of Flame.....	181	Petroleum Hydrocarbons.....	106
Wroblewsky. Orthoxylidine.....	115	Zecchini and Rivizza. Copper in Wire.....	910
Würstl, J. Cinchona Alkaloids.....	475	Zeisel. Methoxyl Groups.....	305
See Skraup.....	815	Zettler, A. Electro-Magnetic Exploder.....	69
Wylle. Chlorate of Potash.....	168	Ziegler, A. Estimation of Silicon in Ferro-Silicon.....	639
Wylde, J. R., and others. Crystallisation of Chlorate of Potash.....	881	Ziegler, C. See Albert, H.....	119
Wylde, J. R. See Bolton.....	706, 884	See Fellner, J. C.....	531
		Ziervogel. Extraction of Silver.....	985
		Zimmer, G. C. Azo-Colours.....	610
		Zimmerman. Dimethylpyrrolone.....	975
		Zincke. Benzene- α -azomaphthol.....	536
		Zinn. Naphthylenediamines.....	278
		Zischokke. Fuse Igniters.....	818
		Zsigmondy, R. Cadmium Sulpide.....	807
		Glass Manufacture.....	194
		See Benedict.....	6
		Zuhelen, J. See Nietzki.....	386
		Zulkowsky. Isomeric Magenta.....	455
		Zulkowski, K. Action of Slag in Cement.....	70
Yaryan. Evaporation (illus.).....	33, 99		
Yeats, J. R. R. Amalgamation of Gold.....	53		
Yglesias, M. Waste Waters containing Metals.....	804		
Yoe. Separation of Cadmium and Zinc.....	639		
Yoshida. Japanese Lacquer.....	903		
Young, J., and A. S. Printing Fabrics.....	982		

INDEX OF SUBJECTS.

	PAGE		PAGE
Absorbent Surfaces, Porous	393	Alkalis from Slag	399
Absorber for Gases	449	Sodium Nitroprusside as Test for	920
Acacia (Australian Wattle)	903	Alkaloids, Reactions of	421
Accumulators	401, 402	Alloys	36, 120, 199, 200, 399, 549, 712, 713
Electrical	54, 201, 289, 405, 623, 624	Aluminium	464
Theory of Lead	899	Allyltribromide	413
Acenaphthene Perhydride	451	Almond Water, Bitter	567
Acetal in Spirit	64	Alpha-naphtholdisulpho Colours	770
Acetamide, Detection of	63	Alum, Soda	706
Reaction	307	Alumina Lustres	984
Acetic Acid Manufacture	543, 697	Salts	393
Rectification of	777, 779	Titration of	252
Acetone on Amidophenols, Action of	384	Aluminium	463
Acetone Manufacture (illus.)	1008	Alloys (illus.)	199, 548, 549, 677, 713
Estimation of	138	Bronze	399
Acetylisoavanillic Acid	816	Chloride	283
Acetylphenylglycine	978	Chloride Manufacture	706
Acetylphenylhydrazine	476	Deposited on Iron	199
Acid Production in France	228	Determination in Iron	965
Pump	380	Extraction	288, 547, 548, 549, 989
Tars, Treatment of	112	And Iron, Separation of	260
Acids, Affinities of Organic	1012	Manufacture	122, 198, 800, 985
Acids and Bases, Interdiffusion of	775	Plating	548, 551, 897
Acids, &c., Evaporation of	780	Separation of	804
Acipiperazines	977, 978	Sulphate, Free Acid in	479
Aerose from Formaldehyde	206	Triple Alloy	897
Address at Annual Meeting, President's	505	United States, Product of	590
Adonidin	1003	Aluminous Cake	720
Aération of Materials	111	Amalgamation of Ores	200, 547
Aerated Waters, Acid for	706	Amalgamation Process (illus.)	287
Affinity Values of Organic Acids and Bases	1012	Amalgams	713
Asaric Acid	413	Amaranth	389
Asiculture in Canada	483	Amber, Optical Properties of	291
Agricultural Experiments, the Rothamsted	820	American Trade, A Century of	430
Air Bath for Small Retorts (illus.)	134	Amido-Acids, G. and R.	277
Air, Carburetted	272	Amidoazobenzene Derivatives	878
Freed from Germs	472	Amidobenzophenones, Rosanilines from	536
Micro-Organisms in the	911	Amidobenzylsulpho-Acid	611
Pyrometers (illus.)	214	Amidodimethylaniline Derivatives	453
Supply to Furnaces, Moist	381	Amido-diethylmercaptide	454
Zymotechnical Analysis of	472	Amidonaphthalenesulphonic Acids	116
Alcohol, Aldehyde in	219	Amidoparacresylmethyl Ether	452
From Bananas and Tamarinds	130	Amidophenols	538
From Crude Spirit	812	Action of Acetone on	384
Detection of Impurities in	924	Amido-saccharine	476
Drawback in Germany	1019	Amidotrimethylchlorinol	455
French Statistics of	827	Amidotriphenylmethanes	455
Fusel Oil in	309	Ammonia, Anhydrous Liquid	462
Manufacture	309	Carbonates	292, 779
Purification of	57, 559, 562, 719, 905, 996	From Coke Ovens	382, 697
Purification by Hydrocarbons (illus.)	441	Determination (illus.)	921
Question in Spain	585	Engines	531
Rectification	910	From Impurities in Black Ash (illus.)	351
Russian Export of	483	Manufacture (illus.)	284, 505
For Scientific Purposes in the United States	485	From Molasses	128
Alcoholic Liquors, Medicinal	995	Nitrate Manufacture	706
Albumen, Relation of Gelatin to	168	Soda Process Mud, Cement from	820
Albuminoids in Plants	628	Soda Process (illus.)	11, 45
Aldehyde in Alcohol, Determination of	219	Soda Process, History of	460
Blue	384	Solutions, Specific Gravity of	390, 541
In Spirit	64	Standard Solutions	820
Aldehydes, Colour Reactions with	1012	Still (illus.)	103, 884
In Spirit	569	Sulphate, Prices and Statistics	66, 67
Algerian Soils	205	Sulphate Production	665
Alizarin Black	42	Ammoniacal Detergents	403
Blue Derivatives	770, 772	Liquor, Treatment of	193, 402, 534
Green	771, 772	Ammonia, Duty on	1017
Alkali Liquors, Treatment of	884	Ammonium Bromide	210, 636
Mud Cement from	778	Chloride, Action of Calcium Carbonate on	461
In Soap, Caustic	478	Salts in Carnallite	283
In Soap, Free	423	Sulphate, Manurial Value of	810
And Sulphur Process	11	Amyl Alcohol, Injurious Effects of	560
Waste, Treatment of	118, 119	Pyridine in	734
Works, Report on	664	In Spirit	64
Alkaline Nitrites	983	Amyl Nitrite, Tertiary	1003
		Amylenhydrate	1002
		Amylodextrin	716, 717

	PAGE		PAGE
Amyrin	635	Balloon "La France," Electric Battery for	53
Anagyrine	413	Bananas, Alcohol from	430
Analysis, Capillary	569	Bandages, Absorbent	1001
Electrolytic (illus.)	256	Barley of 1888	298
Anemouin	1002	Bohemian	293
Anhydro-ecgonine, Pyridine from	634	Endosperm of	290
Anilidobutyric Acid	978	Maceration of	301
Aniline Black Dyeing	703	Manurial Experiments with	556
Blue Process, Theory of	187	Barytes Pigments	592
Determination	422	United States Product of	590
Non-basic By-products of	386	Bases and Acids, Interdiffusion of	775
Animi Resin, South American	141	Bases, Affinities of Organic	1012
Anisic Acid	566	Bassia Latifolia Juice	124
Annealing Metals	898	Batteries, Bichromate	803
Anodes, Disintegration of	288	Electrical	288, 289, 406
Anthelmintic	1004	Galvanic	54, 623, 714, 803, 804, 805
Anthraquinone Derivatives	112	Galvanic and Secondary	401, 402, 403
Antiegyptian Powder, Italian Duty on	482	Galvanic or Voltaic	123
Antifebrin	63	Secondary	201, 623, 624, 803, 804, 805, 901, 902
Anti-fouling Compound for Iron, &c.	168	Secondary or Storage	280
Anti-inecrustator for Steam Boilers	745	Theory of Secondary	899
Antimony Coating on Iron	406	Utilisation of Waste from	123
Detection of	215	Battery, Electric, for Balloon	53
Determination	1012	Gas (illus.)	509, 550, 990
Electrolytic Determination of	258	Liquors, Treatment of	201
Fluorides	612	Solution, Galvanic	992
Ore, Concentration of	390	Beating Yarns, &c.	189
And Potassium Oxalate	189	Beef Stearin in Lard	30
Salts in Cotton Dyeing	188	Beer	50
Separation of Copper from	733	Clarification of	472
And Tin, Separation of	157	Pasteurisation of	301, 719
Antipyrine, Import Notice regarding (Netherlands) ..	221	Sulphurous Acid in	995
Swiss Duty on	141	Wort, Treatment of	206
Antiseptine	722	Beet. See Sugar Beet	205, 206
Antiseptic	131, 411, 634, 720, 1000, 1001	Beet Analysis	1013, 1014
Paper for Wounds	200	Plant, Formation of Constituents	631
Soap	123, 714, 715	Beetroot, Abnormal	557
Solution	301	Ash	204
Washing Compound	391	Manure for	557
Apiol	305, 1007	Nematoids	632
Apiolaldehyde	1007	Beet Sugar, Japanese	587
Apionol	1007	Mud, Lixivation of	632
Areca Nut, Alkaloids of	210	Rallinose in	56
Arecaïne	210	Belgian Prohibition of Saccharine	66
Arecoline	210	Bellite	522
Argan Oil from Morocco	580	Experiments	212, 213
Argentine Republic, Commerce of	223	Benzamide, Reaction with Formaldehyde	876
Argol, Valuation of	420	Benzanilide	476
Arktos Refrigerator (illus.)	578	Benzene in Coal Gas	221
Arsenic in Calcium Phosphate	62	Derivatives, Influence of Thiophen in	383
In Glycerin	639, 726	Derivatives with Tartaric Acid, Rotation of	283
Removed from Chamber Acid	704	Determination in Gas	64
Removed from Hydrochloric Acid	45	Metadiethyl	114
Artichoke, Glucose from Jerusalem	294	Nitration of	275
Asbestos Cementing	808	Penta-ethyl- and Hexa-ethyl-	113
Asparagine	628	Tetra-ethyl	113
Asphalt Composition for Arches, &c.	51	Tetramethyl	113
Asphaltum, United States Product of	510	Benzidine Derivatives	115, 280, 702
Assaying at the Chester Assay Office (illus.)	687	Tetrabenzyl Ether, Colours from	451
Furnace (illus.)	956	Benzoate of Mercury	722
Assimilability of Phosphoric Acid	101	Benzoylcegonine	133
Atropine	1002	Benzoylsulphimide (Saccharine)	216
And Hyoscyamine	59	Benzylidurene	187
Australsomine	313	Benzyl Violet	49, 536
Azines from Tetramidobenzene	385	Beta-ethyl-a-Stilbazol	636
Azobenzene Compounds	609	Betame from Vicia sativa	724
Azo-Colours	281, 709, 701, 702	Beta-naphthol as an Antiseptic	476
Of the Naphthalene Series	276	Derivatives	276, 277
Azo Compounds from Salicyl Derivatives	609	Oxidation of	456
Azo-Dyes	41, 12, 536, 538, 980, 981	Betanaphthylamine, Sulpho-Acids of	276
Azo-Dyestuffs	456, 457, 771	Sulphonic Acid	878
Azometaxylene	114	Betel Oil	816
Azo-orthoxyene	114	Betolphenol	816
Azoparaxyene	114	Bethabana Wood	723
Azoxines	1094	Betol	565
Azoxylenes	114	Beverage, Non-Alcoholic	995
Azulin	455	Beverages, Aerated	719
		Effervescent Milk	997
		Effervescing	407
Bacteria in Grain	560	Bile Reaction, Pettenhofer's	479
Bacasse Furnaces	910	Birch, Oil of	916
Baking Powder	392	Bismuth, Amorphous	285
Baku Petroleum	872	Basic Nitrate	210
Balances	604	Determination	1012
		Purification of	286
		Salicylate	304
		Bisulphites	392
		Bitter Almond Oil, Nitrobenzene in	216
		Black Ash, Purification of (illus.)	351
		Varnish on Iron	712
		Blackberry Wine	120

	PAGE		PAGE
Blast Furnace Practice with Lime as Flux	890	Cables, Submarine.....	121
Refuse, Utilisation of.....	889	Cadmium Determination.....	1011
Slags, Fusing Point of.....	987	Sulphide, Modifications of.....	807
Blast Furnaces	287	From Zinc, Separation of.....	639
Blasting Gelatin.....	213	Caffeine.....	815
Bleach Association.....	934	In Heart Disease.....	1003
Bleaching, &c.....	703	Calcein.....	970
Electrolytic.....	53	Calcium Carbonate Action on Ammonium Chloride.....	461
Fibrous Materials.....	982	Chloride, Hydrates of.....	391
Paper Pulp.....	505	Chloride, Solubility of.....	541
Paper Pulp by Electricity.....	721	Chloride, Treatment of.....	392
Powder Manufacture (illus.).....	192, 194	Phosphate, Arsenic in.....	62
Use of Oxygen in.....	83	Plumbate.....	885
Vats, Linings for.....	511	Salts removed from Water.....	885
Blende, Treatment of.....	286, 287	Sulphide, Cement from.....	622
Blood, Desiccating.....	294	Sulphide, Phosphorescent.....	117
Blowpipe, Gas (illus.).....	508	Sulphide, Treatment of.....	193
Blue, Aldehyde.....	384	Tetrahydrogen Phosphate, Solubility of.....	728
Ancient Roman.....	142	Calico Printing.....	189, 773
Azo-Dyes.....	41	Californian Borax Lake (illus.).....	854
Colours.....	280	Calorific Value of Carbon.....	531
Egyptian.....	200	Value of Coal.....	525
Laundry.....	704	Camphor, Acetates of.....	1008
Paraphenylene.....	189	Monobromo.....	515
Soluble Prussian.....	277	Of Rosemary.....	1008
Board of Trade Returns.....	315, 428	Trade of Formosa.....	931
Boiler Explosions in Germany (illus.).....	37	Camphoric Acid.....	304
Lead-lined (illus.).....	394	Camphor-Phenols.....	636
Boilers, Anti-incrustator for.....	971, 972	Camphonitrophenol.....	815
For Esparto Grass, &c. (illus.).....	302	Candle-making.....	467
Lined with Lead.....	449	Candle Trade.....	837
Purifying Feed Water for.....	271	Japanese.....	602
Bone Meal, Mineral Phosphates in.....	397	Cane Sugar.....	631
Value of Phosphoric Acid in.....	125	From Maize.....	557
Bones, Treatment of.....	292	Cannabine Tannate.....	565
Boracite from Douglashall.....	704	Canned Provisions, Poisoning from.....	826
Borax Lake in California (illus.).....	854	Caoutchouc, Resinous Constituents of.....	173
Mine, Californian.....	935	Cape of Good Hope, Rebate Rates.....	650
United States Product of.....	500	Capillary Analysis.....	569
Bordeaux S. (a Dye).....	42	Carbazol Blue.....	458
Boric Acid as a Plant Constituent.....	569	Colours.....	771
Acid in Wines.....	130	And Pyrrol, Similar Reactions of.....	158
Anhydride, Reduction by Magnesium.....	622	Carbines, Chromogenic.....	117
Borneol.....	1008	Carbo-dynamite.....	522
Artificial.....	476	Carbohydrates from Formaldehyde.....	297
Boron.....	285	Molecular Weights of.....	717
Bottle Manufacture.....	780	Carbolic Acid, Caustic Action in Solvents.....	567
Boxwood, Prints on.....	638	Acid distinguished from Salicylic Acid.....	422
Bradford Water, Hardness of.....	638	Acid, Examination of.....	1013
Brandy, Composition of.....	560	Acid Tablets.....	131
Lyes, Glycerol in.....	424	Carbolincum.....	403
Brass.....	712	Carbon Bisulphide (illus.).....	93
Brazilian India-rubber.....	226	Bisulphide, Fodder preserved by.....	409
Petroleum.....	872	Determination in Iron.....	922
Brazilium.....	700	Dioxide, Action of Chlorine on.....	396
Brazilin, Bromine Derivatives of.....	699	Dioxide, Determination of (illus.).....	736
Bread Fermentation.....	997	Dioxide, Effect on Yeast.....	633
Brewers' Worts.....	497	Flaments, Connection of.....	895
Brewery, Visit to Messrs. Truman, Hanbury, and Buxton's.....	515	Monoxide, Indication of.....	919
Brewing.....	56, 139, 207, 299, 471, 996	Oxysulphide.....	118
Bricks, Absorbent.....	622	In Smoke, Condensation of.....	377
Brickwork, &c., Damp-proof Cement for.....	51	Carbonic Acid Apparatus for Beer, &c.....	719
Brine, Evaporation of (illus.).....	380	Acid Determination.....	136, 479
Bromine, United States Product of.....	599	Acid Generator.....	983
Bromobetanaphthol.....	277	Acid Manufacture.....	284, 779
Bromonaphthalenesulphonic Acids.....	609	Oxide in the Air.....	306
Bromopseudocumene.....	113	Oxide in Gas.....	532
Bronze.....	199	Oxide, Influence on Germination.....	554
Aluminium.....	683	Carbonising Retort.....	970
Antiquity of.....	431	Carbonyl Sulphide.....	283
Paints.....	493	Carboxygalactonic Acid.....	406
Bronzed India-rubber Goods.....	294	Carburettor for Gas.....	381, 767
Bronzing Metals.....	987	For Gas or Air.....	272
Brown Colours.....	538	Cardboard Manufacture.....	304
Building in Frost.....	196	Etc., Waterproof.....	565
Rubbish, Utilisation of.....	889	Carminaphte.....	389
Buoyant Composition.....	625	Carnallite, Ammonium Salts in.....	283
Burette Tap (illus.).....	821	Carraway, Oil of.....	567
Burner for Tar Oils.....	39	Cartridges for Blasting.....	919, 1009
Triple Bunsen (illus.).....	957	Waterproofing.....	726
Butter Adulteration.....	711	Carvacrolsulphonic Acid.....	816
Anal. sis.....	822	Casein, Decomposition Products of.....	813
Cocoa Nut.....	1020	Casks, Seasoning.....	995
Manufacture.....	409	Castor Oil for Lubrication.....	314
Butterine Legislation in Holland.....	1019, 1020	Senegal.....	588
Butter-milk, Fat Determination in.....	509	Catechol as a Photographic Developer.....	817
Butyl Chloral Hydrate.....	476	Cathedral Glass, Red (12th and 13th Centuries).....	886
Butyric Ether, Duty on.....	825	Cattle Food.....	719
		From Cotton Seed.....	634
		Cayota (Tanning Material).....	314
		Cell Juice, Acidity of.....	628

	PAGE		PAGE
Cells, Battery	803	Chromium Alloys	788
Dry Galvanic	289	Determination	138, 421, 572, 1012
For Electric Batteries	711	Sulphide	889
Celluloid Manufacture (illus.)	303	United States Product of	589
Moulding	625	Chromogenic Carbinols	117
Cellulose, Action of Heat and Water on	913	Chronograph	60
Black Spots on	702	Chrysamine Yellow	42
Colloid	1001	Chrysene Hydrides	274
Pure	814	Churn	379
Reaction with Nitric Acid	858	Cincholepic Acid	474, 475
Celluvert	511	Cincholeipon	474, 475
Cement	129, 622, 621, 622, 781, 782	Cinchona Alkaloids	471, 475, 815
Action of Sea Water on	78	Analysis of	640
From Alkali Mud	778	History	332
Effect of Sugar on	515	Trade of Bengal	430
Influence of Frost on	333	Cineol	635, 721
Japanese	483	Cineraria Maritima	413
For Joints	50	Cinnabar Fines, Furnace for (illus.)	709
Manufacture	620	Cinnamic Acid from Cocaine	305
Painting on	715	Aldehyde, Action of Phenols on	610
Portland	513	Cinnamon Oil	421, 567
Slag	888	Cinnamylcocaine	132, 1007
Trade	500	Cinnamylcogonine	132
United States, Product of	500	Citrate Solution, Marker's	139
Cements	708	Citric Acid, Attempted Synthesis of	411
Of the Isère	887	Citronella Oil, Adulteration in Ceylon	583
Permeability of	886	Clay, Action of Carbon Bisulphide on	118
Centrifugal Machine	691	For Decolourising Paraffin Wax	55
Machines for Sugar	107	Efflorescence of Salts from	984
Separator	539, 808	For Puddle	50
For Sugar	811	From Mahren Refractory	984
Cereals, &c., Treatment for Fermentation	300	Cleaning, Composition for	203
Cerium Oxalate	304	Cloth, Treatment of	281, 282
Chalybeate Waters, Artificial	289	Waterproof	625
Chambers of Commerce, Sectional Committees of	962	From Wood	388
Champagne Manufacture	827	Clove Oil	421, 567
Char	573	Coal, Ceylon	630
Charcoal for Powder	60, 61	And Coke, French	797
Purification of Spirit (illus.)	411	Distillation, Products of	949
Spent Animal	573	Heat-producing, Powers of	525
Chemical Industry, German Society for Protection of	588	Japanese	657
Institute in Nancy	315	Production in Germany and France	492
Prizes in France	935	Sulphur in (illus.)	219, 360
Society, American	933	Treatment of	873
Terms, Pronunciation of	580	Treatment of Small	272
Trade in	834	Cod Gas, Benzene in	221
Trade, German	951	Composition of	606
Chemicals, Imports and Exports	128, 592, 602, 713, 936, 1022	Manufacture	960
Chemistry, International Congress of	656	Purification of	112, 581, 634
Technical Education in	325, 350	Purification by means of Oxygen	84
Cheshire, Salt Deposits of (illus.)	620	Studies of Parisian	972
Chili Saltpetre as Manure for Wheat	104	Sulphuretted Hydrogen in	136
For Oats and Wheat	556	Use of Oxygen in Purification of	694
Top-dressing Beets with	908	Coal Tar, Free Carbon in	40
Value of Nitrogen in	205	Tar Oils, Paraffins in	974
Chimney Shafts, Designs of	632	Coating Metals	807
China Glass, Preparation of	655	For Ships' Bottoms	553
Opium Culture in	653	Cobalt Determination	261, 819, 1011
Root	579	Cobalt and Nickel	307, 711, 988
Chitinidine	475	Investigations on	889
Chitening	471, 475	Peroxides of	639
Chloral ammonium	413	Separation of	62, 923
Urethan	722	Cobalt Nitrate and Resorcinol Green	703
Chlorates, Decomposition of	160	Oxide, United States, Product of	580
Manufacture (illus.)	18, 706	Plating	485
Chlorides, Electrolysis of	53	And Zinc separated	479
Hydrochlorides of	883	Coca	223
Chlorination, Barrel	805	Bases	506, 567
Chlorine as a Battery Excitant	289	Leaves, Estimation of Alkaloid in	574
On Carbon Dioxide, Action of	203	Cocaine	131, 637, 1001, 1007
Determination in Mixed Gases (illus.)	88	Crude	724
Evolved from Chlorates by Heat	160	From Ecgonine	132, 133
Liquid (illus.)	777	Hydrochloride, Colour Reaction of	1013
From Magnesium Chloride	190	Valuation of Crude	1013
Manufacture (illus.)	46, 119, 706, 776, 778, 779, 783	In Yellow Fever	916
Water	567	Cocaines	305
Chloro-aceto-nitric Ethers	111	Cocethyline	1004
Chloroform Manufacture (illus.)	108	Cochineal in Food, Detection of	821
Purity of	215	Cocoon, Saccharine with	473
Chocolate Drops, Medicinal	568	Cocoa-Nut Butter in Germany	1020
Cholera, Mercuric Chloride in Asiatic	58	Coffee, Artificial	910
Cholesterol	133	Congo	473
Choline from <i>Vicia sativa</i>	724	Substitute	409, 997
Chromates	391	Coke, Ash Determination in	64
Analysis of (illus.)	307	Manufacture	637
From New Caledonia	585	United States, Product of	590
Chrome Iron	801	Coke Ovens (illus.)	10, 459, 873, 874
Iron, Artificial	196	Products	382
Mordants	13, 982	Cold Producer	759
Chronic Acid, Colour Tests with	821	Collars, &c., Pyroxyline	303
Acid for Foot-sweat	722	Colliery Water	212
Acid as a Local Antidiaphoretic	301		
Chloride	569		

	PAGE		PAGE
Colloid Films.....	414	Coumarin Derivatives converted into Quinobine Derivatives...	635
French Duty on.....	481	Crab Apple Wine.....	129
Colour Industry, Progress in.....	389	Createine.....	476
Mixers.....	280	Therapeutic Importance of.....	131
Photography.....	414	Cresolin.....	274
Printing on Calico, &c.....	189	Croosote.....	567
Reactions.....	821	Disinfecting Properties of.....	912
Reactions for Glass.....	306	Examination of.....	422, 1013
Reactions with Urea.....	1012	Wood Tar.....	1002
Coloured Glasses in Photography.....	918	Cresol Derivatives.....	279
Colouring Matters, Bluish Green.....	701	Salicylates.....	305, 565
Bluish Green and Bluish Black.....	980	Cresotic Acid.....	954
Colours, Action on Animals.....	410	Cresotinic Acid.....	954
Azo.....	700, 701, 702	Croccinesulphonic Acid.....	276
"Conversion".....	43	Croccine Yellow.....	386
From Croccinesulphonic Derivatives.....	279	Croton Oil.....	567
Dyeing with Mixed.....	263	Crucible Furnace, Small (illus.).....	62
Fastness of.....	42	Furnaces.....	400
Under Glazes.....	984	Machine.....	186
Resinate.....	779	Manufacture.....	781
Tetrazo.....	610, 611	Crucibles.....	621
On Wool, Dis-erimination of.....	216	Crusher for Superphosphates.....	111
Columns, Fire-proof.....	622	Cryolite, Artificial.....	713
Combustion, Heat of.....	450	Electrolysis of.....	287
Temperature of.....	181	Glass.....	194
Concentration of Sulphuric Acid.....	983	Silicon and Iron in.....	572
Condenser.....	779	Cumin Seed.....	580
Reflux (illus.).....	81	Cupel Machine.....	186
Stand (illus.).....	82	Cupolas for Melting Iron (illus.).....	394
For Zinc Fumes, &c.....	465	Cuprous Chloride, Action on Iron-Potassium Sulphide.....	212
Condensers, Surface.....	271	Chloride, Solubility of.....	883
Conduranguin.....	413	Oxide Determination.....	134
Conelation, Concentration by Means of.....	210	Curarine.....	476
Conzo Coffee.....	473	Customs Regulations.....	65, 221, 311, 426, 577, 610, 1017
Trade of the.....	439	Cutch Industry of British Burmah.....	579
Conifecine.....	636	Cutlery, Cement for.....	622
Conine, Synthesis of Active.....	723	Cut-Outs for Electrical Currents.....	289
Connectors for Battery Carbons.....	623	Cuttlefish, Chinese Export of.....	580
Conquinine.....	475	Cyanide Method of Copper Determination.....	686
Consumption, Phenol as Remedy for.....	209	Cyanides from Gas Spent Oxide.....	881
Conversazione.....	511	Cyanogen Compounds in Black Ash.....	353
Converter, Bessemer.....	986	Cyperus Esculentus, Oil from.....	714
Cooler for Fluids.....	379		
For Vapours.....	869		
Cooling Lubricating Oils.....	714		
Copper Alloy.....	802		
From Antimony, Separation of.....	733		
Assay.....	603		
Castings, Schneider's.....	136		
Chilian.....	316		
Compounds with Sugars.....	925		
Determination.....	62, 686, 1011		
Determination of Oxygen in.....	131		
Deposition of Pure.....	550		
Extraction.....	801		
Extraction, Treatment of Liquors.....	286		
Gas in Electrolytic.....	990		
Increased Consumption of.....	491		
Influence on Steel.....	546		
Iron Coated with.....	802		
And Nickel Alloy.....	801		
And Nitric Acid, Reactions between.....	858		
Precipitates, Treatment of.....	808		
Pyrites, Artificial.....	212		
Pyrites, Treatment of.....	286		
Salts, Reaction of.....	420		
Separation of.....	819		
Silicium.....	808		
Smelting in the West.....	485		
Statistics.....	652		
And Steel Alloy.....	898		
Sulphate for Spanish Vineyards.....	1021		
Tin and Lead Alloy.....	36		
Triple Alloy.....	897		
United States Imports and Exports.....	151		
United States Product of.....	589		
In Wine.....	206, 910		
Corallin.....	455		
Coronillein.....	413		
Cotarnic Acid.....	60		
Cotamine.....	1006		
Cotaramethinmethylidide.....	59		
Cotarnone.....	60		
Cotarnonoxime.....	60		
Cotton Dyeing.....	460		
Dyeing with Antimony Salts.....	188		
Dyes, Substantive.....	703		
Freed from Starch.....	539		
Plant, Ash of Seed Capsules.....	555		
Seed Oil.....	64, 203		
Seed Oil, Applications of.....	431		
Seed Oil in Lard.....	30, 63		
Seed Oil, Lard Adulterated in.....	480		
Seed Oil in Texas.....	659		
Velvet Dyeing.....	981		
Yarn Dyeing.....	982		
		Dangway Beans as Substitute for Coffee.....	409
		Decimal Association.....	141
		Decolouriser for Syrups, &c.....	558
		Decorative Employment of Seaweed.....	468
		Defecators.....	298
		Dehydrothioluidine.....	383, 608
		Dematium pullulans.....	56
		Dentists' Vulcanising Flasks.....	808
		Deodorising Operations of the London County Council.....	657
		Depolarisers for Batteries.....	289
		Desiccating Drum.....	694
		Detergents, Ammoniacal.....	403
		Developer, Photographic.....	414, 958
		Dextrin, Commercial.....	573
		Determination.....	425
		Free from Sugar.....	295
		Manufacture.....	470, 561
		Dextrose, Pentacetyl.....	718, 994
		Diacetones, Action of Diamines on.....	976
		Dialysis.....	288
		Diamidobenzophenones.....	536
		Diamidodibenzylbenzidine, Colours from.....	611
		Diamidodixylol.....	114
		Diastase, Action of.....	811
		Artificial.....	407
		Determination.....	425
		Preservation of.....	561
		Saccharification by Means of.....	470
		Diastase Ferment of Wheat.....	560
		Diazo-Colours.....	279
		Dyesuffs.....	772
		Diazothiodimethylamine.....	454
		Dibromometaxylene.....	113
		Diethylmercaptol.....	610
		Diethylsulphone Diethylmethane.....	610
		Diethyl Sulphone Methyl Ethyl Methane.....	980
		Diffusion, Action of.....	43, 44
		Experiments.....	633
		Sugar Process in Java.....	558
		Digestibility of Beet Residues.....	628

	PAGE		PAGE
Digestion, Artificial.....	630	Electrical Aluminium Furnace (illus.).....	678
Influence of Saccharine on the.....	813	Batteries, Waste Products from.....	112
Dihydroxynaphthalene.....	535	Dry Elements.....	122
Dihydroxystilbene.....	876	Dry Piles.....	191
Dimethylaniline, Action with Aluminium Chloride.....	877	Electrolysis.....	53, 288, 1011
Dimethylidihydroxydiquinoxaline.....	385	Electrolytic Analysis (illus.).....	137, 276
Dimethylpyrrolines.....	975	Apparatus (illus.).....	818
Dinaphthyl- <i>p</i> -phenylenediamine.....	452	Baths.....	623
Dinitrodiethylbenzidine.....	792	Estimation of Metals.....	62
Dinitroresorcinol Derivatives.....	792	Production of Metals.....	491
Used in Printing and Dyeing.....	42	Separation of Metals.....	639
Dinner, Annual.....	512	Treatment of Sewage.....	68
Diphenoltrichlorethane.....	876	Treatment of Waste Waters.....	804
Diphenyldiacetipiperazine.....	977, 978	Electro-Metallurgy.....	289, 960
Diphenylmethylpyrazole.....	413	Electromotive Force of Various Cells.....	559
Dippel's Oil.....	975	Electro-plating Baths, Stirrer for.....	604
Dises, Photometric.....	420	Electro-plating, Metals prepared for.....	803
Disinfectants (illus.).....	411, 564, 1000	Elemi, Oil of.....	635
Paint.....	553	Emulsions, Photographic.....	306
Application of.....	720	Enamel for Casks, &c.....	808
Disinfection.....	131, 912	Defective White.....	984
Distillation, Fractional (illus.).....	134	Disinfectant.....	553
Of Sea Water (illus.).....	270	Paint.....	291
Distillers' Worts.....	407	Translucent.....	781
Distilling with Reflux Condenser (illus.).....	81	Enamelling Slate, &c.....	621
Douglas salt Carnallite.....	794	Enfleurage.....	442
Drainage, Metropolitan Main.....	469	Engines, Ammonia.....	531
Drug Trade in Constantinople.....	223	Ephedrine.....	724
Trade, German.....	742	Hydrochloride.....	304
Duties, Victorian.....	658	Ergosterin.....	132
Drums for Caustic Soda.....	392	Ergot of Rye, Constituent of.....	132
For Drying, &c.....	604	Eseridine.....	1603
Dry Piles, Electrical.....	901	Eserine.....	1003
Dryer for Fruit, &c. (illus.).....	562	Pilocarpine.....	413
For Granular Substances.....	970	Esparto.....	813
Manganese Oxalate as a.....	714	Grass, Boilers for (illus.).....	392
For Pulps.....	867	Grass, Treatment of.....	878
Drying Animal or Vegetable Substances.....	568	Essacine.....	792
Arrangement.....	111	Essential Oils, French Notice regarding.....	221
Potatoes, &c.....	409	Ether, Purity of.....	215
Dryobalanops, Borneol of.....	1008	Ethyl Bromide as an Anæsthetic.....	477
Durene.....	187	Ethylene Blue.....	389
Dust, Removal of.....	973	Ethylmethylamine.....	476
Settlement of.....	911	Eucalyptus.....	223
Duty-free Spirit.....	390	Eurhodines.....	386
Dye-baths, Stirrer for.....	604	Euxanthone, Synthesis of.....	699
Dyed Fibres, Resistance to Action of Light.....	878	Evaporating Apparatus, Automatic (illus.).....	927
Dyeing.....	117, 188, 189, 763, 794, 773	Pans.....	407
Bleaching, &c.....	281, 282, 283	Evaporation by Multiple Effect (illus.).....	32
Cloth yarn, &c.....	878	Evaporator (illus.).....	128, 539, 531, 970
Industry, Progress in.....	389	For Brine, &c. (illus.).....	389
With Mixed Colours.....	263	For Extracts, &c. (illus.).....	184
Theory of.....	388	Multiple (illus.).....	38, 759
Washing, &c.....	982	Multiple Effect.....	868
Yarns.....	389	The Yarn (illus.).....	34, 99
Dyes.....	556, 537, 538	Evaporators, Treatment of Liquors for.....	884
Violet.....	981	Examine.....	412, 567, 722
Dyestuffs.....	771, 772	Excreta, Disinfection of.....	912
For Mordanted Fibres.....	638	Treatment of.....	209, 1009
Trade in.....	834	Expansion, Photographic Measurement of.....	638
Dyewoods in Bordeaux.....	827	Explosion, Electromagnetic.....	60
Compound Dyes from.....	538	Explosion, Rapidity of.....	519
Extracts.....	265, 612	Velocity of.....	181
Dynamite.....	213, 521, 818	Explosive Oils solidified for Transport.....	112
		Explosives.....	60, 61, 133, 212, 213, 211, 415, 419, 420, 478, 518, 568, 725, 726, 818, 1009, 1010
		Behaviour under Percussion.....	969
		Mode of Action of.....	918
Earthenware, &c., Decorated.....	196	Exports.....	72
Patterns for Printing.....	781	Extraction Apparatus, Withdrawal of Test Liquor from.....	920
Porous.....	781	Extractor, Continuous (illus.).....	919
Ebonite in Works, Danger of.....	60	For Fats, &c. (illus.).....	81
Eburite.....	625	Extracts, &c., Evaporator for (illus.).....	184
Egonine.....	637, 916, 1004	Pharmaceutical.....	210, 916
Cocaine from.....	132, 133		
Methylether, Hydrochloride.....	132		
Education in Chemistry, Technical.....	325, 350		
Effluent Waters, Treatment of.....	968		
Eggs, Preservation of.....	207		
Egyptian Blue.....	290	Fabrics, Printing on.....	549
Eikonogen.....	958	Treatment of.....	879
Electric Bleaching.....	721	Factory Inspection in Austria.....	933
Conductivity of Saline Solutions.....	900	Fankhausine.....	283
Currents, Cut-Outs for.....	289	Fast Yellow.....	388
Deposition of Carbon in Smoke.....	377	Fat Determination in Butter-milk.....	369
Lamps, Incandescent.....	865	Determination in Milk.....	928
Light Corporation, Anglo-American Brush.....	517	Determination of Neutral.....	220
Tanning.....	404	Extraction.....	961
Thermometers.....	492	Extractor (illus.).....	81, 568
Treatment of Sugar Solutions.....	810, 811	In Milk, Estimation of.....	823
Welding.....	899	Uchuba.....	202

	PAGE		PAGE
Fats.....	807	Frilling, Photographic.....	917
Action of Sulphuric Acid on (illus.).....	644	Fritillaria, Alkaloid from.....	132
Decomposed by Heating under Pressure.....	607	Fruit Drying (illus.).....	562
Estimation of Glycerin in.....	7	Fucosol.....	974
Examination of.....	902	Fuel, Artificial.....	381, 534, 535, 767, 872, 873
Purification of.....	624	Block.....	272
Rancidity of.....	202	Gas.....	695
Solidifying Points of.....	423	Gaseous.....	761, 869
Specific Gravity of.....	551	Liquid.....	531
Testing.....	139	Naphtha Residues as.....	661
Treatment of.....	290	Fuels, Valuation of.....	563
Vegetable.....	123	Fumes, Treatment of Noxious.....	814
Fatty Acids of Drying Oils.....	806	Funnel (illus.).....	648, 868
Oxidation of.....	806	Tubes (illus.).....	1010
Purification of Sugar Syrups by.....	558	Fur Dyeing.....	117
In Soap, Free.....	423	Furfural.....	973
Titration of.....	54	Furnace, Aluminium (illus.).....	678
Feed Water Heating.....	970, 971	For Annealing Glass.....	393
Fennel Oil.....	635	Assay (illus.).....	566
Fermentation.....	56, 471, 559, 561	Boiler.....	872, 873, 874
Of Bread.....	997	For Carbonic Acid.....	284
Foaming.....	300	For Chinabar Fines (illus.).....	709
Of Honey.....	910	Crucible.....	884
Of Milk.....	633	Gases, Blast.....	784
Mucic.....	811	For Pyrites.....	119
Fermentol.....	998	Regenerating.....	873
Ferments, Alcoholic.....	300, 471	Siemens (illus.).....	764
Ferrocyanide Determination.....	732	Smoke-consuming.....	39
Residues.....	558	Valves (illus.).....	98
Ferrocyanides.....	881	Furnaces, Bagasse.....	910
Ferro-Manganese.....	788	Blast.....	287
Ferro-Silicon, Determination of Silicon in.....	639	Crucible.....	400
Ferrous Sulphates, Action on Soils.....	205	Electrical.....	501
Agricultural Value of.....	554	For Hydrocarbons.....	381
Fertilisers, Nitrogenous.....	294	Oxygen used with Experimental.....	85
Fertilising Medium.....	473	Perfect Combustion in.....	767
Fibre for Oil-Cloth, &c.....	58	Fusel Oil in Alcohol.....	309
Preparation of.....	578	Removed from Alcohol.....	995
Treatment of Vegetable.....	411	In Spirit.....	559, 560
Fibres, Treatment of.....	303, 539, 634, 702, 773	Fuse Igniters.....	817, 818
Fichtelite.....	582, 583	Fuses.....	420
Fiji Drug Imports and Customs Tariffs.....	222	Electric.....	466
Filaments for Incandescent Electric Lamps.....	901	Safety.....	133
Filicic Acid.....	412	For Shells.....	918
Filling for Painters' Use.....	204	Fustic, Extract of.....	617
Films, Photographic.....	414		
Filters (illus.).....	111, 128, 186, 379, 407, 530, 694, 760, 868, 972		
Filter Presses.....	270, 449		
Stand.....	425		
For Wine.....	207		
Filtering Medium.....	473		
Filtration (illus.).....	271, 998, 999		
Of Sterilised Liquids.....	472		
Finings, Brewers'.....	207		
Fire-damp, Action of Explosives on.....	415, 419		
Explosion of.....	60		
Fire Places, Comparative Value of.....	531		
Fire-proof Columns.....	622		
Fire-resisting Composition.....	621		
Material.....	204		
Fish Manure.....	631		
Oils.....	54		
Fixing-bath, Sodium Sulphite in the.....	725		
Flame.....	179		
Discussion on.....	267		
Flashing Point of Mineral Oil (illus.).....	734		
Flasks, &c., Air-bath for (illus.).....	134		
Flax, Treatment of.....	702		
Flour, Whole-Meal.....	911		
Fluorene Perhydride.....	451		
Fluorescein.....	116		
Chloride, Rhodamine from.....	557		
Fluorspar Glass.....	195		
Fodder, Artificial Wash as.....	300		
Preserved by Carbon Bisulphide.....	100		
Fodders, Digestibility of.....	628, 629		
Food, Preservation of (illus.).....	207, 208, 301, 502, 564, 1001		
Foot-sweat, Chromic Acid for.....	304		
Formaldehyde, Acrose from.....	296		
Carbohydrates from.....	297		
Reactions with.....	876		
Formic Acid, Concentrated.....	210		
Formose.....	207		
Foul Liquors, Treatment of.....	288		
Francinus.....	876		
Frankfort-on-Main, Trade of.....	650		
Freezing Points of some Solutions.....	423		
French Indo China, Customs Tariff of.....	578		
Trade Statistics.....	429		
Friction Tube.....	817		
		Galactose-carboxylic Acid.....	406
		Determination.....	925
		Pentactyl.....	994
		Galena.....	880
		Galloryanines.....	981
		Galvanised Iron Scraps, Treatment of.....	52
		Galvanising, Iron prepared for.....	898
		Liquors, Treatment of.....	780
		Skimmings, Utilisation of.....	713
		Utilisation of Waste Pickle.....	400
		Waste Pickle from.....	484, 548
		Gangue separated from Ores.....	988
		Gas Absorption.....	449
		Analysis (illus.).....	3, 136, 176, 570, 922
		Analysis by Explosion.....	425
		Battery (illus.).....	509, 550
		Benzene in.....	64
		Burette.....	479
		Burner, Triple Bunsen (illus.).....	957
		Burners for Fuel Gas.....	695
		Burners, Incandescent.....	272, 273, 451, 533
		Burners, Mantles for Incandescent.....	768
		Carburetted.....	272, 696
		Carburetter.....	767
		Compressor.....	269
		Dowson and others.....	532
		In Electrolytic Copper.....	990
		Furnaces, Puddling in.....	894
		Generator.....	112, 272, 273
		Generators, Self-Regulating.....	1010
		For Heating.....	186
		Manufacture.....	272, 273, 381, 533, 534, 768, 872, 873
		Measurement of.....	381
		Pipes, Naphthaline in.....	149
		Producers.....	381, 768, 869
		Producers, Ammonia from (illus.).....	506
		Producers, Continuous.....	696
		Purification.....	767
		Purification, Spent Substances from.....	421
		Refuse, Treatment of.....	696
		Residues.....	732
		In Rolled Iron Tubes (illus.).....	298
		Tars, Specific Gravity of.....	951
		Water.....	186, 451, 605
		Water Oil.....	51
		Wells near Sydney.....	112
		Gas-fired Kilns.....	285

	PAGE		PAGE
Gaseous Fuel.....	761, 869	Greek Customs Tariffs.....	221
Gases Absorbed by Vulcanised Ca nitehene.....	55	Green, Leuco-Malachite.....	535
Absorbed by Water (illus.).....	720	Insoluble (Sulphonic Acid).....	433
Blast Furnace.....	784	Soluble (Sulphide).....	453
Composition of Various.....	532	Grids for Electric Accumulators.....	805
Discharge under Pressure.....	760	For Gas Purifiers.....	534
Expelled from Solutions.....	399	Grinding Mills.....	379
Furnace.....	563	Ground Nut-Oil, Exports from China.....	931
Inert.....	636	Guaiacol.....	1002
Machine for submitting Solids to Action of (illus.).....	194	Guaiacum Resin, Oxidation of.....	480
Mixer for.....	767	Guano, Peruvian.....	70
Porous Surfaces for Absorption of.....	393	Gum Benjamin, Siamese.....	312
Pumps for.....	111	Manufacture.....	189
Purification of.....	273	Gums, Purification of.....	206
Etc., Scrubber for.....	112	Gum Barrels, Black Lacquer on.....	400
Utilisation of Heat from (illus.).....	879	Gunpowder, Smokeless.....	478
In Water.....	245	Gypsum, Effect on Wine.....	57
Gasworks Data, Parisian.....	871	Influence on Soils.....	909
Gelatin Blasting.....	522	United States, Product of.....	530
Emulsion, Ammonia in the.....	725		
Manufacture.....	473	Hair, Structure of (illus.).....	19
Negatives, Yellow Stains in.....	457	Harmaline.....	412
Oxidation of.....	468	Harnine.....	412
Generator for Gas.....	112	Harness, &c., Varnish for.....	716
German Export Trade.....	932	Hartsalz.....	704
Spirit.....	472	Hatchisch, United States Duty on.....	141
Spirit Manufacture.....	441	Hay, Spontaneous Combustion in.....	935
Trade Returns.....	144, 650	Heater for Fluids.....	379
Germany, Cultivation of Moors in.....	469	Hedwizia Balsamifera.....	443
Technical Instruction in.....	858	Hemp Cultivation.....	125
Germination, Influence of Carbonic Oxide on.....	554	Heptane Extract, Valuation of.....	220
Germis, Air freed from.....	472	Henequen.....	659
Gilding.....	987	Mexican.....	826
Glass, Action of Lead Oxide on.....	684	Hexadecane, Crystalline Hydrocarbons in.....	124
Annealing.....	393	Herniaria.....	815
Bottles, Solubility of.....	707	Heterodera Schachtii.....	632
For Church Windows, Red (12th and 13th Centuries).....	886	Hexyloide from Sorbite.....	558
Hardening.....	621	Hides, Treatment of.....	292, 473, 954
Jena Normal, for Thermometers.....	886	Homatropine.....	1002
Manufacture.....	194, 196	Homococaine.....	1004
Manufacture in Italy.....	141	Homomarene.....	1004
Metallic Lustrous Surfaces on.....	984	Homopterocarpin.....	59
Opal.....	194	Honey, Fermentation of.....	910, 965
Opaque Etching.....	629	Hop-growing Soils.....	126
For Optical Purposes.....	780	Hop Resins.....	230
Painting on.....	105	Hops.....	627
Red.....	708	Bitter Constituents of.....	129
Rolled Plate.....	543	Extract of.....	719
Silvered.....	196	Treatment of Spent.....	813
Tests for.....	306	Horblende, Treatment of.....	625
Trade.....	838	Humus.....	404
Turbid.....	333	Substances of Soils.....	293
Utilisation of Waste.....	781	Hydrargyrum Oleum.....	567
Glaze, Mexican Pottery.....	707	Hydrastal.....	1007
Glazes, Colours under.....	984	Hydrastic Acid.....	1006
For Porcelain.....	983, 984	Hydrastin.....	412, 637, 1006
Gluconic Acid.....	558	Hydrastinic Acid.....	637, 1006
Glucose from Jerusalem Artichoke.....	204	Hydrastinine.....	412
Manufacture.....	207, 470	Hydraulic Main, Tar Thickening.....	450
Glucosides, Reactions of.....	621	Hydrazine Derivatives.....	279
Glucosone.....	296	Hydrazones.....	536
Glue Manufacture.....	262	Hydrocarbon C ₆₀ H ₁₂₂	382
Etc., Spread on Paper.....	721	Furnaces.....	381
Gluten Manufacture.....	633	Furnace for Assaying (illus.).....	956
In Wheat.....	627	Gas.....	273, 873
Glycerin, Applications of.....	539	Soap.....	991
Arsenic in.....	639, 736	Hydrocarbons, Perhydrides of Aromatic.....	451
Determination.....	4	Hydrochloric Acid Determination in Mixed Gases (illus.).....	88
Manufacture.....	290	Acid Freed from Arsenic.....	45
Purification.....	807	Acid Gas, Condensation of.....	861
Rectifier for (illus.).....	715	Acid from Magnesium Chloride.....	190
Glycerol Determination.....	60, 308, 324, 180, 574	Acid Manufacture.....	193
Glycolic Acid in Suint.....	55	Acid Manufacturers, Conference of.....	934
Gold Alloys.....	129	Acid, Vapour Tension of.....	862
Amalgamation.....	53, 517	Hydrocinnamic Acid.....	565
Assay (illus.).....	657	Hydrogen Manufacture.....	767
Assay, Limits of Error in.....	629	And Nitrogen, Simultaneous Determination of.....	734
Extraction.....	198, 199, 200, 801, 802, 988	Peroxide.....	612
Extraction of.....	286, 287	Peroxide employed in Analysis.....	138
Hall-Marking at Chester.....	687	Peroxide, Manganese determined by.....	216
Monobromide.....	1002	Peroxide from Sulphur Peroxide.....	881
Mines of the Siebenburgen.....	286	Treatment of Alcohol.....	559
Ores, Refractory.....	444	Hydrolime, Swiss Duty on.....	141
Ores, Treatment of.....	199, 711, 713, 894, 895, 987, 988	Hydromel.....	195
And Potassium Alloy.....	52	Hydrometers (illus.).....	726, 761
Salts, Photographic.....	212		
And Silver Extraction.....	800		
Statistics, Transvaal.....	431		
Gooseberry Wine.....	129		
Grain, Bacteria in.....	560		
Etc., Treatment before Brewing.....	130		
Grass Field, History of a.....	554		
Land, Treatment of.....	554		
Grasses, Treatment of Fibres.....	773		
Grease for Axles.....	624		
Yorkshire.....	20		

	PAGE		PAGE
Lead Peroxide, Purity of	215	Malt	301
Pigments	204, 291	Maltogenic Acid	391
Poisoning by Water	912	Maltodextrin	716, 717
Red	203, 220	Maltose, Action in Presence of Diastase	811
Salts, Insoluble	777	Crystallised	298
Separation of Silver from	990	Determination	424
Statistics	71, 152	Oxidation of	994
Sugar of	162	Syrup, Colourless	633
Sulphate, Purification of	553	Mandragora Alkaloids	814
Sulphide	889	Mandragorin	915
Ultramarine	715	Manganese	622
United States Product of	589	Alloys	53, 788
For Vitriol Chambers	774	Carbonate, Action of Air on	620
In Water	611, 638	Manganese Determination (illus.)	138, 216, 307, 819, 1011
White	552, 553	Iron	801
White, Mill for	769	Ore, Chilean	676
Lead-lined Boilers (illus.)	304, 419	Ore in New Zealand	314
Leadville Sulphurets	896	Ore, Treatment of	199
Leather, Artificial	469, 533, 808	Oxalate	123
Waste, Utilisation of	890	Oxalate as a Drier	714
Leguminosae, Researches on	555	Oxides	541, 774
Lemon Essence Manufacture	635	Peroxide Determination	968
Juice, Sicilian	582	Peroxide, Regeneration of	796
Leuco-bases	456	Separation from Lime	922
Leucomethylene Blue	453	In Transcaucasia	226
Lids for Soda Drums	530	United States Product of	580
Light, Resistance of Dyed Fibres to	878	In the United States	141
Lightning Conductors at Powder Works	60	Zinc separated from	62
Lime Burning	120	Mamoiic Acid	394
Determination	821	Mannose	207, 558
Determination in Soils	735	Mannosoxime	558
Effect on Water	243	Mantles, Incandescence	272, 273
Gray Acetate of	1008	For Incandescent Gas Burners	451, 768
Kilns	284, 462, 622	For Incandescent Lighting	973
Mud	462	Manure Act, French	66
Mud, Treatment of	770	Artificial	292, 631
Phosphate	284	Farm-yard	554
Phosphate in Russia	141	Fish Shells as a	1091
Removed from Skins, &c.	124	Insecticide	127
Separation of Manganese from	922	Manufacture, Report on	141
Sulphate, Sulphuretted Hydrogen from	46	Trade, French Regulations	586
In Tanning Materials	992	Manures, Chemical, Brazilian Duties on	579
Limoges, China Trade at	654	In France, English	1019
Linoleic Acid in Olein	641	Phosphate	404
Linsed Cake, Adulterated	554	Value of Nitrogen in	556
Meal, Adulteration of	301	Manurial Experiments	124, 125, 126, 557, 905, 907, 908, 909
Liquids, Aeration of	759	Experiments with Barley	556
Porous Surfaces for Absorption of	393	Experiments in Hanover	891
Specific Gravity Determination (illus.)	310	Values of Phosphates	628
Lithium Carbonate and Sulphate	734	Margarine	408, 409, 641
Fluoride	478	Sale in Russia	739
Salicylate	476	Trade	833
Litmus, Purification of	921	Trade in Sweden	427, 930
Liverpool Association for Technical Education	350	Marsh Gas, Effect of Explosives on	417, 419
Lixivation of Sugar Mass	128	Martinique, Customs Tariff of	427
Loch Katrine Water	245	Mash Tuns, Water Supply to	996
Logwood, Extract of	612	Mastic, Trade in	583, 656
Lubricant	624	Match Monopoly in France	930
Lubricants, Testing	123	Matches, Russian Duty on	649
Lubricating Compound	467	Vesta	1010
Oils, Behaviour at Low Temperatures	423	Mead	995
Oils, Cooler for	714	Meal, Cotton Seed	432
Oils, Testing	990	Meat, Preserved	208
Lucerne, Cultivation of	205	Safes (illus.)	996
Lupinus, Treatment of	555	Meeting, Report of Eighth Annual	503
Lustres, Alumina	984	Meldometer	306
		Meliose, Inversion Products of	718
		Melting Point of Fats (illus.)	643
		Points, Determination of	306
		Menthene	635
		Terpene converted into a	131
		Mercaptol, Diethyl	610
		Merchandise Marks Act	588
		Mercuric Chloride in Asiatic Cholera	58
		Chlorides	883
		Mercury, Ammonia Chlorides	915, 946
		Ammonium Compounds	211
		Benzoate	722
		Carbolic Acid in Soap	123
		Chlorides	815
		Determination	571, 923, 1011
		Fulminate	520
		Oleate	567
		Oxychlorides	916
		Phenate and Phenoxide Double Salts	1003
		Phenate	722
		Thymylate	722
		β-naphthol Acetate	596
		Mercurylthymol Salts	413, 414
		Metacetone	274
		Metacresol	798
		Metadiethylbenzene	114
		Metal Coating	987, 988
		Drums, Lids for	530
Macassar Oil	722		
Mace, Oil of	695		
Machine Oils	302		
For Treatment of Yarns, &c.	189, 190		
Magnesia in Cement, Influence of	48, 50		
Determination	922		
From Sea Water	441		
Magnesium Alloys	622		
Chloride	391, 392		
Chloride, Chlorine from	130		
Chloride on Lead Oxide, Action of	704		
Main Drainage, Metropolitan	1020		
Maize, Cane Sugar from	557		
Malachite Green	456		
Malt of 1888	298		
Combination with Water	633		
Effect of Drying on	290		
Extract	424		
Manufacture	297		
Treatment of Ground	926		
Malta, Opportunities for Trade in	653		

	PAGE		PAGE
Metallie Lustrous Surfaces.....	984	Mustard Seed Cattle Food	719
Oxides, Reduction of.....	196	Seed Oil.....	484
Particles removed from Paper Pulp (illus.)	209	Myeoderma	471
Metallurgy.....	286	Mydriatic Alkaloids	1002
Metals of the Alkaline Earths.....	465	Myrabolans in South Australia.....	226
Allotropy of.....	52	Myricyl Iodide, Hydrocarbon from	382
Deposition of.....	551	Myristica, Fat from Seeds of.....	202
Electrolytic Determination of.....	1011	Myrtle Oil.....	721
Electrolytic Estimation of.....	62		
Electrolytic Production of.....	401		
Extracted from Slag.....	201		
Extraction of.....	802		
Imports and Exports of..... 428, 489, 502, 602, 742, 936,	1022		
Joined without Solder.....	802		
Plates, Decorations on.....	204		
Production in Austria-Hungary.....	483		
Production, German.....	314		
Metanitrotoluene.....	388	Naphtha, Caucasian.....	431
Metaxyleneol, Adjacent.....	114	Residues as Fuel.....	661
Metaxylidine, Adjacent.....	115	Stills (illus.).....	105, 107
Meters.....	381	Naphthalene Dihydroxy.....	535
Methacetic.....	722	In Gas Pipes.....	949
Methose.....	297	Moulds for.....	875
Methoxyl Determination (illus.).....	735	Series, Azo-Colours of.....	276
Methylacetanilide.....	412	Naphthazarin.....	42
Methyl Alcohol, Estimation of Acetone in.....	138	Naphthionic Acid Colours.....	115
Methylene Blue..... 452, 537		Nitration of.....	886
Red.....	454	Naphtholbidiazobenzene.....	116
Methylfurfural.....	973	Naphtholdisulphonic Acid.....	278, 280
Methylglycoamine.....	476	Naphtholsulphide (β).....	187
Methylmorphimethine.....	305, 637	Naphtholsulphonic Acids.....	384, 386, 609, 700
Methylpyrrolines.....	974	Naphthol Yellow.....	537
Methystein.....	305	Naphthoquinone-dianilide Derivative.....	877
Metropolitan Sewage.....	409	Naphthoresorcinols, Nitroso.....	697
Micro-Organisms in the Air and Water.....	911	Naphthylaminebidiazobenzene.....	116
Mikado Brown and Orange.....	389	Naphthylamine, Sulpho-Acids of Beta.....	276
Milk.....	58	Naphthylaminesulphonic Acids.....	385, 387
Alcoholic Fermentation of.....	633	Naphthylene Diamines.....	278, 288
Estimation of Fat in.....	825	Naphthylglycine.....	978
Fat Determination in.....	928	Narcine.....	567
Powder.....	997	Meconate.....	566
Preservation (illus.).....	130	Narcotine Derivatives.....	59
Sodium Bicarbonate in.....	1015	Negatives, Photographic.....	918
Sugar, Oxidation of.....	297	Netherlands-India, Petroleum in.....	872
Mill, Centrifugal Roller.....	196	New South Wales, Salt Beds in.....	118
For Printing Ink, &c.....	760	Nickel Alloys.....	801, 802
Mills, Grinding.....	379	And Cobalt.....	888
Mineral Exports, Chilean.....	316	And Cobalt, Investigations on.....	889
Gelatin for Batteries.....	289	And Cobalt, Separation of.....	62
Lubricating Oil, Flashing Point of (illus.)	734	Determination.....	260, 421, 1011
Oil, Detection of.....	735	And Iron Welded.....	285
Production of Canada in 1888.....	461	Ores in the Ural.....	390
Products of the United States.....	68	Peroxides of.....	639
Resources of Persia.....	933	Separation of Cobalt from.....	923
Sorter (illus.).....	465	Separation of Zinc from.....	307
Statistics, 1886 and 1887.....	842	Sulphide.....	517, 536
Statistics, 1888.....	830	Treatment of and Plating with.....	889
Statistics, United States.....	150	United States Product of.....	548
Mines, Swedish.....	658	Nicotine Bitartrate.....	723
Use of Roburite in.....	585	Determination.....	736
Mixing Machine.....	379	Nitrate, Action of Superphosphate on.....	55
Molasses, Estimation of Sugar in.....	560	Determination.....	569
Separation of.....	993	Industry in Chili.....	427
Treatment of.....	128	Statistics.....	152
Molybdic Anhydride, Reduction by Magnesium.....	622	Nitrates absent from Forest Trees.....	292
Monilia.....	471	Estimation of.....	921
Monomethylamine Determination.....	423	Estimation in Soils.....	572
Moor Land, Treatment of.....	555	In Plants.....	405
Moors, Cultivation of.....	469	In Soils.....	306, 420
Morehione.....	290	In Water.....	158, 1010
Mordant.....	283	Nitration.....	275
Chrome.....	982	Nitre Deposits.....	627
Mordanted Fibres, Colours for.....	698	Nitric Acid Determination.....	820
Morin.....	618	Acid Reactions with Copper.....	858
Morphia, Indian.....	917	Acid in Tropical Rain.....	627
Morphine..... 305, 413, 475, 636		Acid Determination, Table for.....	135
Morpholine.....	1004	Oxide, Preparation of.....	1010
Mortar, Sugar in.....	196	Oxide, Table for Calculation.....	135
Mortars, Roman.....	49	Nitrification.....	907, 909
Moss Destroyed by Ferrous Sulphate.....	205	Nitrites.....	983
Moulded Articles, Compound for.....	781	In Water.....	420
Moulds for Naphthalene.....	875	Nitrobenzene, Detection of.....	216
Mucic Fermentation.....	811	Nitrocellulose Compounds.....	204
Mucor.....	471	Dryer for (illus.).....	303
Muffle Kilns for Glass, &c.....	621	Nitrodextrin.....	214
Mull Substances in Soils.....	293	Nitrogen from the Air.....	46, 306
Mushrooms, Sugar in.....	405	Determination (illus.).....	139, 220, 309, 574, 823, 920
Musk Substitute.....	1004	Determination in Water.....	480
Mustard, Ethereal Oil of White.....	915	Fixation by Soil.....	626
Oil, Estimation of.....	220	And Hydrogen, Simultaneous Determination of.....	736
		Manurial Values of.....	556
		Pentoxide.....	283
		In Plants.....	405
		In Soils.....	56, 907, 909
		Trioxide, Solid.....	726

	PAGE		PAGE
Nitronaphthalene, Action of Sulphuric Acid on	116	Osones	296
Nitrophenols	538	Ossalith	622
Nitroso-Compounds	280	Oxanbame	211
α -Naphthol Colours	41	Ovens, Platforms for	531
β -Naphthol in Quantitative Analysis	819	Oxalic Acid from Molasses	128
Nitrososulphonic Acid	283	Oxanthranol	388
Nitrostarch	214	Oxazines	1001
Nitrosulphuric Acid, Stability of	139	Oxidisers	885
Nitrous Acid, Colour Tests with	821	Oxygen from the Air	10, 306, 414
Acid in Water, Detection of	569	Company, Visit to Works of Brin's	517
Nomenclature, Unification of	691	Industrial Applications of	82
		Manufacture	694
Oats, Cultivation of	205	Through India-rubber, Diffusion of (illus.)	732
Experiments with	556	Treatment of Wines, &c.	596
Smut prevented in	469	Water, Carbonated	501
Obituary—Michel-Eugène Chevreul	268	In Water, Determination of (illus.)	423
John Dale	528	In Water, Solubility of (illus.)	727, 729
Dr. John Percy, F.R.S.	448	Ozokerite	535
Gaston Planté	530	American	315
Dr. Gustave-Augustin Quesneville	897	Calician	768
Warren de la Rue	299	Occurrences of	696
John Williams	184	United States Product of	590
Octaethylidulcose	995	Ozone Determination	136
Odour imparted to Water-Gas	873	Reaction	480
Oenobarometer	561	Ozonised Oxygen	1001
Oil, Analyses of Olive	685		
Californian Olive	467	Paint, Anti-corrosive	291
Of Cloves, Colour Reaction of	573	Austrian Drawback on	578
Cod Liver	54	For Metal, &c.	808
Cotton-Seed	293	For Stone, &c.	553
From <i>Cyperus Esculentus</i>	714	For Tanks	124
Dryers for	123	Remover	716
Of Lemon, Sicilian	582	Removing Compound	552
Olive	292	Painters' Filling	201
Palm-nut	806	Painting on Cement	715
Press	290	On Glass, &c.	403
Testing	990	Paints	204
Testing Machine (illus.)	617	Palladium	710
Trade	580, 836	Palm-nut Oil	806
Walnut	696	Pans, Evaporating	407
Oils, Adulterations in Vegetable	64	Paper, American	314
Analysis of Etheral	925	Blotting	411
Detection of Mineral Oils in	735	Blotting and Copying	58
Essential	722	Etc., coated with Glue, &c.	721
Etheral	635	Estimation of Wood Cellulose in	574
Fatty Acids of Drying	806	Industry in Spain	1019
Imports of	428, 592, 936	Making	729, 721
Imports and Exports	663, 743	Making, Waste Liquors from	765
Lubricating	423	Manufacture	634
Mineral	292	Microscopic Examination of	504
With Nitrate of Silver, Reactions of	324	Mineral for	625
Non-drying	807	Parchment	1001
Pure Olive	139	From Peat	814
Purification of	624	Pulp, Metallic Particles removed from (illus.)	299
Reactions of Etheral	421	Pulp Manufacture	814, 914
Specific Gravity of	551	Pulp, Treatment of	565
Treatment of Mineral	467	Rosin Liquor for	1001
For Woolen Goods	220	From Sugar Cane	515
Oleic Acid, Commercial	425	Trade	838
Stearic Acid from	495	Etc., Waterproof	474, 625
Olein, Commercial	425, 641	Paradiamidodiphenylpiperazine	699
From Yorkshire Grease	91	Paradihydroxybenzene	457
Oleomargarin	408	Paraffins in Coal Tar Oils	974
Law, United States	739	In Crude Petroleum	535
Olibanum, Oil of	635	New Zealand	39
Olive Oil	292	Oil Manufacture (illus.)	100
Analyses of	685	From Peat	697
Californian	467	Residues	273
From Morocco	580	Wax, Decolorisation of	55
Refuse	290	Waxes, Specific Gravities of	162
Spanish	484	Parahydroxybenzoic Acid	917
Trade in Malaga	222	Paranitrobenzylsulpho Acid	611
Olive Oils, Pure	139	Paranitrometa-amidobenzene	388
Onions, Australian	294	Paranitrotoluene Derivatives	41
Opium, Bengal	699	Paraphenylene Blue	189, 389
Culture in China	653	Paraxylidine	274
Extraction in China	916	Paraxyloquinoline	187
Imports into China	931	Parchment Paper	1001
Industry in India	446	Parisian Gasworks Data	871
Smoking	528	Pasteurisation of Beer, &c.	301, 719
Ores, Desulphurisation of	400, 989	Pastinaca, Solid Hydrocarbon in	124
Treatment of	290, 491, 802, 988, 989	Paving, Material for	782
Organic Acids in Beet Plant	631	Slabs	889
Orthohydroxyoximes	628	Peat as an Antiseptic	720
Orthomethylacetanilide	567	Candles	697
Orthonitroanilinesulphonic Acid	116	Fuel	872
Orthoquinonodioximes	698	Litter Manure	907
Orthoxylidine	115	Oil in Brazil	430
Oxazones	296	Treatment of	282
Osmium	710	Utilisation of	539, 814
Osmose	288		

	PAGE		PAGE
Pectins of Sugar Beet	206	Pigments, Barytes	992
Pectous Substances in Plants	1013	South Australian	343
Pentacetyldextrose	718	Pimento Oil	421
Pentacetylbenzene	113	Pines, Resins from Australian	901
Peppermint Oil	421	Pinoite	882
Percussion Caps	919	Piperazines	976, 978
Perfumery Manufacture in Austria	1019	Piperidine	475, 636
Perfumes, Distilled	732	Piperonal	1006
Extraction of	412	Pipette, Gas	922
Extracted from Flowers, &c. (illus.)	133	Pitch	40
Pernanganate, Oxidation of Fatty Acids by	806	Lake of Trinidad	584
Pernanganates, Manufacture of	706	From Yorkshire Grease	92
Peronospora Infestans	554	Plant Constituent, Boric Acid as a	569
Persian Gulf Ports Trade	143	Plants, Albuminoids in	628
Peru Customs Tariffs	222	Function of Potassium in	404
Petroleum	650, 661, 662	Nitrates in	405
Baku and Canadian	607	Pectous Substances in	1013
Galician	583, 768	Plastic Composition	621, 622, 625
Industry, Caucasian	753	Plates Sensitive to Colour, Photographic	725
New Zealand	39	For Voltaic Batteries	289
Paraffin in Crude	535	Platinum, Canadian	314
Soap	714, 715	Metals	710
Solidified for Transport	112	United States Product of	590
South Australian	313	Plattentharin (illus.)	775
Springs at Zante	828	Plumbates	885
Supply of Baku	872	Podophyllin, Himalayan	724
Supply of the Caucasus	1020	Poisoning Cases in 1888	999
Trade	829, 840	Polarising Pyrometer	214
Trade, Russian	484	Poliment, Swiss Duty on	141
United States Product of	590	Polishing Composition	467
Wells, Austrian	485	Polychromine	389
Works in the Punjab	514	Poreclain, Painting on	403
Pharmacists, German	560	Pastes	984
Pharmacopœia, Austrian	587	Sevres	983
Phellandrene	635	Porous Artificial Stone	393
Phenanthrene	475	Surfaces for Electro-Metallurgy	289
Perhydride	451	Portuguese Wines	561
Phenanthroline	976	Potash, Caustic	707
Phenol Process of Soda Manufacture	45	Chlorate, Extraction from Mother-Liquors	884
Spray in Treatment of Consumptives	209	Chlorate Manufacture (illus.)	168
Phenols with Camphor	636	Potassium Antimony Oxalate	189
Phenomorpholine	1005	Cyanide for Lixivation of Silver Ores	120
Phenylacetic Acid	305	Ferrocyanide	757
Phenylendiamine Derivatives	279, 453	Ferrocyanide Compound	283
Phenyldiazine, Action of Nitroso-bases on	387	Manufacture (illus.)	712
Compounds with Sugars	296	In Plants, Function of	404
Phenylpropionic Acid	305	Potato Cultivation	124
Phlobaphenes	404	Culture	472
Phlorizin	413	Development of the	625
Phloroglucinol as a Photographic Developer	817	Disease	554
Phosphate Industry, Canadian	312	Rot	559
Industry of South Carolina	143	Shoots, Bases in	816
Mines at Redonda	653	Potatoes, Cultivation of	204, 205
Precipitated	284	Etc., Drying	409
Rock, United States Product of	590	Prefer for	559
Statistics	71	Potential Difference in Battery Cells	550
Phosphates in Bone Meal, Mineral	307	Pottery Glaze, Mexican	707
Hydrated	118	Visit to Messrs. Doulton's	510
As Manures, Value of	810	Works at Jabulpore	314
Manurial Values of	292, 628	Powder, Smokeless	818, 918
Manurial Experiments with	908	Works, Lightning Conductors at	60
Thomas, Solubility of	904	Prehnite, Synthesis of	113
Treatment of	127	Preservation of Food (illus.)	996
Phosphorescent Sulphides	117	Press for Cupels	186
Phosphoric Acid, Assimilability of	404	For Oils, &c.	290
Constitution of	45	Pressure Regulator	767
Detection of Mineral	569, 819	Primuline	42, 275, 383, 603
Determination	139	Derivatives	117
In Slag, Value of	125	Primulines, Homologues of the	980
In Wines	65	Printing Fabrics	982
Phosphorus Manufacture	884, 983	On Fabrics	540
Photographic Bath	568	Prints, Photographic Gelatino-Chloride	918
Decorations of Glass, &c.	196	Prodner Gas	696, 761
Developers	817, 958	Propylenedicarbonic Acid in Suint	55
Gold Salts	212	Proteids, Reaction for	822
Negatives	637	Prussian Blue	757
Prints on Boxwood	638	Determination	421
Prints, Washing	477	Soluble	277
Transfers	133	Prussiate of Potash Manufacture	757
Photographing in Colours	414	Pseudo-ephedrine	304, 724
Photographs, Coloured, on Glass	477	Pterocarpin	59
Development of	918	Puddle, Clay for	50
Photography	725	Pulps, Dryer for	867
Photometer, Photographic	725	Pump for Acids, &c.	380
Photometry	420	For Filter (illus.)	271
Phylloxera, Prevention of	127	Pumps for Gases and Vapours	111
Piazines, Hydrated	976	Putrefaction	554, 627
Picene	273, 974	Pyrethrum Cultivation in California	658
Perhydride	451	Pyridine	413
Picric Acid, Medicinal Use of	476	In Amyl Alcohol	734
Restrictions on	484		

	PAGE		PAGE
Pyridine from Anhydro-ecgonine.....	634	Retenequinone Derivatives.....	279
Bases removed from Denaturised Spirit.....	471	Retort Lids.....	451
Pyridine-phenyleneketonesulphonic Acid.....	585	Lining.....	872
Pyrites Burner Gases, Utilisation of Heat from (illus.).....	879	Stand.....	425
Calculating.....	200	Retorts for Shale (illus.).....	101
Determination of Sulphur in.....	966	Vertical.....	697
Furnace.....	119	Retting Fibres.....	773
United States Product of.....	590	Rhamnose, Oxidation of.....	718
Pyrodine.....	476, 722	Rhea Canes, Treatment of.....	457
Pyrofuscine.....	476	Fibre, Treatment of.....	702
Pyrometers (illus.).....	214, 623	Rhodamine.....	537
Pyrophosphates, Electrolysis of.....	1011	Rhodium.....	710
Pyroxilin, Artificial Silk from.....	611	And Zinc Alloy.....	52
Collars, &c., Printed.....	503	Rice Product for Brewers.....	301
Treatment of.....	474	Treatment of.....	911
Pyrrol and Carbazol, Similar Reactions of.....	138	Roburite.....	522
Pyrryleinunmyketones.....	975	In Mines.....	585
		Roller Mill.....	196
		Rollers, Immersion, for Dyeing.....	281
Quartzose Ores, Treatment of.....	987	Roman Mortar.....	196
Queensland Customs Tariff.....	140	Roofing Material, Waterproof.....	394
Quercetin.....	618, 770	Ropiness of Beer.....	56
Quercite.....	406	Rosaceæ, Sorbite in Fruit of.....	296
Quicksilver. See Mercury.....	711	Rosaniline, Action of Paraldehyde on.....	384
Ores, Treatment of (illus.).....	708	Bases, Sulphonation of.....	275
Production in Russia.....	225	Salts, Constitution of.....	117
Purification.....	802	Rosanilines.....	435
Russian.....	580, 657, 933	Synthesis of.....	536, 610
Statistics.....	70, 71, 227, 314	Rosemary, Camphor and Borneol of.....	1008
In Tuscany.....	829	Oil added to Olive Oil.....	140
United States Product of.....	580	Rosin, Detection of.....	572
Quinic Acid, Derivatives of.....	723	Liquor for Paper.....	1001
Quinidine.....	475	Rosinduline.....	877
Quinine Compounds.....	721	Rotary Drier.....	970
Consumption in the United States.....	658	Rotation, Change of, in Tartaric Acid Solutions.....	283
Indian.....	916	Rothamsted Experiments.....	314
In Java.....	724	Rubber Trade.....	837
Synthetic Isomer of.....	959	Rubidium.....	658
Quinoline Bases.....	976	Russia, Customs Receipts from Chemicals.....	144
Derivatives from Coumarin Derivatives.....	635	Russian Trade.....	225, 226
Derivatives from Ortho-nitrobenzoylmalonic Ether.....	709	Ruthenium.....	710
Quinoxalines from Tetramidobenzene.....	885	Rye, Experiments with.....	907
Racemic Camphor.....	1008	Saccharification.....	561, 811
Raffinates.....	557	By Means of Diastase.....	470
Raffinose.....	993, 994	Of Starch.....	633
In Beet-root.....	632	Saccharine.....	59, 66
In Beet-Sugar.....	56	Belgian Duty on.....	481
Compounds.....	557	With Cocoa.....	473
Determination.....	446	Detection of.....	216
Extraction of.....	296	Influence on the Digestion.....	813
Inversion Products of.....	718	Italian Prohibition of.....	930
And Saccharose, Estimation of.....	909	Liquors for Brewing.....	207
Railway and Canal Traffic Act (1888).....	144, 228	Liquors, Filter for.....	128
Rates.....	656	Portuguese Duty on.....	825
Rain, Nitric Acid in Tropical.....	627	Spanish Prohibition of.....	481
Reactions, Facilitation of Chemical.....	972	Works, Visit to.....	512
Reagents, Testing Purity of.....	822	Saccharometers.....	496
Receiver for Fractional Distillation (illus.).....	134	Saccharomyces.....	471
For Volatile Liquids.....	1009	Apiculatus.....	56
Red Lead.....	168	Saccharose and Raffinose, Estimation of.....	999
Redonda Phosphate.....	653	Safety Fuses.....	420
Reduction of Oxides.....	196	Sage, Oil of.....	626
Refinery Washings, Purification of.....	558	Salicyl Derivatives, Azo-Compounds from.....	609
Refractive Index of Fats.....	644	Salicylates.....	301, 305
Refrigerating Apparatus.....	940	Salicylic Acid, Reaction for.....	422
Refrigeration (illus.).....	269, 271	Saline Solutions, Electric Conductivity of.....	900
Of Liquors (illus.).....	109	Salol.....	565
Refrigerator (illus.).....	378	Salols.....	817
Refrigerators (illus.).....	691, 759	Salt Beds in New South Wales.....	118
For Food (illus.).....	896	Deposits of Cheshire (illus.).....	629
Liquor for.....	886	Deposits of New York.....	142
Rennet.....	207	Discovery at Barrow.....	580
Resin Compounds for Preserving Wood.....	285	Effect on Vegetation.....	810
Resinate Colours.....	770	French Duties on.....	426
Resins. Estimation of.....	308	Manufacture (illus.).....	780, 885
In India-rubber.....	173	Roumanian Rock.....	774
Treatment of.....	553	Stalactites, Analyses of.....	48
Resorcinol, Dinitroso, Decomposition of.....	189	Union.....	228
As a Photographic Developer.....	817	United States, Product of.....	590
Distinction of.....	734	Water, Action on Vegetation.....	556
Distinguished from Salicylic Acid.....	422	Salts, Solubility of.....	391, 541
Green and Cobalt Nitrate.....	703	Salt-petre Industry in Tampaca.....	932
Resorcinoldisulphonic Acid, Derivatives of.....	535	Sand Filters, Efficiency of.....	998
Retenedodecahydride.....	451	Salufer.....	256
		Sandal Wood, Red.....	59
		Sandarach.....	901

	PAGE		PAGE
Santonin	566	Soap for Sea Water	203
Santonin oxime	721, 1603	Substitute	203
Scales for Weighing	604	Test for Water	256
Scheelite	63	Soda Ammonia Process	11, 193, 460
Schleichera tryzna, Fat of	722	Alum Manufacture	706
Schrieterz	286	Carbonate Manufacture	884
Scrap Metal, Treatment of	989	Caustic	707
Scrubber for Gases, &c.	112, 873	Commercial Caustic	726
Sea Coast Products, Mineral Value of	809	Drums	392
Water, Action on Cement	48	Economy of Pure Caustic	252
Water, Distillation of	38, 760	Hungarian	933
Water, Magnesia from	461	Manufacture (illus.)	45, 778, 779
Water Soap	203	Nitrate, Prices and Statistics	66, 67
Water, Solubility of Minerals in	621	Nitrate Consumption in the United States	659
Water, Still for (illus.)	270	Quadriborate	411
Seaweed Decoration	468	Russian	1021
Products	884	Slag	986
Secureite	522	Waste, Cement from	622
Seed Cake for Cattle	634	Sodium Bath for Tempering Steel	987
Selenic and Sulphuric Acids, Differences in Action of	876	Carbonate determined in Caustic Soda	726
Seminose	496, 558	Carbonate, Examination of	820
Separation of Solids from Liquids	694	Hypochlorite, Electrolytic Production of	805
Separator, Centrifugal	530, 808	Hypophosphite as a Reducer	572
Settler for Solid Impurities in Water	379	Manufacture (illus.)	122, 290, 463, 548, 712, 801
Servia, Trade with	483	Metabisulphite	284
Sewage, Deodorisation of Metropolitan	109	Meta-Sulphite	119
Treatment of (illus.)	58, 131, 208, 209, 302, 411, 473, 563, 564	Nitrate, Manurial Value of	810
Works, Kingston (illus.)	516	Nitrite Manufacture	619
Sewers, Disinfection of (illus.)	1000	Nitroprusside as Test for Alkalis	920
Shale Retorts	697	Sulphide Manufacture	119, 619
Shell Fish, Treatment of	1001	Sulphide, Treatment of	118
Shellac Varnish	204	Sulphite as a Developer	414
Shells, Explosive	1009	Thiosulphate, Action of Acids on	704, 882
Ships' Bottoms, Paint for	715, 808	Soil, Fixation of Nitrogen by	626
Protection of	403, 468, 553	Soils of Algeria	205
Siberian Industry, Condition of	932	Arable and Peaty	293
Siebenhütten, Gold Mines of the	286	Estimation of Nitrates in	572
Silica, Reduction by Magnesium	622	Non-growing	126
Silicium Copper	898	Influence of Gypsum on	909
Silicon	285	Lime Determination in	735
Determination in Cryolite	572	Nitrates in	306, 420
Determination in Ferro-Silicon	639	Nitrogen in	907, 909
And Iron Alloys	788	Nitrogen Determination	56
Silk, Artificial (illus.)	539, 611	Surface Waters of	907
Assay (illus.)	687	Solanaceae, Alkaloids of the	1002
Determination	923, 1011	Solanine	816
Dry Assay of	137	Solanidine	477
Extraction of	286, 287	Solanine	477
Extraction	197, 198, 199	Soldering	711
Mine in Japan	828	Tin	802
Nitrate, Reactions of Oils with	924	Solubility of Salts	883
Ores, Treatment of	120, 400, 711, 713	Solutions, Constitution of	43
Separated from Lead	990	Gases Expelled from	390
Sulphide applied to Jewellery	988	Sorbinose	206
Ultramarine	713	Sorbite	295, 296
Silvering	987	Hexyliodide from	558
On Glass	196	South Carolina, Phosphate Industry of	143
Sinabin	915	Spain, Trade with	72
Sinapin	915	Spanish Trade with the United Kingdom	316, 589, 826
Sisal Hemp Trade	659	Specific Gravity of Ammonia Solutions	390, 541
Treatment of	611	Gravity Bulbs (illus.)	310
Skein Dyeing	283	Heat of Sulphuric Acid	543
Skins, &c., Treatment of	124, 553, 954	Spectra of Organic Compounds	1012
Slag, Alkalis from	399	Spent Oxide, Treatment of Gas	881
Basic as Manure	557	Spiegeleisen Manufacture	141
Cement	888	Spirit, Annual Production of	472
Desulphurised	623	Denatured	471
Fertiliser	909	Duty-free	300
Highly Phosphoric	549	Examination of	64
Manurial Value of	125, 138	Impurities in	309
Separation of Metals from	201	Manufacture	471, 559, 560
Stone from Basic	544	Purification of	472
Utilisation of	622	Spirits, Distillation of	812
Slags, Analyses of	904	Exported as Medicines, Drawback on	70
Fusing Point of	987	Matured by Means of Oxygen	84
Slate, &c., Decoration of	621	Etc. Maturing	812
Smelting	987, 989	Methylated	70
Smoke	450	Spirituous Preparations, Drawback on	226
Condensation of Carbon in	377	Spray Dyeing Fabrics, &c.	703
Smut in Oats prevented	469	Stand for Laboratory Use	425
Smyrna Chemical Industry	141	Starch Determination	295, 574
Soap	123, 290, 624, 714, 715	Iodide	295
Ammoniacal	403	Manufacture	127, 298, 470, 633, 909
Caustic Alkali in	478	Nitrated	878
Examination of	423	Removed from Cotton	539
Laundry	203	Saccharification of	633
Lyes, Determination of Glycerin in	4	Soluble	716, 717
Manufacture	467, 991	Stassfurt Salts, Production of	314
Markine Transparent	807	Steam Boilers, Anti-incrustator for	715
Meal	552	Purification of Water for	604
Mineral Oil in	991	Condensation of	864
Powder	625, 807	Superheated	379
		Stearic Acid from Oleic Acid	466
		Stearine from Yorkshire Grease	92
		Steatins	641

	PAGE		PAGE
Steel Castings, Solid.....	691	Sulphur, United States Product of.....	590
And Copper Alloy.....	898	In Wool.....	458
Effect of Rolling and Wire-drawing on.....	51	In Zinc Smelting, Influence of.....	986
Furnace, Water Oil Gas in the.....	51	Sulphurets, Rare Elements in the Leadville.....	896
Influence of Copper on.....	546	Sulphuretted Hydrogen, Action on Zinc Sulphate.....	216
Influence of Temperature on.....	710	From Calcium Sulphide.....	133
Manufacture.....	287, 465, 546, 801, 802, 986	Determination.....	136
Manufacture and Treatment.....	549	Manufacture.....	118
And Nickel Alloys.....	517, 801, 806	From Sulphate of Lime.....	46
Progress of Basic Process.....	144	Sulphur from.....	284, 513, 706
Soft Back.....	989	Sulphuric Acid, Arsenic removed from.....	704
Tempering.....	548, 987	Acid Concentration.....	983
Treatment of.....	101	Acid Manufacture (illus.).....	9, 193, 283, 774
Steelworks in Italy.....	586	Acid Process, Theories of.....	161
Stibnite Ores, Treatment of.....	399	Acid, Purification of.....	706
Stilbazol Derivatives.....	636	Acid, Specific Heat of.....	543
Stilbene.....	114	Acid Tars, Treatment of.....	112
Stills (illus.).....	103, 105, 107, 539, 531	Anhydride Manufacture.....	119
For Ammonia (illus.).....	881	And Selenic Acids, Differences in Action of.....	876
For Sea Water.....	760	Sulphurous Acid, Action on Hyposulphites.....	478
Stone, Artificial.....	51, 120, 162, 622, 782	Acid, Evolution of.....	131
From Basic Slag.....	541	Acid Solutions (illus.).....	321
Etc., Paint for.....	553	Acid, Swiss Duty on.....	221
Porous Artificial.....	393	Sun Light.....	182
Strainer.....	539	Action on Beer.....	56
Strawberry Wine.....	129	Superphosphate Manures.....	315
Strontium Sulphide, Phosphorescent.....	117	On Nitrate, Action of.....	55
Strophanthus Glabre, Principle of.....	211	For Oats and Wheat.....	556, 557
Styphnic Acid.....	535	Superphosphates, Crusher for.....	111
Subsidence Tanks.....	379	Sydney, Natural Gas near.....	112
Subsoil Fertilisation.....	628	Syphons, Glass Tubes of.....	760
Sugar, Beet.....	292		
Beet, Cultivation of.....	628	Tallow Trade.....	836
Beet, German and Russian.....	205	Vegetable.....	580
Beet, Manuring.....	905, 908	Tamarinds, Alcohol from.....	430
Boiling Apparatus.....	405	Tannin.....	1008
Canadian.....	828	Tanghinin.....	1008
Candy.....	632	Tannin.....	995
Cane, Extraction of Sugar from.....	718	Colouring Matters.....	981
Cane, Paper from.....	315	Estimation of.....	1015
On Cement, Effect of.....	545	Tanning.....	292, 553
Determination.....	295	Electric.....	404, 518
Estimation of Invert.....	1014	Material.....	903
Estimation in Molasses.....	590	Materials, Lime in.....	992
Estimation of Salts in.....	994	Material, Mexican.....	314
Group, Reduction of Acids of the.....	994	Mineral.....	992
Invert.....	295, 994	Tar Acid, Utilisation of.....	874
Juice, Fermentation of.....	561	From Coke Ovens.....	382, 697
From Laminaria.....	406	Distilling.....	535
Liquors, Evaporation of (illus.).....	31, 471	Oils, Burner for.....	39
Manufacture.....	56, 407, 631, 632, 633, 810	Oils, Treatment of.....	403
In Mushrooms.....	495	Thickening in the Hydraulic Main.....	450
Production in the World.....	586	Tariff Changes.....	65, 140, 221, 311, 426, 481, 577, 649, 737, 825, 929, 1917
Pure Grape.....	406	Tartar Emetic, Substitute for.....	612
Pure White.....	811	Tartaric Acid, Analysis of Raw Material.....	216
Refinery, Visit to Messrs. Cowan's.....	516	Acid Determination.....	430
Refining.....	128, 718, 993, 994	Acid, Reduction of.....	474
Refuse Mud.....	462	Acid Solutions, Rotation of.....	283
From Starch.....	295	Tartrates, Analysis of.....	734
Syrups, Purification of.....	558	Tartrazines.....	536
Trade, Austrian.....	935, 1019	Tasmania, Customs Tariff of.....	66
Washing.....	910	Tea, Extract of.....	997
Sugars, Copper Compounds with.....	925	Chinese and Indian.....	651
Phenylhydrazine, Compounds with.....	296	Technical Education in Chemistry.....	325, 350
Synthesis of.....	296	Instruction in Germany.....	858
Suicides by Poison in 1888.....	999	Technology of Textile Fabrics.....	42
Sulph.....	22	Terpenes.....	635
Acids in.....	55	Terpene converted into a Menthene.....	131
Sulphanilic Acid, Acetyl.....	116	Terpin Hydrate.....	636
Sulphates, Volumetric Determination of.....	216	Tetracetylquinic Acid.....	723
Metallic.....	707	Tetrahydronaphthalene.....	387
Sulphides, Phosphorescent.....	117	Tetrahydronaphthoic Acid.....	387
Sulphite Cellulose.....	814	Tetrahydronaphthylamine.....	387
Sulphites.....	284	Tetramethyldiamidobenzophenone.....	978
Constitution of.....	705	Tetramethyldiquinoxaline.....	385
Researches on the.....	882	Tetramidobenzene, Symmetrical.....	385
Sulphocyanide Method of Copper Assay.....	603	Tetramidodiphenazine.....	386
Sulphocyanides.....	881	Tetrazo-Colours.....	279, 280, 281, 610, 611
Sulphonol, Odourless.....	131	Dyes.....	536, 549
Sulphone.....	980	Textile Materials, Treatment of.....	460
Sulphonic Derivatives, Transformation of.....	876	Plant.....	226
Sulphur Candles.....	111	Thalline.....	566
Chloride used for Vulcanising.....	368	Thallium Determination.....	571, 923, 1012
In Coal (illus.).....	219, 239	Salts.....	566
Determination.....	572, 736	Theine Determination.....	822
Determination in Pyrites.....	963	Thermo-couples, Electric.....	901
Dioxide as a Disinfectant.....	1066	Electric Batteries.....	624
Manufacture.....	119	Thermometer Case.....	576, 813
Peroxide, Hydrogen Peroxide from.....	881		
Production.....	585		
Production in Sardinia.....	142		
In Pyrites, Estimation of.....	819		
Recovery.....	11		
Sicilian.....	312, 318, 930		
From Sulphuretted Hydrogen.....	284, 543		

	PAGE		PAGE
Thermometers.....	310, 868	Varnishes.....	204
Electric.....	402	Vaselin.....	202
Zero points of.....	886	Vegetable Fats.....	807
Thiocamf Disinfectants.....	1000	Vegetation, Action of Salt Water on.....	556
Thio-flavines.....	608, 771	Effect of Salt on.....	810
Thiol.....	71	Ventilation.....	911
Thionic Series, Acids of the.....	541	Vesta Matches.....	1010
Thionine Colouring Matters.....	454	Viburnin.....	477
Thiophen in Benzene Derivatives.....	383	Vicia sativa, Betaine and Choline from.....	724
Thiophenols.....	187	Victoria Blue.....	536, 979
Thiophenylethers.....	187	Trade in Colony of.....	654
Thiosulphates, Action of Acids on.....	619	Vinegar, French, Notice regarding.....	221
Decomposition of.....	704, 705	Manufacture.....	300, 393, 812
Thiolutidine.....	275, 383	Netherlandish Duty on.....	481
Tiles, Elastic.....	622	Vines, Treatment of.....	554
Tin.....	62	Vinocolorimeter.....	561
Arsenite.....	32	Violet Dyes, Separation of.....	535
Copper and Lead Alloy.....	35	Vitriol Chambers, Lead for.....	774
Determination.....	1012	Nitrons.....	706
Electrolytic Determination.....	258	Voltmeter (illus.).....	258
Manufacture, German.....	586	Volume of Gas, Molecular.....	450
New Acid of.....	307	Vulcanisation of India-rubber.....	368
And Nickel Alloy.....	802	Vulcanised India-rubber, Gases Absorbed by.....	55
Oxidation.....	120	Plastic Compounds.....	204
Plate Cleaning.....	989	Vulcanising Caoutchouc.....	625
Plate Liquor, Treatment of.....	103	Flasks.....	808
Plate Manufacture.....	201, 860, 801		
Recovery of.....	801		
From Scrap.....	400		
Scrap, Treatment of.....	52, 53		
Separated from Antimony.....	137		
Slags, Treatment of.....	990		
Tinctures, Regulations concerning.....	655	Wakasa Ware, Japanese.....	902
Timing, Utilisation of Waste Pickle.....	400	Walnut Oil.....	466
Waste Pickle from.....	548	Wash, Artificial, as Fodder.....	300
Tobacco Extract.....	425	Washing Compound, Antiseptic.....	991
Plant, Manure for.....	555	Machine.....	379
Tolidine Derivatives.....	115	Waste Acid from Galvanising Works.....	52
Toluidine, Non-basic By-products of.....	386	Liquors, Incineration of.....	780
Sulphur Compounds of.....	383	Pickle, Utilisation of.....	484
Toluidines, Action of Sulphur on.....	275	Waters, Electrolytic Treatment of.....	804
Tolylene Orange.....	540	Watches, Alloy for.....	200
Trade Statistics, 1860-1888.....	843	Water Action on Lead (illus.).....	241
Traffic Act, Railway and Canal.....	144	Atmospheric Gases Absorbed by (illus.).....	724
Traxantin.....	189	For Boilers.....	271
Transcaucasia, Manganese in.....	226	Determination of Oxygen in (illus.).....	923
Trees, Nitrates absent from Forest.....	202	Distillation of.....	38
Triacetylquimide.....	723	Effect of Filtration on.....	249
Tribromhydrin.....	413	Examination of.....	138
Trichloramidoethylic Alcohol.....	413	Examination of Potable.....	998
Trimethylamine, Sewage Treated with.....	563	Filtration of.....	58, 270
Trinidad Import Duties.....	738	Filtration.....	998, 999
Triphenylmethane, Oxidation of.....	877	Gas (illus.).....	186, 272, 273, 451, 605, 606, 761, 767, 768, 869, 873
Tungstic Acid.....	63	Lead in.....	611
Turfa Mines of Brazil.....	872	Lead in Bradford.....	638
Turkey-Red Dyeing.....	188	Lead Poisoning by.....	912
Oil.....	573	Mains, Corrosion of Iron.....	378
		Micro-Organisms in.....	911
		Nitrates in.....	1010
		Nitrites in.....	420
		Nitrogen Determination in.....	480
		Purification of.....	186, 302, 563, 604
		Purification of Foul.....	474
		Purity of Distilled.....	567
		Silicated.....	249
		Soap Test for.....	256
		Softening.....	563
		From Soils.....	907
		Free from Solid Impurities.....	379
		Supply from Wells (illus.).....	208
		For Technical and Drinking Purposes.....	58
		Waterproof Cardboard, &c.....	565
		Cement.....	51
		Fabrics.....	291
		Material.....	808, 992
		Paper.....	474
		Roofing Material.....	394
		Waterproofing.....	467
		Explosives.....	726
		Solution.....	625
		Waters, Artificial Chalybeate.....	289
		Purification of Effluent.....	301
		Wattle, Australian, as a Tanning Material.....	903
		Wax for Polishing, Black.....	991
		Welding, Electric.....	288, 899
		Weldon Mud, Titration of.....	968
		Wells for Water (illus.).....	208
		Wheat, Canadian.....	483
		Chili Saltpetre as Manure for.....	404
		Diastase Ferment of.....	590
		Gluten in.....	627
		Indian.....	293
		Spirit from.....	559
		Treatment of.....	911
		And Wheat Malt.....	298
Vacuum Apparatus for Sugar.....	405		
Pans.....	298, 471		
Pans, Tubular.....	419		
Valve Arrangement for Regenerative Furnaces (illus.).....	98		
Valves for Regenerative Furnaces.....	707		
Vanado-Sulphuric Acid.....	421		
Vanilla Exports from Mauritius.....	931		
Vapour Tension of Hydrochloric Acid.....	862		
Vapours, Condensation of.....	271		
Cooler for.....	869		
Varnish for Harness.....	716		
Manufacture.....	291, 553		
Removing Compound.....	552		
South Australian Drawback on.....	578		

	PAGE
Wine, Bouquet of.....	395
Clarification of.....	472
Copper in.....	206, 436
Exported from Portugal, Abolition of Duty.....	640
Filter for.....	207
Pasteurisation of.....	391
Pure Sherry.....	56
Syrupian Vermouth.....	91
Wines, Boric Acid in.....	139
Effervescing.....	407
Estimation of Extract in.....	924
From Fruits, &c.....	129
Phosphoric Acid in.....	65
Portuguese.....	561
Wintergreen, Oil of.....	915
Wood, Action of Heat and Water on.....	913
Counting-house.....	557
Cellulose, Estimation in Paper.....	574
Cloth.....	388
Fibre Cutter (illus.).....	293
Preservation of.....	285, 403, 603
Pulp, Treatment of.....	911
Woody Matter, Colour Reactions of.....	1012
Wool, Artificial.....	188
Chemical Properties of.....	457
Cleansing.....	282, 618, 773
Detection of Colours on.....	216
Dyeing.....	120
And Fur (illus.).....	17
Oil.....	91, 250
Oils, Analysis of.....	220
Washing.....	691
Woolen Materials, Carbonisation of.....	634
Worts, Brewers'.....	812
Wounds, Aseptic Paper for.....	209
Xtue Fibre.....	430
Xylenes, Separation of Coal Tar.....	874
Xylenol.....	274
Xylydine.....	115
Commercial.....	274
Sulpho-Acids.....	274
Xylydines, Isomeric.....	281
Xyloquinoline, Para.....	187
Xylose.....	555

	PAGE
Yarn, Dyeing	117, 190, 380
Washing	189
Yeast, Effect on Bouquet of Wine	295
Effect of Carbon Dioxide on	653
Increase of	300
Manufacture	57
Microscopic Examination of	300
Poisons	171
Preservation of	559
Yeasts, Discrimination of	56
Wild	176
Yellow Fever, Cocaine in	906
Yolk of Wool	22
Yorkshire Grease	30
Yttria Minerals	314
Zinc Alloys	200
Belgian	655
Containing Metals with	400
And Cobalt, Separated	479
Determination	261, 922
Determination in Presence of Manganese	62
Extraction	286, 287, 545, 802, 803
Fumes, Condensation of	465
From Nickel, Separation of	307
Oxide, Reduction of	551
Production in Silesia	483
Purification	898
Recovered from Battery Liquors	201
Separation of Cadmium from	639
Softening	986
Statistics	152
Sulphate, Action of Sulphuretted Hydrogen on	216
Sulphide	119, 458
Ores, Treatment of	983
Uthmanne	715
United States Product of	589
Vapours, Condensation of	549
World's Production of	151
Zircon, United States Product of	591
Zymotechnical Analysis of the Air	472

•

LIST OF MEMBERS.

A

Abbott, John, Braemar House, Lancaster Gate, Hyde Park, W.
 Abel, Sir F. A., Royal Arsenal, Woolwich, London, S.E.
 Abraham, A. C., Stanley Rock, St. George's Mount, New Brighton (Journals); and 87, Bold Street, Liverpool.
 Acland, Sir H. W., Radclyffe Library, Oxford.
 Adam, A. Learmouth, 40, Sir Michael Street, Greenock, N.B.
 Adam, J. B., 172, Leith Walk, Edinburgh.
 Adams, M. A., Ashford Road, Maidstone, Kent.
 Adams, J. W., 74, Oxford Street, Regent Road, Salford, Manchester.
 Adamson, G. P., Easton, Pa., U.S.A.
 Addie, J., Langloan Ironworks, Coatbridge, N.B.
 Adkins, H., Chemical Works, Smethwick.
 Adriance, John S., 1, East 55th Street, New York, U.S.A.
 Afleck, J., Mill House, Woolton, near Liverpool.
 Aikman, Charles M., 183, St. Vincent Street, Glasgow.
 Aikman, Thomson, jun., 5, Prince's Square, Glasgow.
 Aitken, Dr. A. P., 8, Clyde Street, Edinburgh.
 Aitken, J. B., Gerard's Fold Chemical Works, Widnes.
 Akitt, Thomas, 3, Victoria Road, Lenzie, N.B.
 Albright, G. S., The Elms, Park Road, Edgbaston.
 Albright, W. A., Mariemont, Birmingham.
 Albright, W. B., c/o Halstead & Co., 196-202, Forsyth Street, New York, U.S.A.
 Alexander, J. O., Plantation Leonora, Demerara, British Guiana.
 Alexander, W. T., 20, Booth Street, Moseley Street, Manchester; and Crummock Bank, Victoria Crescent, Eccles.
 Allan, Jno., 12, Woollaston Road, Harringay, N.
 Aldred, C. H., 35, Crisp Terrace, Upper Park Road, Plumstead Common, Kent.
 Allen, A. H., Sydenham Cottage, Park Lane, Sheffield.
 Allen, G. J., Belthles Strasse 47, Tübingen, Germany.
 Allen, J., 164, Upper North Street, Poplar, London, E.
 Allen, Walter S., 13, Beacon St., Boston, Mass., U.S.A.
 Allen, Wm., Edenholme, Bournemouth, Hants.
 Allen, W. H., Peninsular Laboratory, Detroit, Mich., U.S.A.
 Allender, G. M., Stammerham, Horsham, Sussex.
 Allhusen, A., Gateshead-on-Tyne.
 Allhusen, Wilton, 102, Quay Side, Newcastle-on-Tyne.
 Allibon, G. H., Seaview, Litherland Park, near Liverpool.
 Alliott, J., Bingham, Messrs. Manlove, Fryer, Alliott, and Co., Nottingham.
 Alsberg, M. (Sondheim, Alsberg, & Co.), P.O. Box 2437, New York, U.S.A.
 Anderson, Geo. B., Victoria Square, Felling-on-Tyne.
 Anderson, John, Workington Ironworks, Workington, Cumberland.

Anderson, J. M. T., Explosives Co. Ltd., Stowmarket, Suffolk.
 Anderton, G. H., Howendyke, Howden, Yorks.
 Andrew, W. B., Gavinburn, Old Kilpatrick, Dumbartonshire.
 Angell, J., 81, Dueie Grove, Oxford Street, Manchester.
 Angus, James, Thorncliffe Collieries, Chapeltown, Sheffield.
 Angus, John, 3, Brabant Court, Philpot Lane, London, E.C.
 Angus, W. Mathwin, St. John's Leather Works, Newcastle-on-Tyne.
 Annandale, J. H., Polton, Midlothian, N.B.
 Annon, R. H., 16, Water Lane, Tower Street, London, E.C.
 Ansdell, G., 45, Courtfield Road, South Kensington, S.W.
 Ansdell, T. C., Kearsley Cottage, Farnworth, Bolton.
 Archbold, Dr. George, Laboratory, Phoenix, Oswego Co., N.Y., U.S.A.
 Archbutt, L., Argyle Terrace, Rose Hill, Derby.
 Arding, Francis, 5, Jeffreys Square, St. Mary Axe, London, E.C.
 Armstrong, Dr. H. E., Central Institution, Exhibition Road, London, S.W.
 Armstrong, Rt. Hon. Lord, Newcastle-upon-Tyne.
 Ash, T. E., 4, Saltram Place, Citadel Road, Plymouth.
 Ashburn, Wm., 14, Westwood Street, Moss Side, Manchester.
 Ashwell, H., Woodthorpe Grange, Sherwood, Nottingham.
 Ashwell, J. H., Woodthorpe Grange, Sherwood, Nottingham.
 Ashwell, Jno. R., 111, Waterloo Crescent, Nottingham.
 Ashworth L., The Barlows, Radcliffe, near Manchester.
 Atcherley, Dr. R. J., 80, Elsham Road, Kensington, W. (for Journals); and 23, Bucklersbury, E.C.
 Atkins, S. R., Market Place, Salisbury.
 Atkinson, A. J., 44, Loudoun Square, Cardiff.
 Atkinson, R. W., 44, Loudoun Square, Cardiff.
 Attfield, Dr. J., Ashlands, Watford, Hertfordshire.
 Aubrey, W. H., 19, Ryecroft Road, Courthill, Lewisham, S.E.
 Auer, H., Appleton Lodge, near Widnes.
 Auerbach, Dr. C. G., 8, Alderstrasse, Elberfeld, Germany.
 Austen, Peter T., New Brunswick, N.J., U.S.A.
 Austin, E., 126, Bermondsey Street, London, S.E.

B

Babington, F. W., School of Practical Science, Toronto, Canada.
 Bailey, Edwin M., Laboratory, Pumpherson Oil Co., Ltd., Midcalders, N.B.
 Bailey, Wm., The Terrace, Oaken, near Wolverhampton.
 Bailey, Dr. G. H., Owens College, Manchester.
 Bailey, Thos., 25, High Street, Hull.

- Bailey, Richard D., City Brewery, Gloucester.
 Bailey, Dr. T. L., University College, Brownlow Street, Liverpool.
 Bailey, W. H., Albion Works, Salford, Manchester.
 Bailey, Walter P., British Alizarin Works Co., Silvertown, E.
 Bainbridge, Herbert A., Malvern Hall, Solihull, near Birmingham.
 Baker, E., Stoneleigh, Eastern Avenue, Reading, Berks.
 Baker, Harry, The Laurels, Tifford Road, Oldbury, Birmingham.
 Baker, John T., Easton, Pa., U.S.A.
 Baker, W. G., Garden Wharf, Church Road, Battersea, London, S.W.
 Baker, Theodore, E. C. Powder Co., Green Street Green, Dartford, Kent.
 Bald, J. H., Braddock, Pa., U.S.A.
 Baldwin, W. A., 169, West 97th Street, New York City, U.S.
 Ballard, E. G., 1, Eversley Park, Chester.
 Ballard, J. F., Somerby Villa, Norfolk Park, Maidenhead.
 Bamber, H. K., 5, Westminster Chambers, Victoria Street, London, S.W.
 Banister, H. C., 31, Dale Street, Liverpool.
 Banks, Arthur J., 14, Rawlins Street, Fairfield, Liverpool; and c/o Jas. Morrell & Co., Limited, Morpeth Dock, Birkenhead (for Journals).
 Banner, Samuel, 4, Ivanhoe Road, Liverpool.
 Bannister, R., The Laboratory, Somerset House, London, W.C.
 Bannister, W., Victoria Lodge, Cork, Ireland.
 Barber, Geo., 23, Studley Road, Forest Gate, E.
 Barbour, T. F., Chemical Laboratory, University of Edinburgh.
 Barclay, H., Rose Hill, Harrington, Cumberland.
 Barclay, Thos., 17, Bull Street, Birmingham.
 Barsley, Robt., c/o Jewsbury and Brown, 44, Downing Street, Manchester.
 Barlow, E., 2, Old Palace Yard, Westminster, S.W.
 Barnes, H. J., Phoenix Chemical Works, Hackney Wick, E.
 Barnes, J., 37, Avenue Parade, Accrington, Lancashire.
 Barnes, Jonathan, Buckton Vale, near Stalybridge.
 Barnes, R. L., Phoenix Chemical Works, Hackney Wick, E.
 Farr, J., Dinting Vale, Glossop.
 Barrett, E. L., 46, Heathfield Park, Willesden Green, N.W.
 Barrow, J., Beech House, Folly Lane, Swinton, near Manchester.
 Barrow, Jos., Oldham Road, Failsworth, Manchester.
 Bartholomew, G., Halstow, 2, Cranbrook Lane, Ilford Park, E.
 Bassett, H., 26, Belitha Villas, Barnsbury, N.
 Batchelor, Telford C., 8, Baron's Court Road, West Kensington, W.
 Bateson, Percy, Emsworth, Wavertree, Liverpool.
 Battershall, Dr. Jesse P., 402, Washington Street, New York, U.S.A.
 Batty, R. B., Drayton Villa, Erdington, near Birmingham.
 Baxter, Henry, The Tower, Rainhill, Lancashire.
 Baxter, W. H., The Lawn, Brixton Hill, London, S.W.
 Bayley, F. S., 88, King Street, Manchester.
 Bayley, Thos., 2, Clonskeagh Terrace, Clonskeagh, Dublin.
 Baynes, J., jun., Royal Chambers, Seale Lane, Hull.
 Beale, Clayton, c/o W. Joynton & Sons, St. Mary Cray, Kent.
 Beames, E., Montlands, Paddock Wood, Brenchley, Kent.
 Beardmore, Wm., Parkhead Forge, Glasgow.
 Beaumont, F. J., 42, Trinity Square, Borough, S.E.
 Beaven, E. S., 5, Boreham Terrace, Warminster, Wilts.
 Bechler, M., The Manbré Saccharine Co., Limited, Fulham Road, Hammersmith, London, W.
 Beckett, G. H., 25, St. Andrew's Place, Listerhills, Bradford, Yorks.
 Beckett, J. H., Wilmslow Park, Cheshire.
 Beekingham, J. H., Messrs. Scott Brothers, Dean Street, Newcastle-on-Tyne.
 Bedford, J., Woodhouse Cliff, Leeds.
 Beedingfield, C. H., 4, Tichborne Street, High Fields, Leicester.
 Bedson, Prof. P. P., Durham College of Science, Newcastle-on-Tyne.
 Beilby, G., St. Kitts, Slatford, N.B.
 Belcher, J. C., c/o "Sterilene," Ltd., 85, Wool Exchange, London, E.C.
 Bell, C. Lowthian, Linthorpe, Middlesbrough-on-Tees.
 Bell, G., Runcorn Soap and Alkali Co., Runcorn.
 Bell, H. S., 2, St. Anne's Park Villas, Wandsworth, S.W.
 Bell, Jno., 118, Southwark Street, London, S.E.
 Bell, J. Carter, Bankfield, The Cliff, Higher Broughton, Manchester.
 Bell, Sir I. Lowthian, Bart., Rounton Grange, Northallerton.
 Bell, J. Ferguson, Stafford.
 Bell, J. Ralston, Appleby Iron Co., Frodingham, Doncaster.
 Bell, O., 13, Northumberland Terrace, Tynemouth.
 Bell, T. Hugh, Middlesbrough-on-Tees.
 Bellingham, Wm., Dalston Distillery, London, E.
 Bendix, D., The British Alizarin Co., Limited, Silvertown, Victoria Docks, London, E.
 Bengier, F. B., 7, Exchange Street, Manchester.
 Benjamin, M., 15, West 121st Street, New York, U.S.A.
 Bennett, Thos., Birch Vale, near Stockport.
 Bennie, J. W., Minas de Rio Tinto, Huelva, Spain.
 Bentley, J. W., Stakehill Works, Castleton, Manchester.
 Berdoe, Walter, 51, South John Street, Liverpool.
 Beringer, J. J., Treon Road, Camborne, Cornwall.
 Beringer, C., Roskear, Camborne, Cornwall.
 Bermays, J., 96, Newgate Street, London, E.C.
 Berry, E. E., Chemical Laboratory, 20, Bucklesbury, London, E.C.
 Best, T. T., Sliema, Victoria Park, Wavertree, Liverpool.
 Bevan, E. J., 4, New Court, Lincoln's Inn, London, W.C.
 Bevan, I., Llanelly Chemical Works, Llanelly, S. Wales.
 Bevan, J. Williams, Avonmere, Shirehampton, near Bristol.
 Bevan, S. Howel, Goring Road, Llanelly, South Wales.
 Beveridge, J., Northfleet Paper Mills, Kent.
 Bewick, T. Burrell, Hebburn-on-Tyne.
 Bibby, E. V., Garston Copper Works, Garston, near Liverpool.
 Bickerdike, W. E., Clayton Grange, Wiltshire, near Blackburn.
 Bickerton, C. W., Torkington Fold, Norbury, near Stockport.
 Bickett, J. H., Medical College, London Hospital, E.
 Biggart, J. Wm., 29, Cathcart Street, Greenock, N.B.
 Biggs, B., 3, Lawrence Pountney Hill, London, E.C.
 Bilh, G. F., Pennsylvania Salt Manufacturing Co., Philadelphia, U.S.A.
 Billing, H. S., Messrs. Burnard, Lack, & Alger, Plymouth Chemical Works, Plymouth.
 Bindschedler, R., Société pour l'Industrie Chimique, Basle, Switzerland.
 Bingley, J., Chemical Laboratory, Northampton.
 Binks, J. B., 4, Criffel Street, Silloth, Cumberland.
 Binney, H. A., Ravenhead, St. Helens.
 Bird, Henry, South Down House, near Devonport.
 Bird, R., Eilerslie, Roath, Cardiff.
 Birley, R. K., Messrs. Chas. Macintosh & Co., Cambridge Street, Manchester.
 Birch, R. W. Peregrine, 5, Queen Anne's Gate, Westminster, S.W.
 Bischof, Gustav, 4, Hart St., Bloomsbury, London, W.C.
 Bishop, Fred, 12, Charles Street, Edinburgh.
 Bishop, Jos. J. F., 13, Norfolk Street, Manchester.
 Bishop, A. Conway, Three Mills Lane, Bromley-by-Bow, London, E.
 Bishop, G. A., Royal Bank House, Coatbridge, N.B.
 Black, Wm., St. Bede Chemical Co., Newcastle-on-Tyne.
 Black, Wm., Stanrigg, Airdrie, N.B.
 Blackwell, G. G., 26-27, Irwell Chambers West, Fazakerley Street, Liverpool.
 Blades, C. M., Jay Villa, Chester Road, Northwich, Cheshire.
 Blagden, W. G., 1, Fenchurch Avenue, London, E.C.
 Blair, J., Irvine Bank Chemical Works, Kilmarnock, Ayrshire.
 Blair, John, 18, Old Mill Road, New Hendon, Sunderland.
 Blake, C. A., 47, Piccadilly, London, W.
 Blake, F. C., Mansfield Valley, Allegheny Co., Pa., U.S.A.
 Blake, Jas., Thames Sugar Refinery, Silvertown, London, E.
 Blankinsop, W., Garden Wharf, Battersea, London, S.W.
 Bles, A. J. S., 32, Chorlton Street, Manchester.
 Blinkhorn, W. J., 31, Grove Park, Liverpool.

- Bloede, Victor G., Patuxent and Dillen Streets, Baltimore, Md., U.S.A.
- Bloomfield, R., Thurma Factory, via Darbhunga, Tirhoot, India.
- Blount, Bertram, Chemical Laboratory, Broadway, Westminster, S.W.
- Bloxam, Arthur G., Royal Agricultural College, Cirencester.
- Blummann, Moritz, 43, London Wall, London, E.C.
- Blundstone, E. R., Cornwall Lodge, St. James' Road, New Hampton, Middlesex.
- Blythe, F. C., Newholme, Victoria Park, Manchester.
- Blythe, H. F., Holland Bank Chemical Works, Church, near Acerington.
- Blyton, J., 12, Cromford Court, Market Street, Manchester.
- Boa, Peter, 119, George Street, Edinburgh.
- Boake, A., Southwood Lawn, Highgate, London, N.
- Boake, Edmund J., Southwood Lawn, Highgate, N.
- Boam, F. W., 2, De Montfort Square, Leicester.
- Board, J. T., Distillery, Cheese Lane, Bristol.
- Boekisch, J. E., Osier, Roburite Explosives Co., Limited, Gathurst, near Wigan.
- Bolas, Thos., 8, Grove Terrace, Chiswick, W.
- Bolton, G. H., Widnes Alkali Co., Limited, Widnes.
- Bonn, J. Edwin, High Street, Brading, Isle of Wight.
- Boor, Leonard G., 1 and 2, Artillery Lane, London, E.C.
- Booth, Geo., Ark Vale Dyeworks, Middleton, near Manchester.
- Borland, John, Etruria, Kilmarnock, N.B.
- Borland, W. D., 35, Petherton Road, Highbury New Park, N.
- Boston, H. G., Nunthorpe Crescent, Bishopthorpe Road, York.
- Bothamley, C. H., Yorkshire College, Leeds.
- Böttinger, H. T., Elberfeld, Germany.
- Bottle, Alex., 4, Godwyne Road, Dover.
- Boulton, H. E., 64, Cannon Street, London, E.C.
- Boulton, S. B., 64, Cannon Street, London, E.C.
- Boulton, T. S., 15, Richmond Villas, Seven Sisters Road, N.
- Boudry, Chas., 127, The Albany (North Corridor), Oldhall Street, Liverpool.
- Boutmy, H., Saint Fons, Rhône, France.
- Bow, R. H., 7, South Gray Street, Edinburgh.
- Bowen, S. B., Brickfield Chemical Works, Llanelli, South Wales.
- Bower, Frank, 37, Lansdowne Road, Clapham Road, S.W.
- Bower, G., St. Neots, Huntingdonshire.
- Bower, H., Gray's Ferry Road, and Twenty-ninth Street, Philadelphia, Pa., U.S.A.
- Bowler, G. S., Crystal Palace District Gas Co., Limited, Lower Sydenham, S.W.
- Howley, Jos. John, Wellington Works, Battersea Bridge, London, S.W.
- Bowman, F. H., West Mount, Halifax.
- Bowman, R., Eglinton Chemical Works, Irvine, N.B.
- Bowrey, J. J., Kingston, Jamaica, West Indies.
- Boyd, Pythagoras, Box 77, North Adams, Mass., U.S.A.
- Boyd, W., Tharsis Works, East Moors, Cardiff.
- Boyd, W., c/o Messrs. Tennant & Co., St. Rollox, Glasgow.
- Bracewell, Wm., Brinscall, near Chorley.
- Bradburn, J. A., 73, West Genesee Street, Syracuse, N.Y., U.S.A.
- Bradbury, A., Masen's Buildings, Exchange Street East, Liverpool.
- Bradbury, W. A., Steetley Chemical Works, Worksop.
- Bradley, N., 49 and 51, Chapman Street, Hulme, Manchester.
- Bramham, W., 82, Bow Road, London, E.
- Bratley, Wm., 18, Clarence Street, Middlesbro'-on-Tees.
- Bramwell, E., Charlwood House, Huyton, near Liverpool.
- Bramwell, Sir F., Bart., 5, Great George Street, Westminster, London, S.W.
- Bramwell, G. H., Cowley Hill, St. Helens, Lancashire.
- Bramwell, Samuel, 4, St. Ann's Square, Manchester.
- Branson, F. W., 14, Commercial Street, Leeds.
- Bray, Geo., Blackman Lane, Leeds.
- Brayne, Francis W., Bow Pottery, Three Mills Lane, Bromley-by-Bow, E.
- Breckon, J. R., 41, Fawcett Street, Sunderland.
- Breen, George, Irvine Chemical Co., Limited, 204, Vincent Street, Glasgow.
- Breffitt, Wm., Glasshoughton, Castleford, Yorks.
- Brenemann, Dr. A. A., 97, Water Street, New York, U.S.A.
- Bressey, Edw., 209, Romford Road, Stratford, E.
- Briant, L., 24, Holborn Viaduct, London, E.C.
- Briggs, T. Lynton, c/o Read, Holliday, & Sons, 7 Platt Street, New York, U.S.A.
- Briggs, W., Springfield Terrace, Arbroath, N.B.
- Brim, A., 9, College Street, Belvidere Road, Lambeth, S.E.
- Brijjes, J. H., Whitechapel Engine Works, Fieldgate Street, London, E.
- Bristow, G. W., Worcester House, 35, Eastcheap, London, E.C.
- Broad, Jas., 66, High Street, Lewes, Sussex.
- Broadbent, H., c/o Goodall, Backhouse, & Co., Sovereign Street, Leeds.
- Broek, J., British Alkali Works, Widnes.
- Brooke, Edwd., Oakley House, Edgerton, Huddersfield.
- Brookes, E. A., 15, Withington Road, Whalley Range, Manchester.
- Broom, Wm., Irvinebank, Herberston, Queensland.
- Brotherton, E. A., Fern Cliffe, Hkley, Yorkshire.
- Brown, Prof. A. Crum, 8, Belgrave Crescent, Edinburgh.
- Brown, Arthur E., Morden Cliff, Lewisham, S.E.
- Brown, D., 93, Abbey Hill, Edinburgh.
- Brown, D., Donaghmore, Tyrone, Ireland.
- Brown, H., Cannon Brewery, Watford, Herts.
- Brown, Dr. J. Campbell, 27, Abercrombie Square, Liverpool.
- Brown, J. T., 46, Kilmaine Road, Fuiham, London, S.W.
- Brown, Oliphant A., Lennoxmill, Lenoxtown, N.B.
- Brown, T., The Chemical Works, King's Lynn.
- Brown, Horace T., 47, High Street, Burton-on-Trent.
- Brown, Walter, c/o Jas. H. Dennis and Co., Widnes.
- Brown, F. W., 17, Walferton Road, St. Peter's Park, London, W.
- Brown, W. A., Overton Paper Mills, Greenock, N.B.
- Browning, W., Broad Oak, Acerington.
- Bruce, Edw. M., Union Pacific Railroad, Omaha, Nebraska, U.S.A.
- Bruener, H., Holly Mount, Tarboek Road, Huyton, near Liverpool.
- Brunner, J. F. L., Winnington Old Hall, Northwich, Cheshire.
- Brunner, J. T., M.P., Winnington, Northwich.
- Brunner, J. P., 28, Exchange Street East, Liverpool.
- Bryce, A. S., Glenpark Oil Works, East Nelson Street, Glasgow.
- Bryce-Smith, N. J., Oakfield, Barrow, Whalley, near Blackburn.
- Buch, Carl Von, 1, St. James' Street, London, S.W.
- Buchan, A., 13, Willowbank Crescent, Glasgow.
- Buchanan, Jas., jun., Caledonia Foundry, Brasenose Road, Liverpool.
- Buchanan, J. Y., 10, Moray Place, Edinburgh.
- Buckridge, Herbert L., Leighton Villa, Cheverton Road, Hornsey Lane, N.
- Budden, E. R., Camelot, Netherhall Gardens, South Hampstead, N.W.
- Bullock, J. L., 3, Hanover Street, Hanover Square, London, W.
- Bullough, Thos. A., Helsby View, Ditton, near Widnes.
- Bumby, H., Solway Ironworks, Maryport, Cumberland.
- Bunker, H. E., 24, Great Cheetham Street West, Lower Broughton, Manchester.
- Bardekin, G., jun., Sutton Lodge Chemical Co., St. Helens.
- Burghardt, Dr. C. A., 35, Fountain Street, Manchester; and Owens College, Manchester.
- Burnard, R., Plymouth Chemical Works, Plymouth.
- Burnett, E. E., 118, Huddleston Road, Tufnell Park, London, N.
- Burrell, B. A., Bank Chambers, 70, South Mall, Cork.
- Burroughs, S. M., Bell Lane, Wandsworth, S.W.
- Barrows, Edw., c/o Newcastle Chemical Co., Gateshead-on-Tyne.
- Burton, F., 2, Green Street, Bethnal Green, E.
- Burton, Montague, Mostyn Street, Llandudno.
- Bury, J. H., Church Chemical Works, near Acerington.
- Bash, R. A., 20, Artillery Lane, London, E.C.

Bush, W. E., 20, Artillery Lane, London, E.C.
 Butt, E. N., 25, Sussex Gardens, Hyde Park, London, W.
 Butler, Samuel, Compton, Wolverhampton.
 Butler, W. W., Crown Brewery, Broad Street, Birmingham.
 Butterfield, J. C., Ellerslea Lodge, Endlesham Road, Balam, S.W.
 Button, H., Faraday Chemical Works, Rainham, Essex.
 Byard, A. G., c/o Bart, Boulton, and Heywood, Barrière des Minimes, Toulouse, France.
 Bythway, M., 43, Lloyd Street, Albert Street, Manchester.

C

Cabot, Godfrey L., 82, Water Street, Boston, Mass., U.S.A.
 Calderwood, J., Gowanlea, Spencer Park, Wandsworth, S.W.; and Price's Patent Candle Co., Battersea.
 Caldwell, Alfred S., Greenfield Lodge, Lasswade, Midlothian, N.B.
 Caldwell, Wm., Murray Street, Paisley, N.B.
 Caley, A. J., Chapel Field, Norwich.
 Callard, S., Pontamman Chemical Works, Ammanford, Carmarthen.
 Cameron, Ian, 41, Travessa de Sao Nicolau, Lisbon.
 Cameron, Peter, Bath Bridge Colour Works, Bristol.
 Cameron, R., 31, Westbourne Gardens, Kelvinside, Glasgow.
 Cammack, J., 8, Salisbury Street, St. Helens.
 Campbell, A., 42, Whittaker Road, Upton Park, Essex.
 Campbell, Andrew, Lidlithgow Oil Co., Lidlithgow, N.B.
 Campbell, John, 25, New Chambers Street, New York, U.S.A.
 Campbell, Jno. D., Crosby House, Thurlow Park Road, West Dulwich, S.E.
 Candlish, J. J., Bottle Works, Seaham Harbour, co. Durham.
 Cannon, M., Beaufoy's Chemical Works, Lavender Hill, London, S.W.
 Carey, E., Widnes, Lancashire.
 Carlile, T., 23, West Nile Street, Glasgow.
 Carmody, Patrick, Laboratory, Somerset House, London, W.C.
 Carnelly, Dr. Thos., University College, Dundee.
 Caro, Dr. H., Mannheim, Germany.
 Carpenter, H. S., 32, Holborn Viaduct, London, E.C.
 Carpenter, R. F., Bent Terrace, Prestwich, near Manchester.
 Carpenter, W. L., 36, Craven Park, Harlesden, London, N.W.
 Carran, T. W., Girtton House, Shiel Road, Liverpool.
 Carrick, H., Holly House, Gateshead-on-Tyne.
 Carruthers, J. G., Burnbrae House, Milngavie, N.B.
 Carter, W. C., 76, University Street, Belfast, Ireland.
 Carteghe, M., 180, New Bond Street, London, W.
 Castner, Hamilton Y., c/o The Aluminium Co., Ltd., Oldbury, Birmingham.
 Cawley, G., 3, Lansdowne Road, Didsbury, Manchester.
 Cawley, J., 278, Passaic Street, Newark, New Jersey, U.S.A.
 Chadwick, L. N., Ivy Lawn, Ponders End, Middlesex.
 Chaloner, G., 30, Weston Park, Crouch End, N.
 Chamberlain, J., West Melbourne Gasworks, Melbourne, Victoria.
 Chambers, J. M., Te Mata, Havelock, Hawkes Bay, New Zealand.
 Chance, A. M., Alkali Works, Oldbury, near Birmingham.
 Chance, J. E., 51, Prince's Gate, London, S.W.
 Chandler, Dr. C. F., School of Mines, Columbia College, New York.
 Chaney, Harry, 29, Chalcat Crescent, Regent's Park, N.W.; and Mona House, Trawsfynydd, Festiniog, N. Wales (for Journals).
 Chapman, S., 84, Eccleston Square, London, S.W.; and 36, Mark Lane, E.C.
 Chapman, W., Crescent Road, Ipswich.
 Charlton, Jno., 42, Blackfriars Street, Manchester.
 Charlton, Jas., c/o Levinstein & Campbell, 25, New Chambers Street, New York, U.S.A.
 Cheetham, F. W., Carlton Bank, Hyde, Manchester.
 Cheyne, A. M., c/o Messrs. Burgoyne, 16, Coleman Street, London, E.C.
 Chisholm, M. E., 8 Kennington Park Road, London, S.E.
 Christie, J., Messrs. John Orr-Ewing & Co., Alexandria Works, Dumbartonshire.
 Christopher, G., 5, Shoe Lane, E.C. (for Journals); and 6, Barrow Road, Streatham Common, S.W.
 Christy, Thos., Malvern House, Sydenham, S.E.; and 25, Lime Street, London, E.C.
 Chrystal, W. J., Shawfield Works, Rutherglen, near Glasgow.
 Church, Prof. A. H., Shelsley, Kew, Surrey.
 Clananan, H. C., 88, King Street, Manchester.
 Clark, E. B., c/o Clark and Struthers, 17, Royal Exchange Square, Glasgow.
 Clark, Dr. J., 138, Bath Street, Glasgow.
 Clark, John, 80, Great Brook Street, Birmingham.
 Clark, R. Ingham, 2, Park Prospect, Queen Anne's Gate, Westminster, S.W.
 Clarke, Arthur, St. Ann's Hill Factory, Nottingham.
 Clarke, Wm. Randal, 23, Vine Street, Widnes.
 Claudet, A. C., 6, Coleman Street, London, E.C.
 Claudet, F. G., 13, Townley Park Villas, Dulwich Rise, S.E.
 Clans, C., 186, Suffolk House, Cannon Street, E.C.
 Claus, Carl F., jun., Primrose Villa, Ferry Side, Carmarthenshire.
 Clayton, E. G., Chemical Laboratory, 54, Holborn Viaduct, London, E.C.
 Clayton, F. C., 18, St. James' Road, Edgbaston, Birmingham.
 Clayton, Jas. S., Ewhbank House, Acerington.
 Cleminshaw, E., Alkali Works, Oldbury, near Birmingham.
 Clemons, G. H., Cudbear Street, Hunslet Road, Leeds.
 Clerk, Dugald, Driffold Villa, Sutton Coldfield, near Birmingham.
 Cliff, Cromwell, 30, Trentham Street, Runcorn, Cheshire.
 Cliff, D. Y., 7, Wellington Street, Leeds.
 Cliff, J., Nisbet Hall, Fulneck, Leeds.
 Cliff, Stephen, Wortley, near Leeds.
 Clift, J., Kemp Field House, Knottingley, Yorks.
 Clifton, C. D., Royal Oak Brewery, Stockport.
 Cloud, T. C., Wallaroo Smelting Works, Wallaroo, South Australia.
 Clowes, Dr. F., University College, Nottingham.
 Clowes, G. A., Needham Market, Suffolk.
 Coats, Jno. T., 91, Broughton Street, Edinburgh.
 Cochrane, Wm. P., Ormesby Ironworks, Middlesbrough.
 Cockburn, J., 43, Camden Square, London, N.W.
 Cockrell, E. Gordon, 17, Grosvenor Chambers, Manchester.
 Coffey, James H., 111, Grosvenor Road, Pimlico, S.W.
 Coghill, P. de G., 47, Derby Lane, Old Swan, Liverpool.
 Cogswell, W. B., Syracuse, New York, U.S.A.
 Cohen, Dr. J., Owens College, Manchester.
 Colby, W. H., Oakley, Ruthin Road, Denbigh.
 Coleman, Gurney F., University of Pennsylvania, Philadelphia, Pa., U.S.
 Coleman, Jas. B., University College, Nottingham.
 Collens, E., Vinegar Works, Stourport, Worcestershire.
 Collett, J. M., 7, Brunswick Square, Gloucester.
 Collins, J. H., 4, Clark Terrace, Dulwich Rise, S.E.
 Collins, H. S., Messrs. Langton & Co., 230, Upper Thames Street, London, E.C.
 Collins, Walter H., Bradford Chambers, Mawdsley Street, Bolton-le-Moors.
 Collyns, C. S. A., 47, Park Street, Greenheys, Manchester.
 Colquhoun, D., c/o Chas. Tennant & Co., Ltd., Carnoustie, N.B.
 Colson, A., Gas Office, Millstone Lane, Leicester.
 Connor, C. C., Notting Hill House, Belfast, Ireland.
 Conrad, E. C., Parapara, Portland Road, Gravesend, Kent.
 Constable, W. H., Hale Bank, Widnes, Lancashire.
 Cook, E. M., Carteret Chemical Co., 115, Broadway, New York, U.S.A.
 Cook, E. Rider, East London Soap Works, Bow, London, E.
 Cook, H. J., East London Soap Works, Bow, London, E.
 Cook, Jno. J., Atlas Foundry, St. Helens, Lancashire.
 Cook, Robt., Atlas Chemical Works, Widnes.
 Cookson, N. T., Newcastle-on-Tyne.
 Coomber, Thos., 9, Osborne Road, Clifton, Bristol.

Cooper, A., North-Eastern Steel Co., Middlesbrough-on-Tees; and The Laurels, Linthorpe, near Middlesbrough-on-Tees.

Cooper, Astley, The Terrace, Beeston Hill, Leeds.

Cooper, H. P., 15, Haringey Road, Hornsey, N.

Coram, H. C., Technical College, Finsbury, E.C.

Corbett, E., Plaskynaston Chemical Works, Ruabon, North Wales.

Corbett, Jno., M.P., Stoke Works, near Bromsgrove, Worcestershire.

Corder, Walter S., 22, Albion Road, North Shields.

Cornett, Jas. P., Ford Paper Works, Hylton, near Sunderland.

Coste, F. H. Perry, Laboratory, 17, Tower Street, London, E.C.

Cottam, J. C., 39, Lombard Street, London, E.C.

Cotterell, Roeke, 35a, Ann Street, Glasgow.

Cotterill, Thos., Lombard Street West, West Bromwich.

Cotton, J., Church Street, St. Helens.

Couldridge, Ward, Emmanuel College, Cambridge.

Couper, W. G., 1, Fenchurch Avenue, London, E.C.

Cowan, A. B., Tuthoe Ironworks, Spennymoor, Newcastle-on-Tyne.

Cowburn, W. H., 3, Clarence Street, Albert Square, Manchester.

Cowell, Peter, Free Public Library, Liverpool.

Cox, Dr. J., 7, Maze Hill, Greenwich, S.E.

Cox, Walter J., Rock House, Basford, Nottingham.

Crabb, W., Border Counties Chemical and Manure Works, Silloth, Cumberland.

Crabtree, Thos., Spring Valley Dyeworks, Failsworth, near Manchester.

Craig, G., Lugar Iron Works, Cumnock, N.B.

Craig, Jno., Clippens Villa, by Johnstone, N.B.

Crake, William, c/o Guillermo C. Tripler, Coquimbo, Chili.

Craw, John, Meadowbank, Greenock Road, Paisley, N.B.

Crawford, D., Langdale's Manure Works, Newcastle-on-Tyne.

Crawford, D., Glengowan Printworks, Caldercraix, by Glasgow.

Cresswell, C. G., 20, Colinet Road, Putney Park, S.W.; and 9, Bridge Street, Westminster, S.W.

Cresswell, C. N., 1, Hare Court, Temple, E.C.

Crichton, Donald G., Mount Albion, by Herkerton, Queensland.

Crompton, Percy R., Dearden's House, Bury, Lancashire.

Crookes, W., 7, Kensington Park Gardens, Notting Hill, London, W.

Crosfield, A. L., 9, Derwent Square, Stoneycroft, Liverpool.

Cross, C. F., 4, New Court, Lincoln's Inn, London, W.C.

Cross, J., Widnes.

Crossley, R., Bentcliffe House, Acerington.

Crow, J. K., Yiewsley, near Uxbridge, Middlesex.

Crowder, W., 271, Evering Road, Upper Clapton, London, N.

Crowther, Horace W., Messrs. Chance Brothers, Alkali Works, Oldbury, near Birmingham.

Crowther, W. M., Field House, Gomersal, near Leeds.

Cruikshank, G. M., 62, St. Vincent Street, Glasgow.

Crum, A., Thornliebank, Glasgow.

Crumbie, W. D., U.S. Govt. Laboratory, 402, Washington Street, New York.

Cuning, James, jun., Chemical Works, Yarraville, Melbourne, Australia.

Cunliffe, E. T., The Parsonage, Handforth, near Manchester.

Cunliffe, Jos., Rooke Wood, Chorley, Lancashire.

Cunningham, A. Auchie, 13, Rutland Square, Edinburgh.

Curphey, W. S., 268, Renfrew Street, Glasgow.

Curry, W. A., Giltbrook Chemical Works, Awsworth, Notts.

Curtis, Harry E., 1, Croft Villas, The Croft, Hastings.

Cuthbert, H. W., 88, Bishopsgate Street Within, London, E.C.

Cuthbert, R. M., 27a, Ashley Place, London, S.W.

Cuthbertson, Sir J. N., 29, Bath Street, Glasgow.

Cuthbertson, William, Caroline Park, Edinburgh.

D

Dacie, J. C., Soap Works, Putney, London, S.W.

Dagger, J. H. J., Phoenix Smelting Works, Neath, Glamorganshire.

Dale, Jas., 182, Lordship Road, Stoke Newington, N.

Dale, R. S., 1, Chester Terrace, Chester Road, Manchester.

Dalziel, Samuel, Smyrna, Asia Minor.

Daniell, Louis C., Standard Brewery, Elizabeth Street, Sydney, New South Wales.

Darby, J. H., Pen-y-Garth, near Wrexham.

Darling, W. H., 126, Oxford Street, Manchester.

Dauber, H., jun., 1, Victoria Road, Waterloo, near Liverpool.

Davenport, Dr. B. F., 161, Tremont Street, Boston, Mass., U.S.A.

Davidson, G., c/o W. & H. M. Goulding, Limited, The Glen, Cork, Ireland.

Davidson, J. E., 16, Hawthorne Terrace, Newcastle-upon-Tyne.

Davidson, R., c/o Fiji Sugar Co., Tamanoa, Navua River, Fiji.

Davidson, R. H., c/o Messrs. Goulding, Davis, & Co., Marsh Alkali Works, Widnes.

Davies, A. E., 6, Rumbold Place, Liverpool.

Davies, Meurig L., 77, Everton Terrace, Everton, Liverpool.

Davies, R. H., Apothecaries' Hall, London, E.C.

Davis, A. R., 10, Prospect Terrace, Hunslet Moor, Leeds.

Davis, Chas., 10, Oakfield Cottages, Oakfield Road, East Ham, E.

Davis, G. E., South Cliff House, Higher Broughton, Manchester.

Davis, H. W., The Laboratory, Somerset House, London, W.C.

Davis, J. F., Dr., 554, Quiney Street, Brooklyn, New York, U.S.A.

Davis, R. H. (Messrs. Goulding, Davis, & Co.), Widnes.

Davis, T. S., 199, South Lambeth Road, London, S.E.

Davison, Anthony, 9, Pall Mall, London, S.W.

Dawson, B., York House, Malvern Link, Worcestershire.

Dawson, C. A., Holly Bank, Frodsham, Cheshire.

Dawson, Jno., Kirkheaton Coal Tar Colour Works, Huddersfield.

Dawson, Thos., Stonceroft House, Milnsbridge, near Huddersfield.

Dawson, W. E., Pretoria, Transvaal, South Africa.

Dawson, W., Haywood, British Alizarin Co., Limited, Silvertown, Victoria Dock, E.

Day, St. John V., 115, St. Vincent Street, Glasgow.

Deacon, H. W., Appleton House, Widnes.

Deakin, E., Belmont Bleach and Dyeworks, near Bolton.

Deakin, H., Ryecroft Dyeworks, Belmont, near Bolton.

Deans, J. A., Oxalic Acid Manufactory, Morriston, Swansea.

Dearden, Thos., 12, Heywood Street, Bury, Lancashire.

De Deken, A., 18, Rue Vilette, Liège, Belgium.

Deering, W. H., Chemical Department, Royal Arsenal, Woolwich, S.E.

De La Rue, Dr. W., 73, Portland Place, London, W.

Dempsey, Geo. C., P.O. Box 49, Lowell, Mass., U.S.A.

Dempster, A., Rosemount, Elland, Yorkshire.

Demuth, Dr. L., Wharfedale, Church Road, Edgbaston, Birmingham.

Dent, W. Y., Belle Vue House, Wood Street, Woolwich, London, S.E.

Denton, E. Bailey, Palace Chambers, 9, Bridge Street, Westminster, S.W.

Dewar, Prof. J., Royal Institution, Albemarle Street, W. (for Journals); and 1, Serapee Terrace, Cambridge.

Dey, Fred Lall, 4, Beadon Street, Calcutta.

Dibdin, W. J., Metropolitan Board of Works, Spring Gardens, London, S.W.; and Mayfield, Grange Road, Sutton, Surrey.

Dicketts, William, 9, Mincing Lane, London, E.C.

Dick, A., 110, Cannon Street, London, E.C.

Dickinson, A. J., Neptune Tar and Chemical Works, Deptford, London, S.E.

Dickson, Jno., 16, Dale Street, S.S., Glasgow.
 Dittmar, Prof. W., Anderson's College, Glasgow.
 Divers, Dr. E., Hongō, Tokyo, Japan.
 Dixon, Prof. Harold B., Owens College, Manchester.
 Dixon, Jos., Spring Grove, near Sheffield.
 Dixon, M. T., P.O. Box 419, Johannesburg, Transvaal.
 Dixon, Wm., 102, Spring Street, Bury, Lancashire.
 Dixon, William, 3, Belle Vue Park, Sunderland.
 Dobbie, Dr. J. J., University College of North Wales, Bangor.
 Dobbin, Dr. L., Chemical Laboratory, University, Edinburgh.
 Dobson, Geo., Grange Alkali Works, near Cardiff.
 Doherty, Daniel, Laboratory, Somerset House, Strand, W.C.
 Doidge, H., 22, Alberta Terrace, Sherwood Rise, Nottingham.
 Doncier, A., 13, St. Mary-at-Hill, London, E.C.
 Donald, George, Arnold Printworks, North Adams, Mass., U.S.A.
 Donald, Jas., 5, Queen's Terrace, Glasgow.
 Donald, W., 29, Eglinton Street, Saltecoats, N.B.
 Donald, W. J. A., 27, St. Vincent Place, Glasgow.
 Doolittle, Orrin S., Altoona, Pa., U.S.A.
 Dott, D. B., c/o Duncan, Flockhardt, & Co., 104, South Canongate, Edinburgh.
 Dougall, A., Gas-works, Sealecoates, Hull.
 Dougall, Archibald, Gasworks, Kidderminster.
 Douglas, William, Diamond Plantation, Demerara.
 Doulton, Sir Henry, Lambeth Pottery, London, S.E.
 Doux, Jules, jun., 55, Bleeker Street, Utica, New York, U.S.A.
 Dowling, Edmund, 83, Cable Street, London, E.
 Down, F. J., 13, Victoria Road, Charlton, S.E.
 Down, T., Willington-upon-Tyne.
 Doxson, J., Emerson, 3, Great Queen Street, Westminster, S.W.
 Drake, Chas. A., Three Mills Distillery, Bromley-by-Bow, E.
 Dreaper, W. P., 8, Albert Square, Clapham Road, London, S.W.
 Drew, D., Lower House Printworks, near Burnley.
 Dreyfus, C., Clayton Aniline Co., Limited, Clayton, Manchester.
 Driffield, V. C., Farnworth, Widnes.
 Drown, Thos. M., Mass. Inst. of Technology, Boston, Mass., U.S.A.
 Duckworth, C. W., Garner's Buildings, North Road, Clayton, Manchester.
 Duckworth, William, 93, Corporation Street, Manchester.
 Dudley, Prof. W. L., Vanderbilt University, Nashville, Tenn., U.S.A.
 Duffield, Dr. Saml. P., 2, Market Building, Detroit, Mich., U.S.A.
 Duggan, T. R., 32, Narford Road, Upper Clapton, E.
 Dukes, T. William, c/o Messrs. B. G. Lennon and Co., Cape Town, South Africa.
 Duncan, And., Dawsholm Gasworks, Maryhill, Glasgow.
 Duncan, Archibald, 1, Park Place, Great Clowes Street, Manchester.
 Duncan, Arthur W., 69, Market Street, Manchester.
 Duneau, J., 9, Mincing Lane, London, E.C.; and Clyde Wharf, Victoria Dock, E.
 Duncan, James, Cleland, Lanarkshire.
 Dunlop, A. M., 3, Old Palace Yard, Westminster, S.W.
 Dunn, J., 53, Brown Street, Manchester.
 Dunn, J. T., The School, Gateshead-on-Tyne.
 Dunn, P., 53, Brown Street, Manchester.
 Dunn, S., 50, Upper Park Road, Haverstock Hill, N.W.
 Dunn, Wm. Walton, 5, Cheapside, Tudhoe Grange, Spenny-more, co. Durham.
 Dunstan, Prof. W. R., 17, Bloomsbury Square, London, W.C.
 Dupee, H. D., Walpole, Mass., U.S.A.
 Dupré, Dr. A., Westminster Hospital Medical School, Caxton Street, London, S.W.
 Durrant, Reg. G., Marlborough College, Wilts.
 Dyer, B., 17, Great Tower Street, London, E.C.
 Dyson, C. E., Flint, North Wales.
 Dyson, Geo., Hurworth, Darlington.

Dyson, Dr. G., Temple House, Cheetham Hill, Manchester.
 Dyson, H., Calder Vale, Wakefield.
 Dyson, John, Derby Court, Long Millgate, Manchester.

E

Earle, G. Peploe, Brantwood Lodge, Burnt Ash Hill, Lee, S.E.
 Earp, W. R., Halton Road, Runcorn, Cheshire.
 Eastick, J. J., Chemical Laboratory, Plaistow Wharf, North Woolwich Road, London, E.
 Eastick, C. E., Chemical Laboratory, Plaistow Wharf, North Woolwich Road, London, E.
 Eastlake, Thos. L., 23, Great George Street, Westminster, S.W.
 Eastwood, Edward, Tynel Soap Works, Wapping, E.
 Eaton, W. H.,
 Edge, Anthony, Readville, Mass., U.S.A.
 Edgell, G. E., 4, Hardwick Terrace, Gateshead-on-Tyne.
 Edmunds, H. R., 337, East 27th Street, New York, U.S.A.
 Edwards, A. J., The Gasworks, Taunton.
 Ekman, C. D., Dieppe, France.
 Elborne, W., The Owens College, Manchester.
 Elborough, T., 59, Mark Lane, London, E.C.
 Elliott, A. H., "Anthony's Bulletin," 59, Broadway, New York, U.S.A.
 Ellis, C. J., Cassel Gold Extracting Co., 13, West Scotland Street, Kinning Park, Glasgow.
 Ellis, G. E. R., North Main Street, Butte City, Montana, U.S.A.
 Ellis, H., 112, Regent Street, Leicester.
 Elmore, A. S., Tweed Mill, Cockermouth.
 Elworthy, H. S., Gahmar, East Indian Railway, N.W.P., India.
 Emmens, S. H., P.O. Box 63, Harrison, N.Y., U.S.A.
 Endemann, Dr. H., 33, Nassau Street, New York City, U.S.A.
 England, R. J., c/o Farmer and Co., Dunster House, Mark Lane, London, E.C.
 Epstein, Dr. W., 45, Woodlands Street, Cheetham Hill, Manchester.
 Ermen, F., jun., Nassau Mills, Patricroft, Manchester.
 Ernst, Adolf, Oberlangenbielau, Schlesien, Germany.
 Erskine, Jas. K., 6, Lascott's Road, Wood Green, N.
 Eschellman, Dr. George, Dyar Terrace, Winnington, Northwich, Cheshire.
 Esiluan, A., North Road, Clayton, Manchester.
 Esteourt, C., 20, Albert Square, Manchester.
 Evans, Dr. John, Nash Mills, Hemel Hempstead.
 Evans, Enoch, 181, Herbert Road, Small Heath, Birmingham.
 Evans, W. N., 66, Staekpole Road, Bristol.
 Everard, A. G., 9, North Street, Chichester.
 Everett, H. H., c/o The Borneo Co., Limited, 28, Fenchurch Street, London, E.C.
 Everitt, F., Douglas, Fiestall House, Bromsgrove.
 Evershed, F., Atlas Works, Hackney Wick, London, E.
 Evershed, Henry G., Soap Works, Station Street, Brighton.
 Evershed, Wallis, c/o Whitwell & Co., Limited, Kendal, Westmoreland.
 Ewing, Sir Arch. Orr, Bart., M.P., Lennoxbank, Jameston, Dunbartonshire.
 Ewing, H. M. R., Alexandria Works, Alexandria, Dunbarton.

F

Fahlberg, Dr. C., Saccharin fabrik, Salbke-Westerhüsen, a/Elbe, Germany.
 Fairley, T., 16, East Parade, Leeds.
 Fairlie, H. C., 2, University Gardens, Glasgow.
 Fairweather, W., 62, St. Vincent Street, Glasgow.
 Fallowfield, T., Clayton-le-Moors, near Ayrington.
 Farmer, Prof. Moses G., Eliot, Maine, U.S.A.
 Farrant, N., 2, Lawnside, Bearwood Road, Smethwick, near Birmingham.

Farries, T., 16, Coleman Street, London, E.C.
 Farrington, T., 4, Waterloo Place, Cork, Ireland.
 Fasnacht, A. E., Sandy Lane Chemical Works, Clayton, Manchester.
 Faulder, Henry, Lily Grove, Heaton Mersey, near Manchester.
 Faulkner, F., The Laboratory, Langley, Oldbury, near Birmingham.
 Fawsitt, C. A., Atlas Chemical Works, East Nelson Street, Glasgow.
 Fearfield, Jno. P., Stapleford, Notts.
 Fellows, A., Hebburn-on-Tyne.
 Felton, Thos., 364, Romford Road, Forest Gate, E.
 Ferguson, Prof. J., The University, Glasgow.
 Fergusson, H., Prince Regent's Wharf, Victoria Docks, E.
 Ferrie, And., Crown Chemical Works, Harpurhey, Manchester.
 Field, E. W., The Brewery, Nottingham.
 Field, S. E., Thorpe End Brewery, Melton Mowbray.
 Field, S. S., Eagle Villa, Westcombe Park, S.E.
 Field, J. K., 31, Bendon Valley, Wandsworth, S.W.
 Fielding, A., 22, Dantzic Street, Manchester.
 Filcock, P., Chester Road, Macclesfield.
 Finch, Herbert, The Aqueduct, Marple, near Stockport.
 Findlay, J. T. J., Silvertown, London, E.
 Fisher, W. W., 5, St. Margaret's Road, Oxford.
 Fitzbourn, A. G., Ditton Copper Works, Widnes.
 Fletcher, A. E., 57, Gordon Square, London, W.C.
 Fletcher, F., North London Chemical Works, Holloway, N.
 Fletcher, R. Steele, Misterton, Gainsboro', Lincolnshire.
 Fletcher, T., Thynne Street, Warrington.
 Fletcher, T., 99, Great Hampton Street, Birmingham.
 Flower, Major Lamorock (Lee Conservancy Board), 12, Finsbury Circus, E.C.
 Flynn, T. J., 27, Mandrake Road, Upper Tooting, S.W.
 Fogg, Jas., Waterloo Estate, Carapichaima, Trinidad, West Indies.
 Foord, Geo., Royal Mint, Melbourne, Victoria, Australia.
 Forbes, J., Chemical Works, Old Ford, London, E.
 Ford, Alex. E., 4, Orme Square, Hyde Park, W.
 Formoy, J. Arthur, 12, Railway Approach, London Bridge, S.E.
 Forrest, A., Holt Town, Manchester.
 Forrester, J., 87, Cannon Street, London, E.C.
 Forster, Ralph C., c/o Messrs. Bessler, Waechter & Co., Newcastle-on-Tyne.
 Forster, W. G., Lonesome Chemical Works, Streatham Common, London, S.W.
 Forth, Henry, Beech Avenue, Sherwood Rise, Nottingham.
 Foster, F., Niagara Works, Eagle Wharf Road, London, N.
 Foster, H. Le Neve, Seaton Carew, co. Durham.
 Foster, R. Le Neve, The Firs, North Road, Droylsden, Manchester.
 Foster, W., Middlesex Hospital, London, W.C.
 Foster, Wm., 10, Norfolk Terrace, Chapeltown, Leeds.
 Foulerton, Ernest, 73, Boulevard de Strasbourg, Paris.
 Foulis, Wm., 2, Montgomerie Quadrant, Kelvinside, Glasgow.
 Fox, J. Wesley, 115, Lower Thames Street, London, E.C.
 Fox, T., jun., Court, Wellington, Somerset.
 France, G. H., Horsforth, Leeds.
 France, G. T., Friar's Goose, Gateshead-on-Tyne.
 France, H. C. D., Perry Hill, Quinton, near Birmingham.
 Francis, E., Rock Villas, Parkside, Nottingham.
 Francis, E. G., 1, Halstead Villas, Fulham Road, Hammer-smith, W.
 Francis, G. B., 5, Coleman Street, London, E.C.
 Francis, Wm., jun., Chemical Laboratory, The University, Glasgow.
 Francis, W. H., 5, Coleman Street, London, E.C.
 Frankenburg, Isidor, Greengate Rubber Works, Salford, Manchester.
 Frankland, Dr. E., The Yews, Reigate, Surrey.
 Frankland, H., Streonshall House, The Crescent, Linthorpe, Middlesbro'.
 Frankland, Dr. P. F., University College, Dundee.
 Fraser, W. J., 121, Adelaide Road, Haverstock Hill, N.W.
 Free, R., The Elms, Mistley, Essex.
 Freear, H. M., Helgefield, Harpenden, Herts.

Freeman, A., 40, Liverpool Road, St. Helens, Lancashire.
 Freestone, J. W., 33, Brownlow Road, New Ferry, Cheshire.
 French, Andrew, Viewbank, Bearsden, near Glasgow.
 Frew, Wm., 2, King James' Place, Perth, N.B.
 Fries, Dr. Harold H., 92, Reade Street, New York, U.S.A.
 Friswell, R. J., 115, Darent Road, Stamford Hill, London, N.
 Froehling, Dr. H., 17, South 12th Street, Richmond, Virginia, U.S.
 Frost, Joe, Mold Green, Huddersfield.
 Fryer, Dr. A. C., Cornwallis Lodge, Clifton, Bristol.
 Fukahori, Yosukiki, 6, Sanjikkenbori, Sauehome, Tokyo, Japan.
 Fullarton, R., 30, Donegal Place, Belfast, Ireland.
 Fuller, Chas. J. P., Laboratory, Lancashire and Yorkshire Railway, Horwich, near Bolton.
 Fuller, Jno., Rookwood, Chapter Road, Willesden Park, N.W.
 Fuller, W. M., Ely House, Wolverhampton.
 Fulton, H. B., 33, St. Dunstan's Road, West Kensington, S.W.
 Fyfe, Jno., West George Street, Glasgow.

G

Gabbett, E. R., Prince Regent's Wharf, Victoria Docks, London, E.
 Gadd, W. Lawrence, Bank House, High Street, Wath-upon-Deane.
 Gadsden, Capt. H. A., 6, Crosby Square, Bishopsgate Street, London, E.C.
 Gall, Henry, L'Usine de Produits Chimiques de Villers par Hermes, Oise, France.
 Galt, Alexander, 41, Westbourne Gardens, Kelvinside, Glasgow.
 Gamble, D., Windlehurst, St. Helens.
 Gamble, D., jun., Millbrook, Ecclestone, Prescot, Lancashire.
 Gamble, J. C., Hardshaw Brook Chemical Works, St. Helens.
 Gamble, Jas. N., Messrs. Procter and Gamble, Cincinnati, Ohio, U.S.A.
 Gamble, W., Haresfinch, St. Helens.
 Gans, Adolf, Farbenfabrik von L. Cassella & Co., Frankfurt o/Main, Germany.
 Garibaldi, Joachim A., 21, Church Street, Gibraltar.
 Garrick, Dr. A. R., Huyton, near Liverpool.
 Garton, R. (Hill, Garton & Co.), Southampton Wharf, Battersea, S.W.
 Gascoyne, Dr. W. J., 36, South Holliday Street, Baltimore, Md., U.S.A.
 Gaskell, H., jun., Clayton Lodge, Aigburth, near Liverpool.
 Gaskell, Holbrook, Woolton Wood, Liverpool.
 Gaskell, J., 1, Woodlands Road, Cheetham Hill, Manchester.
 Gatheral, G., Heathfield, Hebburn-on-Tyne.
 Gatine, L., 23, Rue des Rosiers, Paris.
 Gausson, W. F. A., 53, Eaton Square, London, S.W.
 Gerland, Dr. B. W., Messrs. F. Steiner & Co., Church, near Aecrington.
 Gibbins, H. B., Holly Lawn, Beechen Cliff, Bath.
 Gibbs, D. Cecil, Hanover Court, Milton Street, London, E.C.
 Gibbs, R. D., Woodlands Cottage, Six Ways, Smethwick.
 Gibbs, W. P., North British Chemical Co., Clydebank, near Glasgow.
 Gibson, J., 29, Greenhill Gardens, Edinburgh.
 Gibson, J. M., c/o Buckley Brick and Tile Co., Buckley, via Chester.
 Gilbert, Dr. J. H., Harpenden, near St. Albans.
 Gilchrist, P. C., Palace Chambers, 9, Bridge Street, Westminster, London, S.W.
 Gilchrist, Peter S., c/o Orient Guano Co., Orient, N.Y., U.S.A.
 Giles, W., Clous Keagh Works, Warton Road, Stratford, London, E.
 Gill, Aug. H., c/o Becker & Co., Bankers, Leipzig, Germany.
 Gillman, Gustave, 10, Callejon del Caidero, Granada, Spain.
 Gilmour, Geo., c/o Dublin Whisky Distillery Co., Jones Road, Dublin.

- Gimingham, C. H., Stamford House, Northumberland Park, Tottenham, N.
- Girdwood, Dr. Gilbert P., 54, Beaver Hall Terrace, Montreal, Canada.
- Gladstone, Dr. J. H., 17 Pembroke Square, London, W.
- Glaeser, F. A., Carpenter's Road, Stratford, E.
- Glendinning, H., Mount House, The Hill, Sandbach, Cheshire.
- Glendinning, N., Merton Bank, St. Helens.
- Gleag, Robt. F., Grove Hill, Middlesbrough.
- Glossop, W. Dale, 93A, Portland Street, Manchester.
- Glover, G. T., The Phospho Guano Co., Limited, Seacombe, Cheshire.
- Glover, John, 2, Jesmond Dene Terrace, Newcastle-on-Tyne.
- Glover, T., Messrs. Mort, Liddell & Co., Widnes.
- Glover, W., Rio Tinto Mines, Huelva, Spain.
- Goldschmidt, S. A., Columbia Chemical Works, 20-30, Jay Street, Brooklyn, U.S.A.
- Goodall, Thos., Hendon Grange, Sunderland.
- Goodhart, E. C., 168, Lower Addiscombe Road, Croydon.
- Goodwin, C. C., Throstle Nest, Old Trafford, Manchester.
- Goold, J. R. P., 68-70, Hop Exchange, Southwark, S.E.
- Goppelsroeder, Dr. F., 14, Brubachstrasse, Mulhausen, Elsass, Germany.
- Gordon, J. G., Landore Steel Works, Landore, R.S.O., South Wales.
- Gore, Dr. G., 67, Broad Street, Birmingham.
- Gossage, F. H., Widnes.
- Gow, Dr. James, High School, Nottingham.
- Gow, R. J., Ditton Iron Works, Widnes.
- Gowland, W., 221, Moss Lane East, Moss Side, Manchester.
- Goyder, G. A., Government Survey Office, Adelaide, South Australia.
- Gracey, R., Tobacco Works, 70, Great George Street, Liverpool.
- Graesser, R., Cefn, near Ruabon, North Wales; and Argoed Hall, Llangollen, North Wales.
- Grafton, F. W., M.P., 91, Portland Street, Manchester.
- Graham, Dr. C., University College, Gower Street, London, W.C.
- Graham, C. C., c/o Blundell, Spence & Co., Beverley Road, Hull.
- Graham, J. A., Sherborne Lodge, Werter Road, Putney, S.W.
- Grandage, H., Calder Dye Works, Brighouse, near Leeds.
- Gray, G. Watson, 12, Argyle Road, Garston, near Liverpool.
- Gray, W., Oil Refinery, Hull.
- Gray, Jno., Clippens Oil Works, by Johnstone, N.B.
- Green, A. G., Atlas Works, Hackney Wick, London, E.; and (Journals) 54, Thistlewaite Rd., Lower Clapton, E.
- Green, C. H., 7, York Street, Liverpool.
- Green, German, 2, Croft Terrace, Jarrow-on-Tyne.
- Green, H., Toxil House, Maidstone.
- Green, John, Iron, Tinsplate, and Chemical Works, Abercarn, Mon.
- Green, Jno. Edw., 32, Claypath, Durham.
- Green, L., Riverdale, College Road, Maidstone.
- Green, R., Soho Mill, Wooburn, near Beaconsfield.
- Green, Upfield, Liebenheim, Charendon Road, Watford, Herts.
- Greenaway, A. J., Fregnal, Hampstead, N.W.
- Greenhalgh, J. Herbert, Shepherd's, Tootington Mill, near Bury.
- Greenhough, D. W., 16 Mining Lane, London, E.C.
- Greenway, T. J., Block 14 Mining Co., Broken Hill, near Silverton, New South Wales.
- Greenwood, H., Holland Bank House, Church, near Acreington.
- Greville, H. L., 11, Lambton Road, Hornsey Rise, London, N.
- Grey, W. J., 9, Tyne Vale Terrace, Gateshead-on-Tyne.
- Griffin, Chas. J., 12, Exeter Street, Strand, W.C.
- Griffin, Martiu L., Holyoke, Mass., U.S.A.
- Griffith, Agnew, Dinas, Alexandra Road, Southport.
- Griffith, R. W. S., Eyeworth Lodge, Lyndhurst, Hants.
- Griffiths, Azariah, Elmhurst, Plesance, Falkirk, N.B.
- Grime, J., Rosebank Cottage, Bushy, near Glasgow.
- Grimshaw, H., Thornton View, Clayton, Manchester.
- Grimwood, R., 41, Lady Margaret Road, London, N.W.
- Grindley, J., Upper North Street, Poplar, London, E.
- Gripper, Harold, Stores Department, M. S. and L. Railway, Gorton, Manchester.
- Grossmann, Dr. J., Hendham Vale Chemical Works, Manchester.
- Groves, C. E., 352, Kennington Road, London, S.E.
- Grundtvig, C. H. W., Sunnyside, Wimbledon, S.W.
- Gunn, W. L., Broad Plain Soap Works, Bristol.
- Gunter, Evan, Nobel's Explosives Co., Ltd., Stevenston, Ayrshire, N.B.
- Guyatt, T., Ceara Gas Co., Limited, 9, Queen Street Place, Cannon Street, London, E.C.

H

- Haacke, A., Kieselguhr Wharf, Hackney Wick, E.
- Habirshaw, W. M., 159, Front Street, New York City, U.S.A.
- Hacking, W. H., The Grange, Clayton-le-Moors, near Acreington.
- Haddow, A., 1, Keith Place, Easter Road, Edinburgh.
- Hadfield, R. A., Newhall Road, Attercliffe, Sheffield.
- Hadkinson, F., Pumpila Oil and Soap Works, Mitylene, Mediterranean.
- Hadkinson, R., Smyrna, Asia Minor.
- Haga, Tamenasa, Chemical Department, Science College, Imperial University, Tokyo, Japan.
- Haig, Robert, Mechanical Retorts Co., Limited, Murray Street, Paisley, N.B.
- Haig-Brown, R., jun., Seymour Terrace, Old Trafford, Manchester.
- Hailes, A. Jas., 22, Beaumont Road, Hornsey Rise, N.
- Hake, C. N., 14, Great Smith Street, Westminster, S.W.
- Hale, Edw. P., Rock House, Rock Ferry, Cheshire.
- Hall, Allan T., Inglebank, Newland, Hull.
- Hall, Archibald D., 95, Bishop-gate Street, London, E.C.
- Hall, Edgar, Sunny Corner Silver Mine, Mitchell, New South Wales.
- Hall, Emlen T., 1623, Spruce Street, Philadelphia, Pa., U.S.
- Hall, G., La Carolina, San Luis, Argentine Republic (Journals); and c/o T. M. Hall, 70, King Street, South Shields (Subscription).
- Hall, J. Albert, 128, Lloyd Street, Greenheys, Manchester.
- Hall, S., East London Soap Works, Bow, London, E.
- Hall, T. Farmer, Dunster House, Mark Lane, London, E.C.
- Haller, Geo., 86, Leadenhall Street, London, E.C.
- Hamburger, Dr. S., 117, North Road, St. Helens.
- Hamilton, David, 224, Ingram Street, Glasgow.
- Hamilton, David R., 19, Graham Street, Bridgeton, Glasgow.
- Hamilton, Geo., 184, Kensington Crescent, Swansea.
- Hamilton, Jas. C., Kingsavil, Llanthegow, N.B.
- Hamilton, Oswald, Owens College, Manchester.
- Hamilton, Robert, Eglinton Ironworks, Kilmassing, N.B.
- Hamlen, G. J., 162, St. Vincent Street, Glasgow.
- Hammersley, Wm., Tar Works, Beckton, E.
- Hammersley, W. A. L., Bridge House, Leek, Staffordshire.
- Hamill, M. J., Dunton Green, near St. Helens.
- Hammoud, J., Gas Works, Eastbourne, Sussex.
- Hand, T. W., Public Library, Oldham.
- Handasyde, C. H., The Dean Works, Dalkeith, N.B.
- Hanks, Abbot A., 1124, Greenwich Street, San Francisco, Cal., U.S.
- Hanrez, Prosper, 9, Rue Moris, Chaussée de Charleroi, Brussels.
- Hanson, A. M., Abbey Printworks, Whalley, Blackburn.
- Hardie, William, The Gas Offices, Newcastle-on-Tyne.
- Hardman, J., Milton Chemical Works, Stoke-on-Trent.
- Hardman, Jas., Whitwood Chemical Works, Normanton.
- Hardy, H. J., 163, Edmund Road, Sheffield.
- Hargreaves, J., Widnes.
- Harkness, W., The Laboratory, Somerset House, London, W.C.
- Harland, R. H., Plough Court, 37, Lombard Street, London, E.C.

- Harley, Boston, Laboratory, Carron Works, Falkirk, N.B.
Harrington, W. B., Ardsullagh, Old Blackrock Road, Cork.
Harris, Booth, jun., Clovelly House, Norwich Road, Forest Gate, E.
Harris, D., Caroline Park, Edinburgh.
Harris, T., The Union Acid Co., Runcorn.
Harrison, A., Thames Sugar Refinery, Silvertown, London, E.
Harrison, C., Anglo-American Oil Mills, Church Street, Hull.
Harrison, G. D., Netham Chemical Works, Bristol.
Harrison, G. King, Hagley, near Stourbridge.
Harrison, G. H., Hagley, near Stourbridge.
Harrison, J., 5, Magdala Terrace, Gardiner's Hill, Cork.
Harrison, Jno., 35th and Gray's Ferry Road, Philadelphia, Pa., U.S.A.
Harrison, S. M., Sutton Alkali Works, St. Helens.
Hart, Bertam H., The Elms, Old Charlton, S.E.
Hart, E., Lafayette College, Easton, Pa., U.S.A.
Hart, P., e/o Tennants & Co., Mill Street, Clayton, Manchester.
Hart, T. G., The Improved Safety Gunpowder Co., Ltd., 50, Frith Street, Soho, W.C.
Hartford, Jas., 3, Cedar Street, New York, U.S.A.
Hartland, W. H. H., 114, Hyde Park Street, Glasgow.
Hartley, Joseph, 7, Brook Road, Gorton Hall Estate, near Manchester.
Hartley, Arthur, Cannon Brewery, Brighton.
Hartley, Prof. W. N., Royal College of Science, Dublin.
Harvey, Ernest W., 9, Main Street, Wislaw, N.B.
Harvey, H. C., Raglan House, Brooklands, near Manchester.
Harvey, J. C., Eccleston Hall, Prescott, Lancashire.
Harvey, J. G., Globe Chemical Works, Toronto, Canada.
Harvey, T. H., Cattedown, Plymouth.
Hasenclever, R., Chemische Fabrik-Rhenania, Aachen, Prussia.
Hastings, Hugh, 13, Neal Street, Bradford, Yorks.
Hastings, H. M., 54, Edith Road, West Kensington, W.
Hatfield, Jno., Windsor Road, Newton Heath, Lancashire.
Hathaway, Nath., New Bedford, Mass., U.S.A.
Haton, Wm. P., 13, St. Quintin Avenue, North Kensington, W.
Hawkins, H., Eyeworth Lodge, Lyndhurst, Hants.
Hawliczek, Josef, 99, Ulet Road, Sefton Park, Liverpool.
Hazelhurst, C. W., Halton Grange, Runcorn.
Head, John, 12, Queen Anne's Gate, Westminster, S.W.
Healey, A. E., Willesden Junction, London, N.W.
Heap, Chas., Caldershaw, near Rochdale.
Heap, L., Stacksteads, near Manchester.
Heath, R. C., Myton Grange, near Warwick.
Heaton, Prof. C. W., Charing Cross Hospital, London, W.C.
Heaton, John, 744, Rochdale Road, Manchester.
Hecht, Jos., University of Pennsylvania, Philadelphia, Pa., U.S.
Heckmann, C., 9, Görlitzerufer, Berlin, S.O., Germany.
Hedley, Armorer, Mayfield, Gosforth, Newcastle-on-Tyne.
Heerlein, Robert, Pennsylvania Salt Manufacturing Co., Natrona, Pa., U.S.A.
Hehner, O., 11, Billiter Square, London, E.C.
Heisch, C., 79, Mark Lane, London, E.C.
Helliell, E. A., 111, Westbourne Avenue, Hull.
Helson, Dr. R., 47, New Lowther Street, Whitehaven.
Hehn, H. J., 13, St. George's Villas, Perry Hill, Catford, S.E.
Hemingway, H., 60, Mark Lane, London, E.C.
Hempleman, F. S., Wennington House, Wennington, Romford, Essex.
Henderson, G. G., Chemical Laboratory, The University, Glasgow.
Henderson, W. F., Moorfield, Claremont Gardens, Newcastle-on-Tyne.
Henshaw, Jno., Brook Street Soap Works, Manchester.
Henning, E. C., Bow Brewery, Bow, E.
Herf, O., Main and Walnut Street, St. Louis, Mo., U.S.A.
Heriot, Wm. Scott, Ph. Leonora, Demerara.
Herman, W. D., West Park, St. Helens.
Herrmann, K. W. (Herrmann, Keller & Co.), 102, Fenchurch Street, London, E.C.
Heron, J., e/o Garton, Hill & Co., Southampton Wharf, Battersea, S.W.
Herroun, E. F., General Steam Navigation Company's Works, Deptford, London, S.E.
Herschel, Prof. A. S., Observatory House, Slough, Bucks.
Heslop, Jos., Jarrow Chemical Works, South Shields.
Hess, Dr. Adolph, Oil Works, Leeds.
Hewitt, Dr. D. B., Wymington House, Northwich, Cheshire.
Heycock, C. T., King's College, Cambridge.
Heyden, Dr. F. von, Chemische Fabrik, Radebeul, bei Dresden, Germany.
Heys, W. E., 70, Market Street, Manchester.
Heys, Z. J., Stonehouse, Barrhead, N.B.
Heys, Z. G., Springhill Villa, Barrhead, near Glasgow.
Heywood, G., Spring Vale Works, Middleton, Lancashire.
Heywood, J. G., 68, Sutherland Avenue, Maida Vale, London, W.
Heywood, J. H., 23, Holland Street, Rochdale.
Heywood, J. S., 7, Caledonian Road, King's Cross, London, N.
Hilbert, W., 8, St. Dunstan's Road, Margravine Gardens, West Kensington, S.W.
Higgin, A. J.
Higgin, W. H., Hall Chemical Works, Little Lever, near Bolton.
Higginbottom, E., Oakfield House, Barrow, Whalley, near Blackburn.
Higgins, C. L., e/o J. Muspratt & Co., Widnes; and 29, Falkner Square, Liverpool.
Hignett, S. C., 66, Whitechapel, Liverpool.
Hilditch, T., Cedar Grove, Heaton Chapel, near Manchester.
Hill, Dr. A. Bostock, 14, Temple Street, Birmingham.
Hill, J. K., Waterside, Irvine, N.B.
Hills, C. H., Anglessea Copper Works, Low Walker, Newcastle-on-Tyne.
Hills, H., Chemical Works, Deptford, London, S.E.
Hills, M. H., Tower Varnish Works, Long Acre, Nechells, Birmingham.
Hills, W., 225, Oxford Street, London, W.
Hills, W. A., Great Barr, near Birmingham.
Hindle, J. H., 67, Avenue Parade, Acerrington.
Hinds, James, 127, Gosford Street, Coventry.
Hislop, L., Saltney, Cheshire.
Hodges, J. F., Derryvolzie, Windsor, Belfast, Ireland.
Hodgkins, J., 12, Dynevor Road, Richmond, Surrey.
Hodgkinson, J. H., Messrs. E. Potter & Co., Dinting Vale, Glossop.
Hodgkinson, Dr. W. R., 75, Vanbrugh Park, Blackheath, S.E. (Journals); and Royal Military Academy, Woolwich, S.E.
Hodgson, C., High House, Eppleby, Darlington.
Hoegger, A., Windsor Villa, Victoria Crescent, Eccles, Manchester.
Hofmann, Dr. A. W., 10, Doratheen Strasse, Berlin, Germany; and e/o C. Hofmann, 20, Oxford Mansions, W.
Hogben, W., e/o Monville Philbrolithoid Co., Limited, Monville, Seine Inférieure, France.
Hogg, Lt.-Col. Sir James, Bart., M.P., see Magheramorne, Rt. Hon. Lord.
Hogg, Quintin, 23, Rood Lane, London, E.C.
Hogg, T. W., e/o John Spencer & Sons, Newburn Steelworks, Newcastle-on-Tyne.
Hohenhausen, J. von, Yew Tree Chemical Works, 303, Collyhurst Road, Manchester.
Holden, G. H., Langley Place, Victoria Park, Manchester.
Holdie, A. H., Wigan Coal & Iron Co., Ltd., Wigan.
Holgate, S. V., 29, Long Row, Nottingham.
Holgate, T. E., 146, Blackburn Road, Darwen, Lancashire.
Holgate, T., 12, Hyde Park Road, Halifax.
Holland, Philip, 3, Leicester Street, Southport.
Holliday, R. (Read, Holliday & Sons), Huddersfield.
Holliday, T., Southgate House, Pontefract, Yorkshire.
Holloway, Wm., Newlands, Middlesbrough.
Holmes, Ellwood, Wellburn, Jesmond, Newcastle-on-Tyne.
Holmes, F. G., Prince Regent's Wharf, Victoria Docks, E.
Holmes, J., 96, Holland Road, Brixton, London, S.W.
Holmes, Joseph, Crown Chemical Works, Leeds.
Holt, G. Crompton, e/o Hugh Hughes, 4, York Buildings, Sweeting Street, Liverpool.

- Holt, J. W., North Road, Clayton, near Manchester.
 Hood, R. W., 46, Sandwell Road, West Bromwich.
 Hooper, E. G., The Laboratory, Somerset House, London, W.C.
 Hooper, Henry A., High Laboratory, Newcastle Chemical Co., Gateshead-on-Tyne.
 Hooten, Edm., The Vinery, Burton Joyce, Notts.
 Hope, Jas., The Nickel Co., Kirkintilloch, N.B.
 Hopkin, W. K., 125, Sutherland Avenue, Maida Vale, W.
 Hori, Etsenjo, Universität Chemisches Laboratorium, Arcis Strasse, München, Bavaria.
 Horn, Wm., City Analyst's Laboratory, 156, Bath Street, Glasgow.
 Horn, W. Freeman, Grove Works, Lombard Road, Battersea, S.W.
 Horner, G. F., Old Basford, Nottingham.
 Horrocks, S., 28, Duke Street, Southport, Lancashire.
 Hough, Oliver, 325, South 16th Street, Philadelphia, Pa., U.S.
 Houston, Robt. S., Hope Villa, Bellahouston, Glasgow.
 Howard, A. G., The Green, Tottenham, London, N.
 Howard, D., Rectory Manor, Walthamstow, Essex.
 Howard, D. L., City Mills, Stratford, London, E.
 Howard, W. D., City Mills, Stratford, London, E.
 Howard, W. Crewdson, Messrs. Howard & Sons, Stratford, London, E.
 Howarth, R. H., Fergustie Thread Works, Paisley.
 Howarth, R. S., 21, Bellott Street, Cheetham, Manchester.
 Howorth, Franklin W., Lyme Grove, Church Road, Urms-ton, near Manchester.
 Hoyle, T. E., Church Terrace, Blackley, near Manchester.
 Hudson, F. V. M., Albany Aniline Co. (Box 35), Albany, N.Y., U.S.A.
 Hughes, E. J., Church Street, Flint.
 Hughes, J., 79, Mark Lane, London, E.C.
 Hughes, R., Church Street, Flint.
 Hughes, T., Public Analyst's Laboratory, West Wharf, Cardiff.
 Hulme, J., Mount House, Hollingworth, Hadfield, near Manchester.
 Hume, William, 88, Thirlestane Road, Edinburgh.
 Humfrey, C., The Villas, Parkgate, Cheshire.
 Hummel, J. J., 7, Moorfield Villas, Woodsley Road, Leeds.
 Humphrys, N. H., Gas-works, Salisbury, Wilts.
 Humphrys, F. C., Gasworks, Ilkeston, Nottingham.
 Humphries, Jacob, Apothecaries' Hall, Low Moor, near Bradford.
 Hunt, B., Victoria Chambers, South Parade, Leeds.
 Hunt, C., Gasworks, Windsor Street, Birmingham.
 Hunt, E., Wood Green, Wednesbury, Staffordshire.
 Hunt, W., Wood Green, Wednesbury, Staffordshire.
 Hunt, J. S., Appleton, Widnes.
 Hunter, F. W., Newbottle, Fence Houses, co. Durham.
 Hunter, John, Minto House Medical School, Edinburgh.
 Hunter, T. G., Wayne, Del. Co., Pa., U.S.A.
 Huntington, Prof. A. K., King's College, Strand, London, W.C.
 Hunzinger, Alfred, c/o E. Potter & Co., Dinting Vale, Glossop, Derbyshire.
 Horman, F. K., Ryton-on-Tyne.
 Hurst, G. H., 22, Blackfriars Street, Salford, Manchester.
 Hurter, Dr. F., Messrs. Gaskell, Deacon & Co., Widnes.
 Huskisson, P. L., 77, Swinton Street, London, W.C.
 Husband, J. Cecil, Knowsley Street (and 21, Heywood Street), Cheetham, Manchester.
 Huson, C. W., 5, York Buildings, Dale Street, Liverpool.
 Hutcheson, J. B., The University, Glasgow.
 Hutchinson, A. H., 5, Derwent Grove, East Dulwich, S.E.
 Hutchinson, C. C., Engineering Works, Carpenter's Road, Stratford, E.
 Hutchinson, Chas. H., Albert Works, Church Street, Barnsley, Yorkshire.
 Hutchinson, T. J., Vicarage View, Tottington Road, Elton, near Bury.
 Huxley, J. H., 40, Brincliffe Edge Road, Sheffield.
- I
 Ikuta, Dr. M., 39, Honmuracho, Yotsuya, Tokyo, Japan.
 Imray, Harold, The Grange, Underhill, near Barnet.
 Ingham, J. W., 11, New Gravel Lane, Shadwell, E.
 Inglis, R. A., Arden, Bothwell, N.B.
 Iriye, Koremasa, c/o Widnes Alkali Co., Limited, Widnes.
 Irvine, R., Royston, Granton, Edinburgh.
 Irvine, G. H., Cloncurry Copper & Smelting Co., Queens-land, Australia.
 Irving, J. M., 17A, Dickinson Street, Cooper Street, Man-chester.
 Irwin, W., The Grange, Polygon Road, Higher Crumpsall.
 Isaac, T. W. Player, Freshford Manor, Freshford, near Bath.
 Isler, Otto, 23, Cooper Street, Manchester.
 Ivey, W. E., School of Agriculture, Lincoln, Canterbury, New Zealand.
- J
 Jackson, A. G., c/o Mr. Hart, Stockwell, Paramatta, Sydney, New South Wales.
 Jackson, Edward, Ashleigh, Beaufort Road, Edgbaston, Birmingham.
 Jackson, Edgar, 106, Queen Victoria Street, London, E.C.
 Jackson, F., Spring Bank, Crumpsall Lane, Manchester.
 Jackson, G. B., Cophthorne House, Congleton, Cheshire.
 Jackson, John, 260, Dobbie's Loan, Glasgow.
 Jackson, Jos., Ash Bank, Rudheath, Northwich, Cheshire.
 Jackson, R. V., 3, Park Terrace, Queen's Drive, Crosshill, Glasgow.
 Jackson, T., Clayton, near Manchester.
 Jackson, Walter, 24, Sydenham Avenue, Sefton Park, Liverpool.
 Jackson, W. P., Saxilby, near Lincoln.
 Jacques, G., 101, St. Sépulchre Street, Doncaster.
 Jago, Wm., Science Schools, Brighton.
 James, E. T., British Alizarin Co., Ltd., Silvertown, Vic-toria Docks, E.
 James, J. H.,
 James, Dr. J. Wm., Aylmer House, Weston-super-Mare.
 Japp, Dr. F. R., 27, Woodstock Road, Bedford Park, Chiswick, W.
 Jarmain, George, 9, York Place, Huddersfield.
 Jarmay, G., Winnington Park, Northwich.
 Jarves, Denning, Michigan Carbon Works, Detroit, Mich., U.S.A.
 Jayne, Dr. H. W., Chem. Lab., Bermuda Street, Frankford, Philadelphia, U.S.A.
 Jekyll, H. H., 7, Carholme Road, Lincoln.
 Jekyll, J., Castle Moat House, Lincoln.
 Jenner, E., Florence Villa, Murehison Road, Leyton, Essex.
 Jenkins, F. C.,
 Jenkins, Thos., Laboratory, Rio Tinto Copper Works, Cwmavon, Port Talbot, Glamorganshire.
 Jessop, W. S., Healey, Ossett, near Wakefield.
 Johnson, A. E., 19, Victoria Street, Wolverhampton.
 Johnson, Frank, Minas de Rio Tinto, Huerva, Spain.
 Johnson, Geo., Grange Metal Works, Jarrow-on-Tyne.
 Johnson, Jno., Franklin Square and Cherry Street, New York, U.S.A.
 Johnson, J. E., 40, Idmiston Road, Stratford, London, E.
 Johnson, J. Grove, 23, Cross Street, Finsbury, London, E.C.
 Johnson, J. H., 47, Lincoln's Inn Fields, London, W.C.
 Johnson, S. H., West Ham Hall, Forest Gate, Essex.
 Johnson, T. A., Winnington Park, Northwich, Cheshire.
 Johnston, W. G., Chemical Works, Catbridge Street, Port Dundas, Glasgow.
 Johnston, W. G., Stevens' Institute of Technology, Hobo-ken, N.J., U.S.A.
 Johnstone, Jas., Shawfield Works, Rutherglen, Glasgow.
 Johnstone, L., Newbattle Collieries, Dalkeith, N.B.
 Johnstone, Dr. W., City Central Laboratory, 13, Fish Street Hill, London, E.C.

Jones, A. Frederick, c/o Campbell, Outram, & Co., Oficina Agua Santa, Iquique, Chili.
 Jones, A. F., South Arthurlie, Barrhead, Glasgow.
 Jones, E. W. T., 10, Victoria Street, Wolverhampton.
 Jones, E. Fielding, Dalmonach, Bonhill, Dumbartonshire, N.B.
 Jones, F., Chemical Laboratory, Grammar School, Manchester.
 Jones, H. Chapman, Royal Normal School of Science, South Kensington, London, S.W.
 Jones, John Arthur, Gijon, Spain.
 Jones, J. W., Basford House, Seymour Grove, Whalley Range, Manchester.
 Jones, T. Tolley, 31, Little Collins Street East, Melbourne, Victoria.
 Jones, Wm., Hurst Mills, King's Norton, near Birmingham.
 Jones, W. Norris, Runcorn Soap and Alkali Co., Weston, near Runcorn.
 Joffet, Cavalier H., Roselle, Union Co., N.J., U.S.A.
 Jowett, W., Lower Hall, Mellor, near Stockport.
 Joy, Douglas G., c/o Wm. Joy & Sons, Hull.
 Joynson, F., c/o The Aluminium Co., Limited, Oldbury, near Birmingham.
 Julien, Alfred, Cours Julien 2A, Marseilles, France.
 Justice, P. M., 14, Southampton Buildings, Chancery Lane, London, W.C.

K

Kalle, Dr. Wm., Biebrich-am-Rhein, Germany.
 Kater, R. McCulloch, Nobel's Explosives Co., Stevenston, Ayrshire, N.B.
 Kates, Clarence S., 1937, Spring Garden Street, Philadelphia, Pa., U.S.
 Kawakita, Michitada, Imperial College of Engineering, Tokyo, Japan.
 Kay, H. A., 13, Maida Vale, London, W.
 Kay, W. E., c/o W. Crum and Co., Thornliebank, Glasgow.
 Kean, J., Acca House, Grant Street, Jarrow-on-Tyne.
 Kearns, H. W., Baxenden, near Acreington.
 Keiser, E. H., Bryn Mawr College, Bryn Mawr, Pa., U.S.A.
 Keller, Dr. Wm., 13, Clarendon Villas, Old Charlton, S.E.
 Kemp, W. J., 17, Rue des Fontaines, Dieppe, France.
 Kennedy, William, 28, Royal Exchange Square, Glasgow.
 Kent, Wm. H., Chammoit, Wokingham Road, Reading, Berks.
 Kent, Wm. J., c/o Tremere, Cumings, and Co., Johannesburg, South African Republic.
 Kenyon, R., Printworks, Handforth, near Manchester.
 Ker, Alan D., Millburn Chemical Works, Garngad Hill, Glasgow.
 Kerr, J., Church, near Acreington.
 Kerry, W. H., Laboratory, 14, Castle Street, Liverpool.
 Kershaw, J., Grease, Varnish, and Cement Works, Hollinwood, near Oldham.
 Kershaw, J. B. C., Sutton Lodge Chemical Works, St. Helens.
 Keys, Jno. G., 9, High Street, West Bromwich.
 Kiddie, Thos., San Pedro Mines, Golden, New Mexico, U.S.
 Kilpatrick, W. S., 4, Annfield Place, Glasgow.
 Kinch, E., Royal Agricultural College, Cirencester.
 King, A. J., Ingersley Vale Bleachworks, Bollington, Macclesfield.
 King, C. M., Elm Tree Lodge, East Finchley, N.
 King, C. M., Campsie Alum Works, Lennoxton, N.B.
 King, Sir James, Bart., 12, Claremont Terrace, Glasgow.
 King, J. Falconer, Russell Place, Edinburgh, N.B.
 King, J. T., Clayton Square, Liverpool.
 King, Robt., 115, Wellington Street, Glasgow.
 King, Walter, Tamworth House, Mitcham, Surrey.
 Kingdon, J. C., c/o Burt, Boulton, and Heywood, Selzaete, Belgium.
 Kingsford, T. P., Oswego, New York, U.S.A.
 Kingzett, C. T., Trevena, Amhurst Park, London, N.
 Kipp, F. W., 1, New London Street, London, E.C.
 Kipping, Dr. F. Stanley, 14, Graham Street, Edinburgh.
 Kirkham, Thos., 22, Leinster Gardens, Runcorn, Cheshire.
 Kirkman, R., Landore Alkali Works, Swansea.

Kirkpatrick, A. J., 179, West George Street, Glasgow.
 Kitamura, Y., c/o Mr. Goto, 4, Chitose Cho, Honyo, Tokyo, Japan.
 Kitchen, Theo., Messrs. J. Kitchen & Sons, 28, Flinders Lane North, Melbourne, Australia.
 Kitto, B., 26, Lancaster Road, Finsbury Park, London, N.
 Kleemann, Dr. S., Villa Hazelwood, Crumpsall Green, near Manchester.
 Klipstein, A., 52, Cedar Street, New York, U.S.A. (P.O. Box 2833).
 Knight, A. H., 18, Chapel Street, Liverpool.
 Knight, Henry, 33, Faraday Street, Breck Road, Liverpool.
 Knight, J. B., Silvertown Soapworks, Silvertown, London, E.
 Knight, J. J., Chemical Works, Queenborough, Kent.
 Knights, J., West County Laboratory, Cambridge.
 Knipfer, F., c/o R. Harper and Co., Melbourne, Victoria.
 Knowles, Jno., Runcorn Soap and Alkali Co., Runcorn, Cheshire.
 Knowles, Joshua, Stormer Hill, Tottington, near Bury.
 Knowles, Samuel, Stormer Lodge, Crumpsall, Manchester.
 Knox, E. W., Colonial Sugar Refining Co., Sydney, N.S.W.; and c/o F. Parbury & Co., 7, East India Avenue, Leadenhall Street, London, E.C.
 Koechlin, Horace, Loerrach, Duché de Bade, Germany.
 Koenig, Prof. G. A., University of Pennsylvania, Philadelphia, Pa., U.S.A.
 Kohn, Dr. Chas. A., University College, Brownlow Street, Liverpool.
 Kolb, J., Soc. Anon. des Manuf. de Produits Chimiques, Lille, France.
 Kraftmeier, E., 6, Great Winchester Street, London, E.C.
 Krause, Dr. G., "Chemiker-Zeitung," Cöthen, Germany.
 Krause, O. H., Box 217, Jersey City, New Jersey, U.S.A.
 Krohn, F. W. T., 12, Brunswick Terrace, Newark-on-Trent.
 Kühl, W. H., 73, Jägerstrasse, Berlin, Germany.
 Kunheim, Dr. Hugo, 23, Lindenstrasse, Berlin.
 Kupferberg, Dr. H., 303, Collyhurst Road, Manchester.
 Kur, Emmanuel, 13, Bath Buildings, Huddersfield.
 Kynaston, J. W., Kensington, Liverpool.

L

Lacey, T. S., Lawn House, Beekton Gas-works, North Woolwich, London, E.
 Lagerwall, Dr. Ivar, 56, Rue de Joncker, Brussels.
 Landler, C. P., 26, Noble Terrace, Gateshead-on-Tyne.
 Laing, John, 38, Warrender Park Terrace, Edinburgh.
 Lake, D. E., 36, Mark Lane, London, E.C.
 Lake, G., jun., 4, Brighton Terrace, Cornbrook Park Road, Manchester.
 Lakeman, T., 178, Phillip Street, Sydney, New South Wales.
 Lamb, Chas., 60, Mark Lane, London, E.C.
 Lamond, H. B., Levenshulme Printworks, Manchester.
 Lane, D., 72, South Mall, Cork, Ireland.
 Landsberg, Dr. Ludwig, Josephsplatz 1, Nürnberg, Bavaria.
 Langbeck, H. W., The Park, Loughton, Essex.
 Larios, P., c/o Messrs. R. Marsden & Co., 47, Spring Gardens, Manchester.
 Larkin, T., St. Bede Chemical Works, South Shields.
 Larned, J. N., Young Men's Library, Buffalo, N.Y., U.S.A.
 Latham, Baldwin, 7, Westminster Chambers, Victoria Street London, S.W.
 Laurie, A. P., Chemical Laboratory, People's Palace, Mile End Road, London, E.
 Lawrance, H. A., Brockweir, Grosvenor Road, Gunnersbury.
 Lawrence, Jas., Standard Explosives Co., Toms River, New Jersey, U.S.A.
 Laws, J. P., 3, Tyfield Road, Oxford.
 Lawson, Wm., Bellshill, Lanarkshire.
 Lawson, Arthur J., Marsh Soapworks, Bristol.
 Lawson, Dr. Thos. A., 15, Alexandra Road, London, N.W.
 Lazarns, M. J., Ashburn House, Victoria Park, Manchester.
 Leach, Walter, Stephenson's Buildings, Sunbridge Road, Bradford, Yorks.
 Leathart, J., Lead Works, Newcastle-on-Tyne.
 Leather, Dr. J. W., Royal Agricultural Society of England, 12, Hanover Square, London, W.

- Lee, C. Tennant, 45, Kilby Street, Boston, Mass., U.S.A.
 Lee, S. Wright, 6-10, Whitechapel, Liverpool.
 Lee, J. E., Wallsend, Newcastle-on-Tyne.
 Lee, H. C., 14, Gray's Inn, London, W.C.
 Leech, F. S., c/o B. G. Lennon & Co., Cape Town, South Africa.
 Leeds, F. H., 29, Bonverie Road, Stoke Newington, N.
 Leeming, T. H., Burneston House, Barking Road, Plaistow, London, E.
 Lees, Asa, 76, Duncombe Road, Upper Holloway, N.
 Lees, S., jun., 4, Carlingford Road, Hampstead, N.W. (for Journals); and Park Bridge, Ashton-under-Lyne.
 Leese, Joseph, c/o Messrs. S. and E. Leese, Fylde Road Mill, Preston; and (Journals) Palace Hotel, Birkdale, Southport.
 Leete, Jos., 71 and 73, Tooley Street, London Bridge, S.E.
 Leffmann, Dr. H., 715, Walnut Street (Third floor front) Philadelphia, Pa., U.S.A.
 Leigh, Cecil, Seaham Chemical Works, Seaham Harbour, co. Durham.
 Leith, J., Lancashire Alkali Co., Ltd., Widnes.
 Lennard, F., 165, Fenchurch Street, London, E.C.
 Lennox, Robt. N., Royal Institution, Albemarle Street, London, W.
 Leonard, Wm. J., Hope Chemical Works, Hackney Wick, E.
 Leon, J. T., 38, Portland Place, London, W.
 Lequin, E., 9, Rue Ste. Océile, Paris.
 Leverkus, Otto, 1 and 3, Leamington Place, Princess Street, Manchester.
 Levinstein, Ivan, 21, Minshull Street, Manchester.
 Lewes, Prof. Vivian B., Royal Naval College, Greenwich, S.E.
 Lewinton, B., 14, Cleveland Street, Fitzroy Square, London, S.W.
 Lewis, J. H., c/o Muspratt and Sons, Widnes.
 Lewis, G. T., 231, South Front Street, Philadelphia, Pa., U.S.A.
 Lichtenstein, Theodore, Chemical Works, Silvertown, London, E.
 Liddle, W. T.,
 Liebermann, L., 54, Portland Street, Manchester.
 Liebmann, Dr. A., 10, Marsden Street, Manchester.
 Liepmann, Dr. H., The Liepmann Carbon Co., Limited, Nelson Wharf, Millwall, London, E.
 Lightfoot, T. E., 3, Church Terrace, Acerrington.
 Lilley, H. L., Albert Works, Queen's Road, Manchester.
 Lilly, Oliver M., The Croft, Spondon, Derby.
 Limpach, Dr. L., 20, St. Mary's Road, Crumpsall, Manchester.
 Lindley, L., Sherwood Street, Nottingham.
 Lineff, A. L., West Metropolitan Tram Depot, High Road, Chiswick, W.
 Lishman, W. W. L., 36, Washington Street, Girlington, Bradford, Yorks.
 Lister, Simeon, 70, High Street, Great Horton, Bradford, Yorks.
 Littlejohn, J., 53, Renfield Street, Glasgow.
 Liversedge, A. J., c/o Watson, Laidlaw & Co., Kingston, Glasgow.
 Liversidge, Prof. A., The University, Sydney, New South Wales; and c/o Trubner & Co., 57, Ludgate Hill, London (for Journals).
 Livesey, Frank, South Metropolitan Gas Co., 709A, Old Kent Road, London, S.E.
 Livingston, W. J., Metropolitan Board of Works, Spring Gardens, London, S.W.
 Lloyd, Fred. J., Agricultural Laboratory, 4, Lombard Court, London, E.C.
 Lloyd, Jas. D., jun., Sandwich, Mass., U.S.A.
 Lodge, A. S., Spring Side, Prestwich, near Manchester.
 Lodge, Edw., 35, Cowcliffe Hill, Huddersfield.
 Lomas, T., Seaham Chemical Works, Seaham Harbour, co. Durham.
 Lombard, Emile, 32, Rue Grignan, Marseilles, France.
 Longshaw, Jas., Willow Bank, Longsight, near Manchester.
 Longstaff, Dr. G. D., Butterknowle, Southfields, Wandsworth, S.W.
 Lorenz, H., 7 and 8, Idol Lane, London, E.C.
 Lorimer, J., Britannia Row, Islington, N.
 Lorrain, J. G., Norfolk House, Norfolk Street, Strand, London, W.C.
 Lott, F. E., The Laboratory, Bridge Chambers, Burton-on-Trent.
 Louis, D. A., 77, Shirland Gardens, London, W.
 Love, E. G., School of Mines, Columbia College, 50th Street, New York, U.S.A.
 Lovett, W. Jesse, Jessamine Cottage, Thornes, near Wakefield.
 Lovibond, J. W., 26, St. Ann's Street, Salisbury.
 Lovibond, T. W., Tyne Brewery, Newcastle-on-Tyne.
 Lovibond, V. L., The Hermitage, North End, Fulham, S.W.
 Low, Wilson H., c/o N. K. Fairbank & Co., 18th and Blackwell Streets, Chicago, Ill., U.S.A.
 Lowe, C. W., Summerfield House, Reddish, near Stockport.
 Lowe, Horace A., Holly Bank, Heaton Moor, near Stockport.
 Lowe, W. F., Cambrian View, Chester.
 Lowson, J. G. F., St. Leonard's Mill, Lasswade, Midlothian, N.B.
 Lucas, R. J., 4, Dyne Road, Kilburn, N.W.
 Luck, A., Powder Mills, Dartford, Kent.
 Luck, E., 70, Stamford Street, Blackfriars Road, London, S.E.
 Luck, H. C., 70, Stamford Street, Blackfriars Road, London, S.E.
 Lund, Jas., c/o Cochrane Chemical Co., Potter Street, East Cambridge, Mass., U.S.A.
 Lundberg, Alf., Northfleet Paper Mill, Northfleet, Kent.
 Lundholm, Carl O., Ardeer Factory, Stevenston, Ayrshire.
 Lunge, Dr. G., Englisches Viertel, Hottingen, Zürich, Switzerland.
 Lunn, C., Fenay Bridge, near Huddersfield.
 Lupton, Sydney, The Harehills, near Leeds.
 Lüthy, Otto, 2336, Fairmount Avenue, Philadelphia, Pa., U.S.A.
 Lye, W. T., The Firs, Luton, Beds.
 Lyle, James, Plaistow Wharf, North Woolwich Road, London, E.
 Lyle, Jno., 37, Mining Lane, London, E.C.
 Lyon, J. G., The Aire Tar Works, Knottingley, Yorks.
 Lyte, F. Maxwell, 60, Finborough Road, Redcliffe Square, London, S.W.
 Lytle, A. M., North of Ireland Chemical Co., Belfast.

M

- Mabery, Prof. Chas. F., Case School of Applied Science, Cleveland, Ohio, U.S.A.
 Macadam, C. T., 116, Fenchurch Street, London, E.C.
 Macadam, Dr. Stevenson, Surgeons' Hall, Edinburgh.
 Macadam, Prof. W. Ivison, Surgeons' Hall, Edinburgh.
 McAlister, R., Lawes' Chemical Manure Co., Limited, Barking Creek, Essex.
 McAllum, C. D., 7, Dean Street, Newcastle-on-Tyne.
 Macalpine, G. W., Parkside, Acerrington.
 McArthur, Jno., 3, Nicotia Road, Wandsworth Common, S.W.
 McArthur, J. B., Price's Patent Candle Co., Limited, Bromborough Pool, near Birkenhead.
 Macarthur, J. G., 260, Dobbie's Loan, Glasgow.
 McArthur, J. S., Cassel Gold Extracting Co., Limited, 13, West Scotland Street, Kinning Park, Glasgow.
 McBeath, J. W., 38, Exeter Street, West Hartlepool, Durham.
 McCallum, J. M., South Park, Paisley, N.B.
 McCalman, D., 50, Loudon Street, Irvine, N.B.
 McCowan, W., 3, Duncan Street, Cannon Street, Glasgow.
 McCubbin, Wm. A., The Elms, West Derby, Liverpool.
 McCulloch, J., 2, Tyne View Terrace, Hebburn-on-Tyne.
 McDaniel, J. J., Bandon, Ireland.
 Macdonald, A., 16, Cochrane Street, Glasgow.
 Macdonald, J. W., c/o Messrs. H. Tate & Sons, Love Lane, Liverpool.
 McDonald, Percy C., Eveleen Silver Mine, Port Darwin, Australia.

- McDonald, T. M., Walilabo Estate, St. Vincent, West Indies.
 McDougall, Arthur, Clifton Lodge, Gore Street, Greenheys, Manchester.
 McEwen, Jas., 11, Rushton Street, Hulme, Manchester.
 McEwen, T. G., 53, New Road, Commercial Road, London, E.
 Macfarlane, J. A., Hacienda de San Pascual, El Chico, Hidalgo, Mexico.
 Macfarlane, J. F., 139, Greenhead Street, Glasgow.
 Macfarlane, R. F., Grange Metal Works, Jarrow-on-Tyne.
 Macfarlane, Thos., Inland Revenue Dept., Ottawa, Canada.
 Macfarlane, Walter, Crosslee House, Thornliebank, near Glasgow.
 McGlashan, John, Woodneuk, Gartcosh, near Glasgow.
 McGowan, John, Ash House, Talke, near Stoke-upon-Trent.
 MacHwaite, A. W., Stoneferry, Hull.
 MacIndoe, G. D., Hall's House, North Woolwich Road, Victoria Docks, E.
 MacIntosh, C. J., 51, Leadenhall Street, London, E.C.
 MacKean, Wm., Incandescent Gas Light Co., Ltd., 3, Victoria Mansions, Westminster, S.W.
 McKeechie, D., Copper Works, St. Helens.
 McKeechie, D. M., Roche Lea, St. Anne's, St. Helens.
 McKellar, W. G., Eglinton Chemical Works, Irvine, N.B.
 McKenny, C., Drogheda Chemical Manure Co., Drogheda, Ireland.
 Mackenzie, Jas., 24, Shuttle Street, Glasgow.
 Mackenzie, T. E., Tharsis Mines, Huelva, Spain.
 Mackenzie, W. Cossar, 6, Hartington Gardens, Edinburgh.
 Mackey, J. A., 1 and 2, Bonverie Street, London, E.C.
 McKinlay, R. W., Amelaville, Aytoun Road, Pollokshields, N.B.
 Mackinlay, Wm., 121, Main Street, Alexandria, Dumbarton-shire.
 Mackinnon, A. K., 79, Drayton Gardens, London, S.W.
 MacLagan, R. C., 5, Coates Crescent, Edinburgh.
 MacLean, Alex. S., c/o Alex. Scott & Sons, Berry Yards, Greenock, N.B.
 McLellan, J. Y., Cullochfanks Chemical Works, Craig Street, Glasgow.
 MacLellan, Peter, Glasgow Rubber Works, Maryhill, Glasgow.
 McLeod, H., Cooper's Hill, Staines.
 MacMahon, J. H., Lancashire Alkali and Sulphur Co., Limited, Widnes.
 McMillan, T. O., Laboratory, Glengarnock Ironworks, Glengarnock, Ayr-shire.
 McMillan, W. G., Chemical Department, Shell Factory, Cossipore, Calcutta, India.
 Maenab, C., Lillyburn, Milton of Campsie, N.B.
 Maenab, W., jun., 6, East India Avenue, London, E.C.
 Maenair, D. S., Chemical Laboratory, University of Wurzburg, Bavaria.
 McRoberts, G., Nobel's Explosives Co., Stevenston, Ayr-shire, N.B.
 Maclart, J., 2, Victoria Mansions, Westminster, S.W.
 Magheramorne, Rt. Hon. Lord, 17, Grosvenor Gardens, London, S.W.
 Mahon, R. W., 110, Arch Street, Camden, New Jersey, U.S.A.
 Maiden, J. H., Technological Museum, Sydney, New South Wales; Journals to c/o Trübner & Co., Ludgate Hill, London, E.C.
 Maignen, P. A., 32, St. Mary at Hill, London, E.C.
 Main, Robt., Ardeer Ironworks, Stevenston, Ayrshire, N.B.
 Major, J. C., The Bhylls, Compton, Wolverhampton.
 Major, L., Sculcoates, Hull.
 Makin, James, Wallhead Mills, Rochdale.
 Makins, G. H., Dancesfield, Upper Latimore Road, St. Albans.
 Malcolm, S., Jarrow Chemical Works, South Shields.
 Malcolmson, A. S., 172, Pearl Street, New York, U.S.A.
 Mallinckrodt, Edw., Mallinckrodt Chemical Works, St. Louis, Missouri, U.S.A.
 Manby, Eardley B., Lightbourns, Halliwell, Bolton-le-Moors.
 Mander, S. T., 17, Gracechurch Street, London, E.C.; and (Journals) Varnish Works, Wolverhampton.
 Manlove, E. Alick, 3, Holtham Road, London, N.W.
 Manning, F. A., 18, Billiter Street, London, E.C.
 Mannington, H. T., Pontre, near Flint, North Wales.
 Mansfield, Harvey M., Fairfield, Somerset co., Maine, U.S.A.
 Markel, Dr. K., c/o Brunner, Mond & Co., Wilmington, Northwich.
 Markham, A.D., 5, Denman Street, London Bridge, S.E.
 Marks, E. G., c/o W. S. Brown & Co., Bank Street and North River, New York, U.S.A.
 Marley, J. E., Hebburn-on-Tyne.
 Marriott, Wm., 88, Halifax Old Road, Huddersfield.
 Marsh, W., Union Alkali Co., Soho Works, Manchester.
 Marsh, J. T., British Alkali Works, Widnes.
 Marsh, T. S., Netham Chemical Co., Bristol.
 Marsh, Walter, 83, York Terrace, Northam, Southampton.
 Marshall, T. R., 4, East Castle Road, Merchiston, Edinburgh.
 Marshall, Wm., 7, Walter Street, Nottingham.
 Marshall, Wm., The Baths, St. Andrews, N.B.
 Martin, H., Poole, near Wellington, Somerset.
 Martin, N. H., 29, Moseley Street, Newcastle-on-Tyne.
 Martin, W. H., 183, King's Road, Chelsea, London, S.W.
 Martineau, Sydney, South Road, Clapham Park, S.W.
 Martins, Dr. C. A., 28, Vosse Strasse, Berlin, Germany.
 Martyn, S. E., Trevemper Bridge, New Quay, Cornwall.
 Martyn, W., c/o Messrs. Tennant, Hebburn-on-Tyne.
 Mason, J., Eynsham Hall, Witney, Oxon.
 Mason, J. Francis, Eynsham Hall, Witney, Oxon.
 Mason, W. B., 117, Derby Street, Bolton-le-Moors.
 Mason, A. H., 46, Jewin Street, London, E.C.
 Masson, Prof. D. Orme, University of Melbourne, Victoria, Australia.
 Master, Ardesheer B., 679, Tardeo, Bombay, India.
 Master, C. H., Friary Brewery Co., Guildford.
 Mather, J., Blaydon Chemical Works, Blaydon-on-Tyne.
 Mathieson, N., Widnes.
 Mátos, Louis J., 3913, Fairmount Avenue, Philadelphia, Pa., U.S.A.
 Matthews, C. G., Laboratory, Bridge Chambers, Burton-on-Trent.
 Matthews, W. E., Kerford Place, Albert Park, Melbourne, Victoria.
 Mayor, James, 134, St. Vincent Street, Glasgow.
 Maxwell, Thos., 49, Harvie Street, Bridgeton, Glasgow (Journals); and Mossknowe, Braeside Avenue, Rutherglen.
 May, J., Hyde House, Old Battersea, Surrey.
 Mayenfeld, Dr. E. von Salis, c/o Clayton Anilin Co., Ltd., Clayton, Manchester.
 Mayhew, E. W. A., High Street, Freemantle, Western Australia.
 Mead, Frank, Sutton Gasworks, Surrey.
 Mease, G. D., 23, Killieser Avenue, Telford Park, S.W.
 Meikle, Jno., 4, Woodlands Road, Glasgow.
 Meldola, Prof. R., 6, Brunswick Square, London, W.C.
 Melland, Wm., c/o G. H. Midwood and Co., Bridge Street, Ardwick, Manchester.
 Melliss, J. C., 232, Gresham House, Old Broad Street, London, E.C.
 Mellon, W. W., Howdendyke, Howden, Yorks.
 Mellor, S., Magnesium Metal Co., Patricroft, Manchester.
 Melville, D., North Woburn, Mass., U.S.A.
 Menzies, R. C., Inveresk Mills, Musselburgh, N.B.
 Menzies, W. J., Greenbank Alkali Works Co., Limited, St. Helens.
 Mercer, J. B., 322, Lower Broughton Road, Manchester.
 Mercer, F. M., 89, Bishopsgate Street, London, E.C.
 Mercer, Thos., The Brewery, Edenfield, near Bury, Lancashire.
 Merrell, Geo., Lock Box 786, Cincinnati, Ohio, U.S.A.
 Messel, Dr. R., Silvertown, London, E.
 Metcalf, Jno., Moorfield, Altham, near Accrington.
 Metcalf, W. M., Stanhill House, Oswaldtwistle, near Accrington.
 Mewburn, J. C., 55 and 56 Chancery Lane, London, W.C.
 Meynier, J. A., 19, Rue Baudin, Paris.
 Middleton, J., 179, West George Street, Glasgow.
 Miest, Emile, Sté Marie d'Oignies, par Taminies, Belgium.
 Miller, E. V., c/o New Zealand Sugar Co., Auckland, New Zealand.
 Miller, Dr. A. K., Ashfield Villa, Kirkintilloch, N.B.

- Miller, A. Russell, The Cairns, Cambuslang, near Glasgow.
 Miller, Geo., 22, Trentham Street, Runcorn.
 Miller, H. von, Chemische Fabrik, Hruschau, Austria.
 Miller, J. Hopkins, 23, McAslin Street, Glasgow.
 Miller, Jno. Poynter, Sandilands Chemical Works, Aberdeen.
 Miller, Dr. N. H. J., Harpenden, near St. Albans.
 Miller, Robt., 79, West Nile Street, Glasgow.
 Miller, W. M., Laboratory, Phn. Tuschen den Vrienden, Demerara, West Indies.
 Miller, T. Paterson, The Cairns, Cambuslang, near Glasgow.
 Mills, Prof. E. J., 60, John Street, Glasgow.
 Milne, G. A., Welham Villa, Norton, Malton, Yorks.
 Milne, Dr. J. M., Roy. Infirm. Medical School, 86, Castle Street, Glasgow.
 Milner, E., Hartford Manor, Northwich.
 Milnes, Edmund, Seedfield, Bury, Lancashire.
 Miniati, T., Kenwood, Broom Lane, Higher Broughton, Manchester.
 Mitchell, J. W., Holme Mill, Rawtenstall, Lancashire.
 Mitchell, S. W., Craigbank, Giffnock, near Thornliebank, N.B.
 Mitting, E. K., 326-363, North Water Street, Chicago, Ill., U.S.
 Mohr, Dr. B., 69A, Parliament Hill, Hampstead, N.W.
 Moir, R. M., Bankside, Christchurch Road, Hampstead, London, N.W.
 Molineux, J. C. B., Selsley House, Albert Road, Battersea, S.W.
 Mond, L., 20, Avenue Road, Regent's Park, London, N.W.
 Mook, Chas., Douglasshall, Westeregeln, Magdeburg, Germany.
 Moon, G. Ivens, 85, Gracechurch Street, London, E.C.
 Mooney, M., Chemical Works, 74, Rogerson's Quay, Dublin.
 Moore, B. T., Longwood, Bexley, Kent.
 Moore, Chas. C., 125, Chester Road, Hartford, Cheshire.
 Moore, G. E., 69, Liberty Street, New York, U.S.A.
 Moore, R. T., 134, St. Vincent Street, Glasgow.
 Moore, Wm. Bailey, Cauldon House, Shelton, Stoke-on-Trent.
 Moorhouse, J. B., Horton Bank, Bradford.
 Moretti, Giuseppe, Via Cerretani 8, Firenze, Italy.
 Morgan, Arthur F., 21, Rufford Street, Chorlton-on-Medlock, Manchester.
 Morgan, E. B., 318, Neehells Park Road, Birmingham.
 Morgan, Dr. Wm., Public Analyst's Laboratory, Nelson Terrace, Swansea.
 Morgans, Thos., The Guildhall, Bristol.
 Moritz, Dr. E. R., 72, Chancery Lane, London, W.C.
 Morley, Dr. H. Forster, University Hall, Gordon Square, London, W.C.
 Morice, Jas. A., 1, Athole Gardens Place, Kelvininside, Glasgow.
 Morris, Dr. G. Harris, Avondale, Alexandra Road, Burton-on-Trent.
 Morris, J. H., 61 and 65, Blundell Street, Liverpool.
 Morris, M. Ivor E., Ammanford, R.S.O., South Wales.
 Morris, R., Doncaster.
 Morrison, J., Pottery Lane, Forth Bank, Newcastle-on-Tyne.
 Morrison, Jno., P.O. Box 336, North Adams, Mass., U.S.A.
 Morson, T., 124, Southampton Row, Russell Square, London, W.C.
 Morson, T. P., 33, Southampton Row, Russell Square, London, W.C.
 Mosenthal, Chas. de, 58, Boulevard Pereire, Paris.
 Mosenthal, Henry de, 220, Winchester House, Old Broad Street, London, E.C.
 Moss, J., Hirdir Lodge, New Thornton Heath, Surrey; and Wilson Street, New Cross Road, London, S.E.
 Moul, Frank, Aldersgate Chemical Works, Southall.
 Moul, J., 3, Gladstone Terrace, Gateshead-on-Tyne.
 Muir, J. P., 233, Camden Road, London, N.W.
 Müller, Dr. H., 13, Park Square East, Regent's Park, London, N.W.
 Mumford, A., 9, Westwell Street, Plymouth, Devon.
 Mumford, T. W. B., 1, Glendale Villas, Sylvan Road, Wainstead, Essex.
 Munro, Dr. J. M. H., College of Agriculture, Downton, Salisbury.
 Munroe, Chas. E., Torpedo Station, Newport, Rhode Island, U.S.A.
 Muras, T. H., H.M. Patent Office, Southampton Buildings, London, W.C.
 Murdoch, H. R. M., 4, Nobel's Villas, Stevenston, Ayrshire.
 Murphy, John, Kingston House, Aigharth Road, Liverpool.
 Murray, H. S., Glenmayne, Galashiels, N.B.
 Murrie, Jas., 103, Bishop Street, Anderston, Glasgow.
 Muspratt, E. K., Seaforth Hall, near Liverpool.
 Muspratt, J. L., Kempton House, Rhyl, North Wales.
 Muspratt, S. K., 31, Dale Street, Liverpool.
 Muter, Dr. J., Winchester House, Kennington Road, London, S.E.
 Muter, James, Oil Mills, Dunneadaw, Rangoon, Burmah.
 Myall, A. A., 21, Cockspur Street, London, S.W.

N

- Naeef, P., Uetikon, Zürich, Switzerland.
 Nakamura, Teikichi, c/o Y. Fukuzawa, Mita-Nichome, Tokyo, Japan.
 Napier, J., 1, St. Matthew's Place, Norwich Road, Ipswich.
 Napier, Jas., jun., 10, Carment Drive, Shawlands, Glasgow.
 Nason, Prof. H. B., Troy, New York, U.S.A.
 Naylor, W. A. H., c/o Heaton, Squire, & Francis, 5, Coleman Street, London, E.C.
 Neil, Jas., North British Chemical Co., Clydebank, Glasgow.
 Neil, W., 126, Turner's Road, Burdett Road, London, E.
 Neild, A., Mayfield, Manchester.
 Neill, F. A. R., Bold Ironworks, St. Helens Junction, Lancashire.
 Neilson, James, 107, John Street, Glasgow.
 Neilson, Thos., Distington Hematite Iron Co., Ltd., near Whitehaven, Cumberland.
 Ness, T., Black Banks Chemical Works, Darlington.
 Nettlefold, E., 16, Broad Street, Birmingham.
 Nettlefold, E., 35, Minford Gardens, West Kensington, W.
 Newall, F. S., Washington, co. Durham.
 Newall, R. S., Ferndene, Gateshead-on-Tyne.
 Newbury, Prof. Spencer B., Cornell University, Ithaca, N.Y., U.S.A.
 Newlands, B. E. R., 27, Mincing Lane, London, E.C.
 Newlands, W. P. R., Rosa, N.W.P., India.
 Newman, G. J., jun., Laurel Bank, Wilmslow, Cheshire.
 Newton, A. H., Belsize Court, Hampstead, N.W.
 Newton, A. H., jun., 4, Croftdown Road, Highgate Road, N.W.
 Newton, Harry, 136, Buxton Road, Macclesfield.
 Newton, Jno., Park Green, Macclesfield.
 Newton, H. C., Belsize Court, Hampstead, N.W.
 Newton, Jno., Manor Works, Rotherhithe New Road, London, S.E.
 Nichols, J. A., Hurstfield, New Mills, near Stockport.
 Nichols, W. H., 41, Cedar Street, New York, U.S.A.
 Nicholson, E. C., Carlton House, Herne Hill, S.E.
 Nicholson, J. C., Chemical Works, Hunslet, Leeds.
 Nickels, B., jun., 150, Holborn, London, E.C.
 Nickolls, John B., States Analyst's Office, Trinity Square, Guernsey.
 Nicol, W. W. J., Mason College, Birmingham.
 Nicoll, G. B., c/o Burnard, Lack, & Alger, Plymouth, Devon.
 Nimmo, J., 2, Bath Villas, Portland Road, South Norwood, London, S.E.
 Nishigawa, T., 14, Go Bancho, Koji Machi, Tokyo, Japan.
 Nixon, J., 64, Elswick Road, Newcastle-on-Tyne.
 Nolting, Dr. E., Ecole de Chimie, Mulhouse, Alsace, Germany.
 Norman, F. J., Lyndhurst, Higher Runcorn, Cheshire.
 Norman, Wm., Mersey View, Runcorn (Journals); and Runcorn Soap and Alkali Co., Weston.
 Norrington, A. Reginald, Cattedown, Plymouth.
 Northing, J., 96, Tritonville Road, Sandymount, Dublin.
 Norton, Prof. Lewis M., Massachusetts Institute of Technology, Boston, U.S.A.
 Norton, Dr. S. A., 363, East Town Street, Columbus, Ohio, U.S.A.
 Norton, Dr. T. H., University of Cincinnati, Ohio, U.S.A.

O

- O'Beirne, W. G., North British Chem. Co., Clydebank, near Glasgow.
 Oddie, Jas., School of Mines, Ballarat, Australia (Journals); and (Subscription) Mercantile Bank, 39, Lombard Street, E.C.
 Oddie, Robt., 10, Molesworth Street, Rochdale.
 Odling, Dr. W., 15, Northam Gardens, Oxford; and 38, Lad-broke Grove Road, North Kensington, W.
 Oehler, K., Offenbach-am-Main, Germany.
 Ogata, Saburo, c/o T. Hirano, 11, Ginzi Shichome, Tokyo, Japan.
 Ogilvie, T. R., Mill Lane House, Plymouth, Devon.
 Ogden, J. M., Ellscope House, Sunderland.
 Ogston, G. H., Junior Athenæum Club, Piccadilly, London, W.
 Okubo, C. Bunsekika, Noshomusbo, Tokyo, Japan.
 Oliver, F., 70, Winchester Street, South Shields.
 Oliver, Wm. Letts, 1110, 12th Street, Oakland, Cal., U.S.
 Ollerenshaw, S., Sutton Alkali Works, St. Helens.
 Olsen, Olaus E., Sandøen, Berøen, Norway.
 O'Neill, C., Laboratory, 72, Denmark Road, Manchester.
 O'Neill, E. H., Johnson's Saccharum Co., Limited, Stratford, London, E.
 Orme, J., 65, Barbican, London, E.C.
 Orr, A., 1, Park Terrace, Irvine, N.B.
 Orr, J. B., Blantyre Lodge, Westcombe Park, London, S.E.
 Orr, Robert, 79, West Nile Street, Glasgow; and Falkirk, N.B.
 Osterstetzer, J., Balearras House, Serpentine Avenue, Ballsbridge, Dublin.
 O'Shea, L. T., Firth College, Sheffield.
 O'Sullivan, C., 140, High Street, Burton-on-Trent.
 O'Sullivan, J., 71, Spring Terrace, Barton-on-Trent.
 Overbeck, Baron Gustavus de, 23, Ryder Street, St. James', London, S.W.
 Owen, Thos., Thralehyrst, Cotham Park, Bristol.
 Oxland, Chas., Greystoke, Palace Park Road, Sydenham, S.E.
 Oxland, Robert, 32, Portland Square, Plymouth.

P

- Paekard, E., jun., Bramford, near Ipswich.
 Page, F. J. M., 98, Alderney Street, London, S.W.
 Pagés, Albert, 32, Boulevard Henri IV., Paris.
 Paine, S., 7, Exchange Street, Manchester.
 Palmer, I., Chalkley, 22, North Front Street, Philadelphia, U.S.A.
 Palmer, Thos. C., 98, Commercial Road East, London, E.
 Panario, Thos. C., 48, Octavia Street, Battersea, S.W.
 Pantou, J. A., The Manor House, Watford, Herts.
 Park, J., c/o Stevenson, Carlile & Co., Milburn Chemical Works, Garngad Hill, Glasgow.
 Parker, Chas. E., Vine House, Fenketh, Warrington.
 Parker, H., Woodhall Mill, Juniper Green, Midlothian, N.B.
 Parker, Thos., 6, Crawford Street, Wolverhampton.
 Parkinson, Dr. R., Sun Bridge Buildings, Bradford, Yorkshire.
 Parnell, E. W., Lancashire Sulphur and Alkali Works, Widnes.
 Pass, A. C., Rushmer House, Durdham Down, Clifton, Bristol.
 Paterson, Alex., c/o B. G. Lennon & Co., Cape Town, South Africa.
 Paterson, Jas. H. R., 10, Millerfield Place, Edinburgh.
 Paterson, John, Belle Isle Place, Workington, Cumberland.
 Paton, J. M. C., Messrs. Maclove, Allott, Fryer & Co., Nottingham.
 Paton, W. Grant, Greenbank Alkali Co., Limited, St. Helens, Lancashire.
 Pattberg, J. C. H., Valleyfield, Helensburgh, near Glasgow.
 Patterson, G., 85, Carleton Road, Tufnell Park, London, N.
 Patterson, T. L., Messrs. J. Walker & Co., sugar refiners, Greenock, N.B.

- Pattinson, H. L., jun., Heworth Lodge, Felling-on-Tyne.
 Pattinson, J., 75, The Side, Newcastle-on-Tyne.
 Pattison, J., 83, North Oswald Street, Glasgow, N.B.
 Pattison, Percy J., 11, Park Road, West Ham, E.
 Paul, Fred. W., c/o The Steel Company of Scotland, Limited, 150, Hope Street, Glasgow.
 Pauli, Dr., Höchst, Germany.
 Payne, Geo., Calder Soapworks, Wakefield, Yorks.
 Payne, J. B., 15, Mosley Street, Newcastle-on-Tyne.
 Peak, C. P., Bridgewater Chemical Works, Wigan.
 Pearce, W., jun., Bow Common, London, E.; and Brent House, Brentwood, Essex (for Journals).
 Pearmain, Thos. H., 9, Broad Street, Bloomsbury, W.C.
 Pears, Andrew, Lanadron Soapworks, Isleworth, Middlesex.
 Pearson, Wm., African Chambers, Old Hall Street, Liverpool.
 Peaty, Henry, Longport, near Stoke-on-Trent.
 Pechiney, A. R., Salindres (Gard), France.
 Pedler, A., Presidency College, Calcutta, India.
 Pedler, J. R., Woodbank, Lordship Lane, Dulwich, S.E.
 Pegge, J. V., c/o Nunneley & Co., Bridge Street Brewery, Burton-on-Trent.
 Peile, H., Walsden Chemical Works, near Todmorden.
 Pemberton, Henry, jun., 1947, Locust Street, Philadelphia, Pa., U.S.
 Peniston, Alex. H., 34, Disraeli Road, Upton, Essex.
 Pentecost, S. J., Nottingham Road, New Basford, Nottingham.
 Pentermann, H. T., 51, Clifton Crescent, Peckham, S.E.
 Percy, Dr. J., 1, Gloucester Crescent, Hyde Park, London, W.
 Perkin, Dr. W. H., The Chestnuts, Sudbury, Harrow.
 Perkin, Dr. W. H., jun., Heriot Watt College, Edinburgh.
 Perkin, T. D., Greenford Green, Harrow.
 Perkin, A. G., 55, Victoria Crescent, Eccles, Manchester.
 Perry, D., Forth and Clyde Chemical Works, Kirkintilloch, N.B.
 Pettigrew, J., 18, St. Helen's Place, Bishopsgate Street, London, E.C.
 Petty, A., Silvertown, London, E.; and Wood Lodge, Shooter's Hill, Kent.
 Peyton, E. P., Chemical Works, Lister Street, Birmingham.
 Pfeiffer, Karl, 63, Queen Victoria Street, London, E.C.
 Philip, Arnold, 43, Onslow Road, Richmond, Surrey.
 Phillips, H., 183, Moss Lane East, Manchester.
 Phillips, A. G., 18, Popstone Road, South Kensington, S.W.
 Phipps, Thos., 169, Bridge Street, Northampton.
 Phipson, Dr. T. L., Laboratory, 8, Hotham Villas, Putney, London, S.W.
 Pick, Dr. S., Direction der Soda Fabrik, Szezskowa, Galizien, Austria.
 Pickles, H., Prussiate Works, Droylsden, Manchester.
 Pilkington, G., Widnes.
 Pilkington, G., Wood Bank, Bury, Lancashire.
 Pilkington, Herb., Tipton Green Furnaces, South Staffordshire.
 Pirkerton, D. J., 18, Stanley Street, Glasgow, W.
 Pinkney, Robert, 18, Bread Street Hill, London, E.C.
 Pipe, Jas., Messrs. Wm. Henderson & Co., Irvine, N.B.
 Pitt, T., 16, Coleman Street, London, E.C.
 Pittuck, F. W., 25, Carr Street, Hebburn-on-Tyne.
 Playfair, David J., 12, Woodside Terrace, Glasgow.
 Plumb, Ben. M., The Cowles Electric and Aluminium Co., Ltd., 36, Lombard Street, London, E.C.
 Pollock, A., Dilliehip Turkey-red Dyeworks, Bonhill, Dumbartonshire.
 Pond, J. A., 99, Queen Street, Auckland, New Zealand.
 Poole, Thos., 25, Water Street, Liverpool.
 Pooley, T. A., 121, The Grove, Denmark Hill, S.E.
 Pope, S., Camden Works, Runcorn.
 Porter, Herbert, 4, Lime Tree Terrace, Stowmarket.
 Porter, J. H., 165, Queen Victoria Street, London, E.C.
 Pott, W. Hamilton, 22, Southwark Bridge Road, London, S.E.
 Potter, E. P., Hollinhurst, Bolton-le-Moors.
 Potter, Chas. E., Love Lane Sugar Refinery, Liverpool.
 Potter, Chas. J., Heaton Hall, Newcastle-on-Tyne.
 Powell, Alfred E., 6, Dryden Street, Longsight, Manchester.
 Powell, L. S., 5, Notting Hill Square, Campden Hill, London, W.

Powell, W. A., Maison Marie Louise, Hyères (Var), France.
 Poynter, J. Edgar, 72, Great Clyde Street, Glasgow.
 Prescott, Dr. Albert B., Ann Arbor, Mich., U.S.A.
 Preston, R., Hill End, Holcombe, near Manchester.
 Price, A. E., 715, Post Street, San Francisco, California, U.S.A.
 Price, D. S., 26, Great George Street, Westminster, London, S.W.
 Price, W. E., Gasworks, Hampton Wick, Middlesex.
 Pringle, W., Laboratory, Meerara, Coorg, India.
 Prinz, Dr. Otto, Schwarzenberg, Saxony.
 Pritchard, W. S., Farnworth, Widnes.
 Probert, Thos., Higher Grade School, Cardiff.
 Procter, H. R., 38, Percy Park, Tynemouth.
 Procter, J. W., Skeldergate Bridge, York.
 Proctor, C., Government Laboratory, Somerset House, London, W.C.
 Proctor, C. W. Cope, Heathercliffe, Clifton Down, Bristol.
 Proctor, B. S., 11, Grey Street, Newcastle-on-Tyne.
 Proctor, W. W., 33, The Side, Newcastle-on-Tyne.
 Pugh, G., 12, Mark Lane, London, E.C.
 Pullar, R., Pullar's Dyeworks, Perth, N.B.
 Pullar, R. D., Pullar's Dyeworks, Perth, N.B.
 Purser, E. T., 82, James Street, Dublin.

Q

Quaas, Gustav, Turn Lee Mills, Glossop, Derbyshire.
 Quibell, Oliver, Highfield, Newark-on-Trent.

R

Rademacher, H. A., c/o Mons. Henri Ehram, 374, Weinbergstrasse, Zurich, Switzerland.
 Rae, G., Tharsis Sulphur and Copper Co., Widnes.
 Rait, G. L., 31, Moorgate Street, London, E.C.
 Ramsay, Dr. W., University College, Gower Street, London, W.C.
 Ramsay, Wm., 20, Brock Street, Kirkdale, Liverpool.
 Ramsden, Edw., Holly Bank, Great Horton, Bradford, Yorks.
 Ramsden, J., Lion Brewery, Belvidere Road, Lambeth, London, S.E.
 Rathbone, P. H., The Cottage, Greenbank, Liverpool.
 Rawes, F. B., 15, Gough Road, Stratford, London, E.
 Rawlinson, A. J., Newton-le-Willows, Lancashire.
 Rawson, C., 3, Union Street, Bradford.
 Rawson, S. G., Chemical Laboratory, University College Liverpool; and 118, Chatham Street, Liverpool.
 Ray, Wm., School of Science, Kidderminster.
 Raymond, C. W., 24, Lawrence Road, Addington Road, Bow, London, E.
 Rayner, J. A. E., Sutton Alkali Works, St. Helens.
 Readman, Dr. J. B., Chemical Laboratory, India Buildings, Edinburgh.
 Readman, J. F., Parkgate Ironworks, Rotherham.
 Reay, T. Burdon, 85, Herrington Street, Sunderland.
 Reckitt, Ernest, Caen Wood Towers, Highgate, N.
 Reddrop, J., Laboratory, L. & N. W. Railway, Crewe.
 Redfern, G. F., 4, South Street, Finsbury, London, E.C.
 Redmayne, J. M., 27, Grey Street, Newcastle-on-Tyne.
 Redwood, B., 85, Gracechurch Street, London, E.C.
 Redwood, I. J., Thorn House, Walthamstow, Essex.
 Redwood, Robt., 83, Gracechurch Street, London, E.C.
 Redwood, Dr. T., 2, Fisher Street, Red Lion Square, London, W.C.
 Rée, Dr. A., 121, Manchester Road, Middleton, near Manchester.
 Reed, Albert E., Trevarno, Cathedral Road, Cardiff.
 Reeks, T. H., 20, Perham Road, West Kensington, W.
 Reid, David E., Kaboonga Mines Co., Kilkivan, Maryborough, Queensland.
 Reid, T. Anderson, 11, Mersey View, Runcorn.
 Reid, W. Hamilton, c/o Messrs. Mandall & Co., Stockton-on-Tees.
 Reid, W. F., Fieldside, Addlestone, Surrey.
 Reid, W. G., c/o Adam L. Cochrane and Bros., Netherdale, Galashiels, N.B.
 Remfry, H. H., 5, Fancy Lane, Calcutta, India.
 Renard, Chas., 25, Allées de Meilhan, Marseilles, France.
 Renant, F. W., 65, Radipole Road, Fulham Road, S.W.; and 19, Great George Street, S.W. (for Journals).
 Rennie, Dr. E. H., University of Adelaide, South Australia.
 Rennoldson, W. L., St. Bede Chemical Works, East Jarrow.
 Reoch, R., River Point, Rhode Island, U.S.A.
 Reynolds, Henry C., 8, The Avenue, Clifton, Bristol.
 Reynolds, Dr. J. Emerson, Trinity College, Dublin.
 Reynolds, R., 13, Briggate, Leeds.
 Rhodes, E., c/o Thos. Viekers & Sons, Widnes.
 Rice, Dr. Chas., Bellevue Hospital, New York, U.S.A.
 Richards, W. A., Sandbach, Cheshire.
 Richardson, B. S., Scottdale, Westmoreland Co., Pa., U.S.A.
 Richardson, Clifford, Office of District Commissioners, Washington, D.C., U.S.A.
 Richardson, C. T., Monkton Lodge, Jarrow-on-Tyne.
 Richardson, David B., 2, Church Place, Greenock, N.B.
 Richardson, J. G. F., Elmfield, Stoneycote, Leicester.
 Richardson, J. G., Springwell Paper Mills, Jarrow-on-Tyne.
 Richardson, J. H., 67, Blackburn Road, Church, Accrington.
 Richardson, F. W., 2, Farecliffe Place, Bradford, Yorkshire.
 Richmond, H. D., Thornton Lodge, Stonebridge Park, Willesden, N.W.
 Richmond, W. H., Liver Alkali Co., Limited, Ditton Road, Widnes.
 Rickman, J. Pellatt, Falcon Glass Works, St. Bride Street, London, E.C.
 Riddell, Robert, Messrs. Allsopp & Co., New Brewery, Burton-on-Trent.
 Ridenal, Dr. Samuel, 161, Devonshire Road, Forest Hill, S.E.
 Ridsdale, C. H., Hatton Grange, Guisborough, Yorks.
 Rigby, John S., 35, Bagot Street, Wavertree, Liverpool.
 Rigg, R., Messrs. McBride & Co., Union Chemical Works, St. Helens.
 Riley, E., 2, City Road, Finsbury Square, London, E.C.
 Riley, Jas., 150, Hope Street, Glasgow.
 Riley, J. E., Arden Hall, near Accrington.
 Riley, J., Hapton Chemical Works, Accrington.
 Riley, J., Sunnyside, near Rawtenstall.
 Riley, James, Laboratory, Brinsall Works, near Chorley, Lancashire.
 Riley, W. G., Hapton Chemical Works, near Accrington.
 Ripley, H., Bowling Dyeworks, Bradford, Yorkshire.
 Ritchie, Robt., Shawfield Works, Rutherglen, near Glasgow.
 Ritson, T. N., 96, St. Saviour's Road, Jersey.
 Rix, W. P., Poulton & Co., Lambeth Art Pottery, London, S.E.
 Robbins, J., Gibraltar Walk, Bethnal Green Road, London, E.
 Robbins, J., 147, Oxford Street, London, W.
 Roberts, Frank A., Messrs. Roberts, Dale & Co., Warrington.
 Roberts, F. G. Adair, Clydach, Bethune Road, Stamford Hill, N.
 Roberts, R. Wightwick, 22, Calle Arturo Prat, Valparaiso, Chili.
 Robertson, R. A., 42, Aytoun Road, Pollokshields, Glasgow.
 Robinson, G. C., Royal Institution, Hull; and Laboratory, Bond Street, Hull (for Journals).
 Robinson, H. H., 12, Montpelier Row, Twickenham.
 Robinson, J., Farnworth, Widnes; and 50, Irwell Street, Widnes.
 Robinson, Jno., 5, Elizabeth Terrace, Ditton, Widnes.
 Robinson, R., Apsley Buildings, Old Hall Street, Liverpool.
 Robinson, Thomas, 401, West Street, Glasgow.
 Rodger, Edw., 1, Clairmont Gardens, Glasgow, W.
 Rohling, Ferd., c/o Rohling and Rave, Münster, Westphalia, Germany.
 Rollin, J. C., St. Bede Chemical Co., Limited, Newcastle-on-Tyne.
 Rooke, J. A., Horrocks Lane, Red Bank, Manchester.
 Rooth, J. S., Walton Chemical Works, Chesterfield.
 Roques, Adolphe, 36, Rue Sainte Croix de la Bretonnerie, Paris.
 Roscoe, Sir Henry, M.P., 10, Bramham Gardens, South Kensington, S.W.

Roseow, Jas., Fairview, Littleborough, Lancashire.
 Rosicki, Dr. F., 5, Quai Claude Bernard, Lyons, France.
 Roskell, Jos., Port Tennant Copper Works, Swansea.
 Ross, Alex. J. J., Tayavalla, Falkirk, N.B.
 Ross, J. G., 14, Argyle Place, Edinburgh.
 Rostron, G. E., Levenshulme Bleachworks, near Manchester.
 Rothwell, C. F. Seymour, c/o Edm. Potter & Co., Dinting Vale, near Glossop.
 Rottenburg, Paul, c/o Messrs. Leisler, Bock & Co., 130, Hope Street, Glasgow, N.B.
 Rowan, F. J., 121, West Regent Street, Glasgow.
 Rowell, W. A., 21, Victoria Square, Newcastle-on-Tyne.
 Rowland, W. L., 4800, Chester Avenue, Philadelphia, Pa., U.S.A.
 Rowley, Thos., Croston Cottage, Alderley Edge, Cheshire.
 Rowley, W. J., c/o Abbot, Anderson, and Abbott, Dod Street, Burdett Road, Linchouse, E.
 Roxburgh, J. W., Levenbank Works, Jamestown, Dumbartonshire, N.B.
 Royle, T., Dalton House, Upton Lane, Forest Gate, E.
 Royse, S. W., St. Andrew's Chambers, Albert Square, Manchester.
 Ruffle, Jno., 21, Gnoil Park Road, Neath, Glamorganshire.
 Rumble, C., Belmont Works, Battersea, London, S.W.
 Rüntz, John, Linton Lodge, Lordship Road, Stoke Newington, N.
 Ruscoe, Jno., Albion Works, Henry Street, Hyde, near Manchester.
 Rushton, H. F., 30, Juvenal Street, Liverpool.
 Russell, D., Silverburn, Leven, Fife, N.B.
 Russell, Jno., Anchor Brewery, Britten Street, Chelsea, London, S.W.
 Russell, Dr. W. J., St. Bartholomew's Hospital, London, E.C.
 Ryder, C. E., c/o Messrs. Elkington, Newhall Street, Birmingham.
 Ryland, Howard P., The Cedars, Gravelly Hill, Birmingham.

S

Sadler, A. E., Sandhall, Ulverston, Lancashire.
 Sadler, S. A., Middlesbrough-on-Tees.
 Sadtler, Prof. Samuel P., University of Pennsylvania, Philadelphia, Pa., U.S.A.
 Saint, W. Johnson, Spitalstrasse 1. H., Erlangen, Bavaria.
 Saito, Kenji, Yeisei Shikengo, Osaka, Japan.
 Salamon, A. G., 1, Fenchurch Avenue, London, E.C.
 Sakumori, Jno., The Willows, Wennington, near Romford, Essex.
 Samuel, W. Cobden, 203, Norwood Road, Herne Hill, London, S.E.
 Samuelson, Sir Bernard, Bart., M.P., 56, Prince's Gate, London, S.W.
 Sandon, R., 118, Leighton Road, Kentish Town, London, N.W.
 Sanderson, T. C., Minas do Corgo, Oporto, Portugal.
 Sansone, A., 8, Bignor Street, Cheetham Hill, Manchester.
 Saul, C. H., 76, Mosley Street, Manchester.
 Saunders, T. B., Upper House, High Town, Liversedge, via Normanton.
 Savage, W. W., 109, St. James's Street, Brighton.
 Savary, W. J. H., 10, Avenue Elmers, Surbiton.
 Schad, Julius, 14, Charlotte Street, Manchester.
 Schäppi, Dr. H., Mitlödi, Canton Glarus, Switzerland.
 Schellhaas, H., 54, Navigation Road, Northwich.
 Schenkelen, Dr. Adolf, Paper Mills, Oberlenningen u/Teck, Wurtemberg.
 Sehener-Kestner, Dr. A., 57, Rue de Babylone, Paris, France.
 Schishkoff, Sergius A., Elabonga, Govt. of Viatka, Russia.
 Schloesser, R., 14, Charlotte Street, Manchester.
 Schofield, C., Whalley Range, Manchester.
 Schofield, C. J., Clayton, Manchester.
 Schofield, E., Scout Bottom, Newelurch, near Manchester.
 Schofield, H. E., 52, Edge Lane, Liverpool.
 Schorlemmer, Dr. C., The Owens College, Manchester.

Schott, A., 26, Princess Street, Manchester.
 Schreiber, F. T., Salford Ironworks, Manchester.
 Schroeder, C., 8, Chatham Street, Piccadilly, Manchester.
 Schütz, Dr. Karl E., Fabrik L'indenhof (C. Weyl & Co.), Mannheim, Germany.
 Schunck, Dr. E., Kersal, near Manchester.
 Seorgie, J., College of Science, Poona, India.
 Scott, F., Rhodes Works, Middleton, near Manchester.
 Scott, F. Walter, 44, Christian Street, London, E.
 Scott, G. H., 3, Alton Terrace, Fairfield, near Manchester.
 Scott, Wm., c/o F. Tagnard et Cie., 52, Rue Riquet, Paris.
 Scott, W. Lascelles, Ambleside, Forest Gate, E.
 Scott, W. T., 11, Cromartie Road, Hornsey Rise, N.
 Scrutton, Willis, Arara, Esmeralda co., Nevada, U.S.A.
 Sessler, F., 116, Earls Court Road, South Kensington, S.W.
 Segner, P., 26, Princess Street, Manchester.
 Sellon, J. S., 78, Hatton Garden, London, E.C.
 Sellon, S., 3, Salter's Hall Court, Cannon Street, London, E.C.
 Senet, Louis, 217, Chaussée de Vleurgat; and 19, Rue du Prince Albert, Brussels.
 Senior, Dr. A., Thornfield, Harold Road, Upper Norwood, S.E.
 Serre, C. A., Mitre Chemical Works, Cordova Road, Bow, E.
 Sevin, C., Strathmore, 72, Central Hill, Upper Norwood, S.E.; and c/o Dolman & Pritchard, 3, Laurence Pountney Hill, E.C. (for Journals).
 Sexton, Prof. A. Humboldt, 7, Sefton Terrace, Rutherglen, Glasgow.
 Seymour, J. R. W., Northcroft Farm, Inkpen, near Hungerford, Berks.
 Shackel, W., Three Mills Distillery, Bromley-by-Bow, E.
 Shadwell, J. E. L., Highfield, Southborne, Christchurch, Hants.
 Shapleigh, W., Welsbach Incandescent Gas Light Co., Gloucester City, N.J., U.S.A.
 Sharp, Henry, Loseley Hurst, Bournemouth.
 Sharp, James, The Towers, Low Moor, near Bradford, Yorks.
 Sharples, Stephen P., 13, Broad Street, Boston, Mass., U.S.A.
 Shaw, D., Clayton, near Manchester.
 Shaw, F. W., Heapey Bleachworks, near Chorley, Lancashire.
 Shaw, Geo., 37, Temple Street, Birmingham.
 Shaw, R., West Bank Chemical Works, Widnes.
 Shaw, Walter, Sherdley Glass Works, St. Helens.
 Shearer, A., Messrs. Boake & Co., Stratford, London, E.
 Shenstone, W. A., Clifton College, Bristol.
 Sherlock, T., New Market Place, St. Helens.
 Shidzuki, Iwaichiro, Engineering College, Imperial University, Tokyo, Japan.
 Shimidzu, Tetsukichi, c/o T. Hirano, 11, Ginza Shichome, Tokyo, Japan.
 Shimosè, Masachika, Heiki-Seizo-Sho, Akabanè, Tokyo, Japan.
 Shipstone, Jas., jun., Woodthorpe Lodge, Sherwood, Nottingham.
 Siddall, F. P., Park Side, Barnet Common, Herts.
 Sieber, C. H., Whitworth, near Rochdale.
 Siebold, L., 18, Exchange Street, Manchester.
 Sill, P. T., Wallsend Chemical Co., Newcastle-on-Tyne.
 Sillar, W. Cameron, The Native Guano Co., Limited, 29, New Bridge Street, Blackfriars, E.C.
 Silva, Prof. R. D., 26, Rue de la Harpe, Paris.
 Simou, H., 20, Mount Street, Manchester.
 Simpson, J., 83, Rumford Place, Liverpool.
 Simpson, R., Grecian Terrace, Harrington, Cumberland.
 Simpson, W. S., 95, Darent Road, Stamford Hill, N.
 Sims, T. H., Mayfield Printworks, Manchester.
 Sisson, G., jun., Washington Chemical Co., Washington, co. Durham.
 Skaife, Wilfred T., 630, Sherbrooke Street, Montreal, Canada.
 Skinner, Sidney, 24, St. Andrew's Street, Cambridge.
 Slade, H. E., Streatham Common, London, S.W.
 Slater, H. H., 36, Wray Crescent, Tollington Park, N.
 Slatter, Geo. W., Saltire Works, Shipley, Yorkshire.
 Smail, J. I., Messrs. Gibbs & Co., Iquique, Chili.

- Small, Evan W., 11, Arthur Street, Nottingham.
- Smeaton, F. W., New Zealand Crown Mines Co., Ltd., Karangahake, Thames, New Zealand.
- Smetham, A., 18, Brunswick Street, Liverpool.
- Smiles, Jas., 3, Brandon Terrace, Edinburgh.
- Smith, Alfred, Excelsior Chemical Works, Clayton, Manchester.
- Smith, Anthony, Dublin Vitriol Works, Ballybough Bridge, Dublin.
- Smith, A. E., Widnes.
- Smith, A. J., Elswick Ordnance Works, Newcastle-on-Tyne.
- Smith, Chas., c/o Roxburgh Street Refining Co., Greenock, N.B.
- Smith, C. A., The Laboratory, 8, Loftus Street, Sydney, New South Wales.
- Smith, Prof. Edgar F., University of Pennsylvania, Philadelphia, Pa., U.S.A.
- Smith, Edgar F., 35, Amptill Square, Hampstead Road, London, N.W.
- Smith, Ernest, 182, West Street, Glasgow.
- Smith, Fred., Laboratory, 107, Queen Victoria Street, London, E.C.
- Smith, G., Polmont Station, Scotland.
- Smith, Geo. F., Cromwell Lodge, Putney Hill, S.W.
- Smith, Henry, 11, Malvern Road, Dalston, London, E.
- Smith, H. R., 1, Aubert Park, Highbury, London, N.
- Smith, J. Johnstone, Castle Brewery, Newark-on-Trent.
- Smith, J., Ash Grove House, Radcliffe, Manchester.
- Smith, Dr. J. H., 1, Bute Terrace, Low Fell, Gateshead-on-Tyne.
- Smith, Jas. C., 104, Salisbury Road, Wavertree, Liverpool.
- Smith, J. Tertius, Pattiswick Hall, Braintree, Essex.
- Smith, J. W., Massachusetts Institute of Technology, Boston, Mass., U.S.
- Smith, M. H., Messrs. Hopkin & Williams, Waterside, Wandsworth, S.W.
- Smith, Richard, Metallurgical Laboratory, Royal School of Mines, South Kensington, S.W.
- Smith, R. W., The Grange, Kirkburton, near Huddersfield.
- Smith, S., 35, Amptill Square, Hampstead Road, London, N.W.
- Smith, Thos., Heriot Hill House, Edinburgh.
- Smith, Watson, The Owens College, Manchester; and 147, High Street, Chorlton-on-Medlock, Manchester.
- Smith, Wilfred, 182, West Street, Glasgow.
- Smith, W., 10, Corn Street, Bristol.
- Smithells, Prof. A., Yorkshire College, Leeds.
- Smithers, F. O., Dashwood House, 9, New Broad Street, London, E.C.
- Smithson, J., Park Printworks, Halifax.
- Snape, Dr. H. Lloyd, University College, Aberystwith.
- Snape, Thos., Phoenix Alkali Works, Widnes.
- Snelling, E., 5, Spital Square, Bishopsgate Street, London, E.
- Soames, J. K., Thames Soap and Candle Works, Greenwich, S.E.
- Solvay, Ernest, 19, Rue du Prince Albert, Brussels.
- Solvay, Alfred, Boitsfort, Belgium.
- Sommer, Dr. G. Shack, 323, Vauxhall Road, Liverpool.
- Sommer, Adolf, West Berkeley, Alameda Co., California, U.S.A.
- Sonthall, A., Richmond Hill Road, Edgbaston.
- Sowerby, W. M., 8, Clervaux Terrace, Jarrow-on-Tyne.
- Soward, A. W., 18, Seylla Road, The Rye, Peckham, S.E.
- Spackman, Chas., c/o John Ellis & Sons, Barrow-on-Sour, Loughborough.
- Spackman, Jas., 7, Ward Road, Dundee.
- Spence, D., Alum Works, Manchester.
- Spence, F., Alum Works, Manchester.
- Spence, J. W., 63, West Regent Street, Glasgow.
- Spencer, Hugh T., 104, Thomas Lane, Broad Green, near Liverpool.
- Spencer, Jno., Globe Tube Works, Wednesbury.
- Spencer, J. W., Newburn, Newcastle-on-Tyne.
- Spiegel, Dr. Adolf, Messel, bei Darmstadt, Germany.
- Spiller, J., 2, St. Mary's Road, Canonbury, London, N.
- Spiller, A., 2, St. Mary's Road, Canonbury, London, N.
- Spoor, John L., 30, Hotspur Street, Tyne-mouth.
- Sprengel, Dr. H., Saville Club, 107, Piccadilly, London, W.
- Squire, E. L., Coalbrookdale, Shropshire.
- Squire, P. W., 413, Oxford Street, London, W.
- Squire, Dr. W. S., Clarendon House, St. John's Wood Park, N.W.
- Stacey, H. G., 300, High Holborn, London, W.C.
- Stacey, S. L., 300, High Holborn, London, W.C.
- Stahl, Dr. K. F., Johnstown Chemical Works, Johnstown, Cambria Co., Pa., U.S.A.
- Stanford, E. C. C., Glenwood, Dalnair, N.B.
- Stanley, C. L., Sandgate House, Wath-upon-Deane, Yorkshire.
- Stantial, Frank G., c/o Cochrane Chemical Co., Everett, Mass., U.S.A.
- Stapleton, Jos., 3, Lower Sackville Street, Dublin.
- Staples, H. J., Spondon, Derby.
- Staples, Sir Nath. A., Bart., Lissan, Cookstown, Ireland.
- Stark, J. F., Price's Patent Candle Co., Ltd., Bromborough Pool, near Birkenhead.
- Starling, J. H., 7, Pier Road, Erith, Kent.
- Staub, Dr. A., care of Brunner, Mond & Co., Northwich, Cheshire.
- Staveley, W. W., Baghill, Pontefract.
- Stead, J. E., 5, Zetland Road, Middlesbrough-on-Tees.
- Stead, W. H., 23, Boundary Street, Liverpool.
- Stebbins, J. H., 114, Pearl Street, New York, U.S.A.
- Steedman, R. H., North British Chemical Co., Clyde Bank, near Glasgow.
- Steel, J. M., 85, Gracchurch Street, London, E.C.
- Steel, R. Elliott, Springcliffe House, Heaton Road, Bradford, Yorkshire.
- Steel, Thos., Yarraville Sugar Refinery, Melbourne, Victoria.
- Steele, Dr. M., Newton Hall, Frodsham, Cheshire.
- Steiger, Alph., 16, Mining Lane, London, E.C.
- Steinhart, Dr. Oscar J., c/o Thomas and Dower, Ltd., Garratt Lane, Tooting, S.W.
- Stenhouse, T., 1, Milton Street, Rochdale.
- Stephens, H. Chas., M.P., Avenue House, Finchley, N.
- Steuart, D. V., Albert Chemical Works, Clayton, near Manchester.
- Steuart, D. R., Broxbaro, near Edinburgh, N.B.
- Stevens, Wm., The Native Guano Co., Ltd., 29, New Bridge Street, Blackfriars, E.C.
- Stevens, W. J., Marsh Soapworks, Bristol.
- Stevenson, J., Broxburn, N.B.
- Stevenson, Jas., 23, West Nile Street, Glasgow; and The Bromfields, Largs, N.B.
- Stevenson, J. C., M.P., South Shields.
- Stevenson, Dr. T., Guy's Hospital, London, S.E.
- Stevenson, W., Standard Works, 95A, Southwark Street, London, S.E.
- Stewart, S., Caledonian Railway Stores Department, St. Rollox, Glasgow.
- Stiker, Flavius P., 453, Fourteenth Street, Buffalo, N.Y., U.S.A.
- Stillwell, C. M., Box 1261, New York, U.S.A.
- Stirk, Jos., 126, Station Street, Burton-on-Trent.
- Stockdale, Wm., Irwell Printworks, Stacksteads, near Manchester.
- Stocks, H. B., 58, Nuttall Street, Liverpool.
- Stoddart, F. Wallis, Western Counties Laboratory, Bristol.
- Stoddart, J. E., 60, Robertson Street, Glasgow.
- Stoer, J., 6, Hanover Quay, Dublin.
- Stoker, G. N., The Laboratory, Somerset House, London, W.C.
- Stone, F. D., 19, Lever Street, Piccadilly, Manchester.
- Stone, F. B., 1, Norfolk Villa, Picardy Hill, Beldere, Kent.
- Stone, Thos. W., Chemical Works, St. George, Bristol.
- Stopes, H., Keawyn, Cintra Park, Upper Norwood, S.E.
- Storey, I. H., Haverbreaks, Lancaster.
- Storrar, J. M., 70, Wellington Street, Glasgow.
- Stowe, Wm. Thos., Laboratory, Somerset House, Strand, W.C.
- Strangman, J. Pin, Sarno, Salerno, Italy.
- Strong, Colin R., 18, Exchange Street, Manchester.
- Stroud, Walter R., 2035, Mount Vernon Street, Philadelphia, Pa., U.S.A.
- Strype, W. G., The Murrrough, Wicklow, Ireland.
- Stuart, C. E., 29, Mosley Street, Newcastle-on-Tyne.

Stuart, Jas., Prince's Avenue, Hull, and 22, High Street, Hull.
 Stuart, T. W., Newton Villas, Hebburn-on-Tyne.
 Stunder, Dr. A., 10, Marsden Street, Manchester.
 Suilliot, H., 21, Rue Sté Croix de la Bretonnerie, Paris.
 Sumner, R. M., 50A, Lord Street, Liverpool.
 Sutherland, D. A., Burntisland Oil Co., Burntisland, N.B.
 Sutherland, Jas., Ballyclare, co. Antrim, Ireland.
 Sutherland, Jno., 16, Flinders Lane West, Melbourne, Victoria, Australia.
 Sutherland, R. M., Lime Wharf Chemical Works, Falkirk, N.B.
 Sutton, Chas. W., Free Reference Library, King Street, Manchester.
 Sutton, E., London Street, Norwich.
 Sutton, F. Napier, 22, Hardham Road, Holloway, N.
 Swan, J. C., 4, Dean Street, Newcastle-on-Tyne.
 Swan, J. W., Lauriston, Bromley, Kent.
 Swinburne, Geo., c/o J. Coates & Co., Planet Chambers, 8, Collins Street East, Melbourne, Australia.
 Sykes, E., 28, Church Street, Bradshaw, near Bolton.
 Sykes, Dr. B. Clifford, St. John's House, Cleckheaton, Yorkshire.
 Syme, W. B., c/o Young's Paraffin Oil Co., Addiewell, West Calder, N.B.

T

Takamatsu, T., Tokyo University, Japan.
 Takamine, J., Fertilizer Works, Fukagawa, Tokyo, Japan.
 Tanner, A. E., High Cross, Tottenham, N.
 Tanqueray, Arthur C., Reid's Brewery, Clerkenwell Road, London, E.C.
 Tarn, Albert, 26, Summer Hill Terrace, Birmingham.
 Tate, A. Norman, Hackins Hey, Liverpool.
 Tate, E., Froggall Priory, Hampstead, N.W.
 Tate, F. H., Holland Bank Chemical Works, Church, near Acreington.
 Tate, H., jun., Allerton Beeches, Allerton, near Liverpool.
 Tatlock, J., 100, Sauchiehall Street, Glasgow.
 Tatlock, R. R., 156, Bath Street, Glasgow.
 Tatters, J. G., Dean House, South Shields.
 Taubman, R., 33, Southampton Row, London, W.C.
 Taylor, Andrew, 11, Lutton Place, Edinburgh.
 Taylor, C., Friars Field Villas, Uttoxeter New Road, Derby.
 Taylor, G. Crosland, Ravenscar, Helmsby, near Warrington.
 Taylor, Jno., The Belgrave Pharmacy, Torquay, Devon.
 Taylor, Jas., Osgathorpe Crescent, Sheffield.
 Taylor, Jas. Davis, 9, Mining Lane, London, E.C.
 Taylor, H. E., 4A, Brand Street, Greenwich, S.E.
 Taylor, J. Scott, c/o Winsor and Newton, Limited, 38, Rathbone Place, London, W.
 Taylor, R. L., 37, Mayfield Road, Alexandra Park, Manchester.
 Taylor, W. J., 55, Forsyth Street, Greenock, N.B.
 Teahby, G. W. A., 22, Grosvenor Place, Blackman Lane, Leeds.
 Teed, Dr. F. L., 8, Victoria Chambers, Westminster, London, S.W.
 Tennant, Sir Chas., Bart., 35, Grosvenor Square, S.W.; and Glen, Peebleshire, N.B.
 Tennant, Jas., Dartmouth Lodge, Saltwell, Gateshead-on-Tyne.
 Terry, Albert, 19, Warrington Crescent, Maida Vale, W.
 Terry, Hubert L., 13, Duke Street, Greenheys, Manchester.
 Tervet, R., White Lead Works, Possilpark, Glasgow.
 Thew, Walter H., 47, Castle Street, Liverpool.
 Thom, John, Birkacre, Chorley, Lancashire.
 Thomas, C., Broad Plain Soapworks, Bristol.
 Thomas, Henry, 44, Amberley Street, Sunderland.
 Thomas, J., Brook House, Woburn, near Beaconsfield.
 Thomas, J. W., c/o D. R. Roberts, 10, Park Grove, Cardiff.
 Thomas, R. Schofield, The Brewery, Studley, near Redditch.
 Thomas, S. M., 143, Cannon Street, London, E.C.
 Thomas, Philip A., 5, Astwood Road, South Kensington, S.W.
 Thomas, S. Percy, Chemical Laboratory, Royal Veterinary College, Edinburgh.
 Thompson, Chas., 15, Pat-shull Road, Kentish Town, N.W.
 Thompson, Prof. Claude M., University College, Cardiff.
 Thompson, G. E., Birkdale, South Road, Smethwick, Birmingham.
 Thompson, W., jun., Larkfield, Earl-stown, Lancashire.
 Thompson, W. G., Tonge Springs Works, Middleton, near Manchester.
 Thompson, W. P., Patent Office, 6, Lord Street, Liverpool.
 Thomson, Dr. Andrew, 1, Blackness Crescent, Dundee.
 Thomson, G. Carnithers, 39, Kersland Terrace, Hillhead, Glasgow.
 Thomson, John, 70A, Grosvenor Street, London, W.
 Thomson, Prof. J. M., King's College, London, W.C.
 Thomson, J. S., Uphall Oil Works, Uphall, N.B.
 Thomson, R., 138, Bath Street, Glasgow.
 Thomson, Robt. T., 156, Bath Street, Glasgow.
 Thomson, W., Royal Institution, Manchester.
 Thomson, Wm. Garth, 41, Mitchell Street, Glasgow.
 Thorne, E. E. H., c/o H. E. Thorne, Bridgetown, Barbadoes.
 Thorne, Dr. L. T., 19, Dafforne Road, Upper Tooting, S.W.
 Thorncroft, Wallace, Merryton Collieries, Hamilton, N.B.
 Thorntou, H., 5, George Street, Euston Road, London, N.W.
 Thorp, W., 24, Crouch Hall Road, Crouch End, N.
 Thorpe, T. W., Messrs. Crossman & Co., Albion Brewery, Mile End Road, London, E.
 Thorpe, Dr. T. E., Royal Normal School of Science, South Kensington, S.W.
 Tiebhorne, C. R. C., 15, North Great George Street, Dublin.
 Tickner, G., Castle Brewery, Guildford.
 Tidy, Dr. C. Meymott, 3, Maudeville Place, Manchester Square, London.
 Tighe, Patrick, Lake House, East Jarrow.
 Tilden, Dr. W. A., Mason Science College, Birmingham.
 Timmins, A., Stanley Villas, Runcorn.
 Timmis, T. Sutton, Widnes.
 Todd, A. M., Nottawa, St. Joseph Co., Mich., U.S.A.
 Tomlinson, G. G., Post Office, Valparaiso, Chili.
 Toms, F. Woodland, States Analyst's Office, St. Heliers, Jersey.
 Tonks, E., Packwood, Knowle, near Birmingham.
 Tothill, W. W., Messrs. Reckitt & Son, Limited, Hull.
 Towers, J. W., Grosvenor Buildings, Victoria Road, Widnes.
 Townsend, H. H., 14, Elgin Park, Redland, Bristol.
 Townsend, Jos., 19, Crawford Street, Port Dundas, Glasgow.
 Trachsel, E. F., c/o W. C. Moore, 9, Old Jewry Chambers, London, E.C.
 Trechmann, A. O., Norton Lodge, Stockton-on-Tees.
 Trechmann, C. O., 10, Cliff Terrace, Hartlepool.
 Trench, G., Standard House, Faversham, Kent; and the Cotton Powder Co., Limited, Faversham.
 Trewhy, Herbert, Langford Lodge, New Park Road, Clapham Park, S.W.
 Tribe, P. C. M., Oswego, New York, U.S.A.
 Trimble, Prof. H., 632, Marshall Street, Philadelphia, U.S.A.
 Trinnell, C. H., Ewhurst, New Malden, Surrey.
 Trobridge, A., c/o Chance Bros., Alkali Works, Oldbury, Birmingham.
 Truby, Charles, 53, High Street, Manchester.
 Truman, Dr. E. B., 31, Derby Road, Nottingham.
 Tsukiyama, S., Printing Department, Ministry of Finance, Tokyo, Japan.
 Tuer, Arthur H., 28, Church Street, Standish, near Wigan.
 Tulloch, John, 18, Suffolk Street, Jarrow-on-Tyne.
 Turgensen, Dr. R., Oberröblingen a. Sec, bei Halle, Germany.
 Turnbull, G. W., 10, Northgate, Darlington.
 Turnbull, Wm., 14, Wilberforce Terrace, Gateshead-on-Tyne.
 Turnbull, W. S., Place of Bonhill, Renton, Dumbarton-shire.
 Turner, F. T., 17, Copeland Street, Stoke-on-Trent.
 Turner, Thos., Mason College, Birmingham.
 Turner, W. Spencer, 225, Oxford Street, Manchester.
 Turney, Sir J., Trent Bridge Leather Works, Nottingham.
 Tweedie, G. R., 2, Torriano Villas, Broadstairs, Kent.
 Twynan, T., 7, Marlborough Crescent, Bedford Park, Chiswick, W.

Typke, P. G. W., Fairlawn, New Malden, Surrey.
 Tyrer, T., Garden Wharf, Battersea, London, S.W.
 Tyzaek, Stuart, Brockett House, Montgomery Road, Sheffield.

U

Umney, C., 50, Southwark Street, London, S.E.
 Underhill, Thos. J., H.M. Victualling Yard, Deptford, S.E.
 Underwood, G. R., Box 460, Peabody, Mass., U.S.A.
 Upward, W., Albert Road, Widnes.
 Usmar, J. H., 34, Palmerston Buildings, London, E.C.

V

Vandenbergh, Frank P., Laboratory, University of Buffalo, N.Y., U.S.A.
 Vargas-Vergara, J. M., Apartado No. 237, Bogota, Republic of Colombia, S. America.
 Vary, G. M. P., 1319, O'Farrell Street, San Francisco, Cal., U.S.A.
 Vasey, T. E., 6, South Parade, Leeds.
 Vaughan, J. I., Woodleigh, East Dulwich Grove, S.E.
 Vaux, Cuthbert, The Brewery, Sunderland.
 Veitch-Wilson, J., Queen Street, Bradford, Manchester.
 Venables, T., Parkburn Chemical Works, Kirkintilloch, N.B.
 Verel, W. A., 136, West George Street, Glasgow.
 Vickers, W., Rose Hill, Smedley Lane, Manchester.
 Vieth, Dr. P., 31, St. Petersburg Place, Bayswater, London, W.
 Voelcker, E. W., 11, Salisbury Square, Fleet Street, London, E.C.
 Voelcker, Dr. J. A., Royal Agricultural Society of England, 12, Hanover Square, London, W.
 Vorster, Fritz, 7, Bayenstrasse, Cohn a Rhein, Germany.
 Voss, Hermann, Holstein House, Whitworth Road, South Norwood, S.E.

W

Waché, Alf., 6, Rue Lambrecht, Douai, France.
 Wainwright, Dr. J. H., 402, Washington Street, New York, U.S.A.
 Waite, C. N., Newton Upper Falls, Mass., U.S.A.
 Walker, A., Irvine Chemical Co., Limited, Irvine, N.B.
 Walker, Archibald, 8, Crown Terrace, Glasgow.
 Walker, Arthur J., 38, Portsdown Road, Maida Vale, London, N.W.
 Walker, E. Robinson, 18, St. Ann's Street, Manchester.
 Walker, James S. H., 304, Morningside Road, Edinburgh.
 Walker, R., The Pallett, Quarlton, near Bolton.
 Walker, R. W., Quarlton Vale Printworks, Turton, near Bolton.
 Walker, S. R., 21, School Street, Radcliffe, Manchester.
 Walker, T., Merton Bank Chemical Works, St. Helens.
 Wallace, Robert, 126, St. Leonard's Street, Bromley, London, E.
 Waller, Dr. E., School of Mines, Columbia College, 50th Street, 4th Avenue, New York, U.S.A.
 Walsh, F. T., Hamilton Printworks, Lowell, Mass., U.S.A.
 Walsh, P. H., c/o Procter & Gamble, Soap Factory, Ivorydale, Ohio, U.S.A.
 Waltham, T., Brewery, Stockwell, London, S.W.
 Walton, Cornelius, 63, Queen Victoria Street, London, E.C.
 Warburton, J., Kearsley House, Farnworth, near Bolton.
 Ward, G., Messrs. Hirst, Brooke and Hirst, Leeds.
 Ward, Geo., c/o Richardson & Co., 10, Friar Lane, Leicester.
 Ward, Howard Chas., Yeaton, Hordle, Lymington, Hants.
 Ward, Thos., Brookfield House, Northwich.
 Wardale, J. D., Redheugh Engine Works, Gateshead-on-Tyne.
 Warden, Dr. C. J. H., Medical College, Calcutta, India.
 Wardle, Thos., Leek, Staffordshire.
 Waring, E. S., Lillie Terrace, Castle Street, Sncinton, Nottingham.
 Warington, Robt., Harpenden, Herts.
 Warne, Thos., c/o Rainham Ferry Vitriol Co., Rainham, Essex.
 Warner, H. G., c/o Wallis & Milestone, Garrett Lane, Wandsworth, S.W.
 Warren, T. T. P. Bruce, Tamworth Villa, Earlham Grove, Forest Gate, Essex.
 Warrington, A. W., P.O. Box 176, Redlands, San Bernardino Co., Cal., U.S.
 Warwick, Jno., 11, Ashfield Terrace West, Newcastle-on-Tyne.
 Warwick, J. F., The Brewery, Newark-on-Trent.
 Waterfall, W. B., c/o Avon Manure Co., Bristol.
 Waters, Edw. A., 4, Prince's Road, Lewisham, S.E.
 Watson, Chas., Walsden Chemical Works, near Todmorden.
 Watson, D., Broughton Copper Works, Manchester.
 Watson, F. Percy, 31, Carholme Road, Lincoln.
 Watson, G., jun., 16, East Nelson Street, Whitevale, Glasgow.
 Watson, J. C., c/o J. Bennett & Sons, Birch Vale, near Stockport.
 Watson, T. Donald, 23, Cross Street, Finsbury, London, E.C.
 Watson, Jno., Cement Works, Gateshead-on-Tyne.
 Watson, Jno., Laboratory, Newcastle Chemical Co., Gateshead-on-Tyne.
 Watson, W. H., Laboratory, The Folds, Bolton.
 Watt, A., 89, Hartington Road, Sefton Park, Liverpool.
 Watts, A. J., 130, Caixa, Pernambuco, Brazil.
 Watts, Chas. W., Corporation Gasworks, Belfast.
 Webb, Saml. G., c/o W. Pilkington & Son, Widnes.
 Webb, Wm. Hubert, Randalstown, co. Antrim, Ireland.
 Webster, Geo. W., Oswald Hill, Broomhill Drive, Partick, Glasgow.
 Webster, C. S. Stanford, Malvern House, Redland, Bristol.
 Webster, Wm., jun., 50, Lee Park, Lee, S.E.
 Weightman, John F., c/o Powers & Weightman, Philadelphia, Pa., U.S.A.
 Weir, Surgeon-Major P. A., 7, Kelvininside Gardens, Hillhead, Glasgow.
 Weldon, Ernest, 42, Sandon Street, New Basford, Nottingham.
 Weldon, W. F. Raphael, 14, Brookside, Cambridge.
 Wells, G. I. J., Kinderton Lodge, Middlewich, Cheshire.
 Welsh, Jas., Clayton Mount, Newton Heath, near Manchester.
 Welsh, W., Broomfield, Ashton-on-Mersey.
 Wessel, Carl, Bernburg, Anhalt, Germany.
 Wesson, David, c/o N. K. Fairbank & Co., 225, 18th Street, Chicago, Ill., U.S.A.
 West, John, Barfield House, Didsbury, Manchester.
 Westmoreland, J. W., 25, Park Square, Leeds.
 Weston, Wm., H.M. Dockyard, Portsmouth.
 Wetzel, H. A., Box 470, Detroit, Michigan, U.S.A.
 Whalley, L. J., Belmont, Drayton Road, Leytonstone, E.
 Wheateroft, Ernest, 62, Page Hall Road, Sheffield.
 Whewell, G., 15, Exchange Street, Blackburn.
 Whiffen, T., Lombard Road, Battersea, London, S.W.
 Whiffen, T., jun., Lombard Road, Battersea, London, S.W.
 Whiffen, W. G., Lombard Road, Battersea, London, S.W.
 Whitaker, Thorp, Messrs. E. Ripley & Sons, Bradford, Yorks.
 Whitaker, Thos., 22, Delaunays Road, Higher Crumpsall, Manchester.
 Whittaker, C. J., Church Alkali Works, near Acerrington.
 White, A., Horton Field, West Drayton, Middlesex.
 White, A. D., Avenue House, West Drayton, Middlesex.
 White, J. Campbell, 7, West George Street, Glasgow.
 White, P. T., Castle Street, Saffron Hill, London, E.C.
 White, S. J., Moreland Avenue, Chesnut Hill, Philadelphia Pa., U.S.A.
 White, W. H., Killingworth House, Killingworth, Newcastle-on-Tyne.
 Whitehouse, Enoch, 128, Coventry Road, Birmingham.
 Whitelaw, A., 87, Sydney Street, Glasgow.
 Whiteley, Geo., Victoria Lead Works, Burdett Road, Limehouse, E.
 Whiteley, R. Lloyd, University College, Nottingham.
 Whowell, F., Carr Bank, Tottington, Bury, Lancashire.
 Wigg, C., Hoole Bank, Chester.
 Wigg, G. L., Runcorn.
 Wigg, Walter J., Old Quay Copper and Alkali Works, Runcorn, Cheshire.

- Wiggin, W. W., Wiggin Street, Birmingham Heath, Birmingham.
- Wightman, C. I., Fenchurch Avenue, London, E.C.
- Wild, Eugene.
- Wilde, T., Penclawdd, near Swansea.
- Wiley, M. W., Billsdale House, York Road, West Hartlepool.
- Wilkie, T. M., Nobel Co.'s Works, Stevenston, Ayrshire, N.B.
- Wilkin, Walter H., Appold Street, Finsbury, E.C.
- Wilkinson, J. B., Tong Street, Dudley Hill, Bradford, Yorks.
- Will, W. Watson, The Laurels, Galveston Road, Putney, S.W.
- Williams, Chas., Staffel a Lahn, Germany.
- Williams, Edward, Folly Farm, Warrington.
- Williams, J., 63, Warwick Gardens, Kensington, W.
- Williams, J. W., 6, Giltspur Street, London, E.C.
- Williams, M. W., Edison Swan Electric Light Co., Ponders End, N.
- Williams, Rowland, 28, Pall Mall, Manchester.
- Williams, T., 3, York Buildings, 14, Dale Street, Liverpool.
- Williams, T. Howell, 10, Ascham Street, Kentish Town, N.W.
- Williams, Prof. W. Carleton, Firth College, and 33, Bromsgrove Road, Sheffield.
- Williams, W. Collingwood, 68, Grove Street, Liverpool.
- Williams, W. J., 623, Market Street, Camden, N.J., U.S.A.
- Williamson, J. H., Goldenhill Works, Stoke-on-Trent.
- Williamson, Robt., Cleveland Chemical Works, Middlesbrough.
- Wills, G. S. V., Arundel Lodge, Tulse Hill, S.W.
- Wills, J. Laisson, Canadian Phosphate Co., Limited, Buckingham, Quebec, Canada.
- Wilson, A., Stafford.
- Wilson, Alexander, Caroline Park, Granton, N.B.
- Wilson, Anthony W., 20, Westcott Street, Hull.
- Wilson, C. T., 16, Gordon Square, London, W.C.
- Wilson, Cecil H., c/o Sheffield Smelting Co., Sheffield.
- Wilson, David W. R., 200, Manchester Road, Bradford, Yorks.
- Wilson, David, jun., Carbeth, Killearn, by Glasgow.
- Wilson, Frank, The Brewery, Castle Street, Long Acre, London, W.C.
- Wilson, F. H., Lancashire Sulphur and Alkali Co., Limited, Widnes.
- Wilson, G., jun., Cairnview, Kirkintilloch, Dumbartonshire.
- Wilson, G. E., The Chemical Works, Oldbury, near Birmingham.
- Wilson, Jno. Ed., Wyddrington, Edgbaston, Birmingham.
- Wilson, Jno., Redheugh Chemical Works, Gateshead-on-Tyne.
- Wilson, Jos. A., Crossfields, Tottington, near Bury, Lancashire.
- Wilson, J. H., 6, Fenchurch Buildings, E.C.
- Wilson, J. Millar, Ridley Park, Delaware Co., Pa., U.S.A.
- Wilson, R. H., Egglecliffe, Yarm-on-Tees.
- Wilson, Dr. W. H., Presidency College, Madras.
- Wilson, Wm. Robt., 110, Long Acre, London, W.C.
- Wilton, Geo., Gasworks, Silvertown, E.
- Wilton, Jno., Clydesdale, Norwich Road, Forest Gate, Essex.
- Wilton, Thos., Winsor House, Beekton, E.
- Windus, W., 15, Vyvyan Terrace, Clifton, Bristol.
- Wingham, A., 30, Oxford Mansions, London, W.
- Wincer, P. J., c/o Lever Bros., Soapworks, Warrington.
- Winsloe, H., Messrs. Tennant & Co., 49, Faulkner Street, Manchester.
- Winstone, A. B., 7, Gray's Inn Square, London, W.C.
- Winstone, E. H., 2, Victoria Mansions, Victoria Street, London, S.W.
- Wire, A. P., 1, Seaton Villas, Birkbeck Road, Leytonstone, E.
- Witt, Dr. Otto N. E., 33, Lindenallee, Westend, Charlottenburg, Berlin.
- Wolfenden, S., Wellington Terrace, Cowley Hill, St. Helens.
- Wollner, Dr. Robt., 17, Amberley Street, Liverpool.
- Womersley, P. B., Lynton Road, Wanstead, Essex.
- Wood, C. H., 46, Lorraine Road, Holloway, London, N.
- Wood, E. T., Brinscall, Chorley, Lancashire.
- Wood, Robt. B., Dalquhurn Works, Renton, N.B.
- Wood, Jas.,
- Wood, Joseph, Brinscall, near Chorley, Lancashire.
- Wood, J. Turney, Trent Bridge Leather Works, Nottingham.
- Wood, Milton R., c/o Church & Co., 36, Ash Street, Brooklyn, N.Y., U.S.A.
- Wood, Wm., Antwerp, Belgium.
- Wood, W. C., Avenue Cottage, Alexandria, Dumbartonshire.
- Woodecock, R. C., American and Continental Sanitas Co., 636-642, West 55th Street, New York, U.S.A.
- Woodham, Kingston G., 45, Parsonage Road, Withington, Manchester.
- Woodhead, Jas., Ashfield Terrace, Slaithwaite, near Huddersfield.
- Woodland, J., 173, Marylebone Road, London, N.W.
- Woodward, W. C., Biddulph Valley Coal and Iron Works, Stoke-on-Trent.
- Woolf, Mortimer, 3, Acre Road, West Hampstead, N.W.
- Woolley, G. S., 69, Market Street, Manchester.
- Wootton, A. C., 42, Cannon Street, London, E.C.
- Worms, Emil, Elabouga, Govt. of Viatka, Russia.
- Worrall, H., Crimsworth, Whalley Range, Manchester.
- Worrall, J., Whalley Range, Manchester.
- Worsley, P. J., Rodney Lodge, Bristol.
- Wray, O. J. P., British Alizarin Co., Limited, Silvertown, Victoria Docks, London, E.
- Wright, A. R., The Patent Office, 25, Southampton Buildings, Chancery Lane, London, W.C.
- Wright, Jos., 19, Arboretum Street, Nottingham.
- Wright, W., Fairfield Road Chemical Works, Droylsden, Manchester.
- Wright, Dr. C. R. Alder, St. Mary's Hospital, Paddington, London, W.
- Wright, Jas. C., 8, Portland Terrace, Redcar, Yorks.
- Wright, L. T., 511, Calle Alsina, Buenos Ayres.
- Wuth, A., 14, Dambachthal, Wiesbaden, Germany.
- Wyatt, J. W., Nash Mills, Hemel Hempstead, Herts.
- Wykes, L., Minas de Rio Tinto, Huelva, Spain.
- Wylde, J., Frizinghall Chemical Works, near Shipley, Yorks.
- Wylde, J. R., Heatherlea, Penketh, near Warrington.
- Wyndham, Dr. Stanley, c/o Mrs. Jamieson, 4, Marles Road, Kensington, W.

Y

- Yates, F., 64, Park Street, Southwark, London, S.E.
- Yates, R., 64, Park Street, Southwark, London, S.E.
- Yglesias, M., 2, Tokenhouse Buildings, London, E.C.
- Yoshida, Hikokuro, Imperial University, Hongo, Tokyo, Japan.
- Young, A. C., 64, Tyrwhitt Road, St. John's, S.E.
- Young, Brougham, Home Lyn, Woodberry Down, London, N.
- Young, Fred., Tonge Lane, Middleton, Manchester.
- Young, Jno., 22, Belhaven Terrace, Kelvinside, Glasgow, N.B.
- Young, Jno., Clive Villa, Cemetery Road, Hanley.
- Young, J. R., 17, North Bridge, Edinburgh, N.B.
- Young, Dr. Sydney, 13, Aberdeen Terrace, White Ladies Road, Bristol.
- Young, T. Graham, Westfield, West Calder, N.B.
- Young, W. C., 22, Windsor Road, Forest Gate, E.
- Yule, Wm., Hendon Paper Works, Sunderland.

Z

- Zimmerman, A., 6, 7, Cross Lane, St. Mary-at-Hill, London, E.C.
- Zinkeisen, W., 30, Cochran Street, Glasgow.

List of Exchanges and Free Copies.

- "School of Mines Quarterly," cor. 49th Street and 4th Avenue, New York, U.S.A.
 "Engineering and Mining Journal," P.O. Box 1833, New York, U.S.A.
 "Iron," P. F. Nursey, 161, Fleet Street, E.C.
 "Engineering," Bedford Street, Covent Garden, W.C.
 "The Engineer," 163, Strand, W.C.
 "Iron and Coal Trades Review," 342, Strand, W.C.
 "Chemical News," Boy Court, Ludgate Hill, E.C.
 "Chemist and Druggist," 42, Cannon Street, E.C. 2 copies.
 "Journal of the Pharmaceutical Society," 17, Bloomsbury Square, W.C.
 "Oil, Paint, and Drug Reporter," 72, William Street, New York, U.S.A.
 "Journal of Gas Lighting," 11, Bolt Court, Fleet Street, E.C.
 "Textile Colourist," Philadelphia, Pa., U.S.A.
 "Chemical Review," c/o John Walsh, 47, Fetter Lane, Holborn, E.C.
 "L'Industria," 12, Via Meravigli, Milano, Italy.
 "Industries," 70, Market Street, Manchester.
 "Journal für Prakt. Chemie," J.A. Barth, Leipzig, Germany.
 "Brewer's Journal," F. W. Lyon, Eastcheap Buildings, Eastcheap, E.C.
 "Brewing Trade Review," Dr. Moritz, 72, Chancery Lane, W.C.
 "Journal für Gasbeleuchtung und Wasserversorgung," Prof. Dr. H. Bunte, Norwacksanlage 13, Karlsruhe.
 "Dingler's Polytechnische Journal," Herrn. Dr. H. Kast, Dozentum Polytechnikum, Karlsruhe, Germany.
 "Revue Industrielle," 48, Rue de Bondy, Paris.
 "Journ. de la Société de Mulhouse," Alsace, Germany.
 "Journ. de la Société Industrielle de Rouen," France.
 "American Chemical Journal," Prof. Ira Remsen, Baltimore, Md., U.S.A.
 "Chemische Industrie," Herrn. H. Heyfelder, Schönebergerstrasse 26, Berlin, S.W.
 "Bulletin de la Soc. d'Encouragement," 44, Rue de Rennes, Paris.
 Scheibler's "Rübenzucker Industrie," Herrn. Dr. C. Scheibler, Bleichenstrasse 6, Berlin.
 "Pharmaceutical Society" Library, 17, Bloomsbury Square, W.C.
 "Chemical Society of Paris," M. de Bechi, 44, Rue des Ecoles, Paris.
 "Royal Society," Burlington House, W.
 "Chemical Society," Burlington House, W. 2 copies.
 "Berliner Berichte" (Germ. Chem. Soc.), Dr. W. Will, 38, Georgenstrasse, Berlin, N.W.
 "Society of Dyers and Colourists," Bradford.
 The Society of Arts, John Street, Adelphi, W.C.
 "American Chemical Society," New York, U.S.A.
 "Society of Public Analysts," 325, Kennington Road, S.E.
 "Institute of Mechanical Engineers," Victoria Street, S.W.
 "Historical and Scientific Society," Winnipeg, Manitoba, Canada.
 "Philosophical Society of Glasgow," 207, Bath Street, Glasgow.
 The Librarian, "Royal Society of Edinburgh."
 "Geological Society of Cornwall," Penzance.
 The Librarian, Royal Institution, Albermarle Street, W.
 "Institute of Chemistry," Adelphi Terrace, W.C.
 "Institution of Civil Engineers," Great George Street, S.W.
 "Iron and Steel Institute," Victoria Street, S.W.
 "North of England Institute of Mining and Mechanical Engineers," Newcastle-on-Tyne.
 "Mining Institute of Scotland," c/o Jas. Barrowman, Portland Park, Hamilton, N.B.
 "Institution of Electrical Engineers," 4, The Sanctuary, Westminster, S.W.
 "City and Guilds of London Institute," South Kensington.
 "Chem. Centralblatt," Lessingstrasse 2, Leipzig, Germany.
 The Librarian, "Franklin Institute," Philadelphia, Pa., U.S.A.
 The Librarian, "Massachusetts Institute of Technology," Boston, Mass., U.S.A.
 The Imperial Institute, 1, Adam Street, Adelphi, W.C.
 "Fittica's Jahrsbericht der Reinen Chemie," Marburg, Germany.
 "University of Glasgow."
 "University College," Brownlow Street, Liverpool.
 "University College," Nottingham. Copy to Prof. F. Clowes.
 "Bodleian Library," Oxford. } These four copies to
 "University Library," Cambridge. } c/o G. W. Eccles,
 "Trinity College Library," Dublin. } 96, Great
 "Advocates Library," Edinburgh } Russell Street, W.C.
 University of Pennsylvania, Philadelphia, Pa., U.S.
 "Royal School of Mines," South Kensington, S.W.
 The Librarian, "Mason Science College," Birmingham.
 The Librarian, "Durham College of Science," Newcastle-on-Tyne.
 "Farb. Muster Zeitung," Gustav Weigel, 5, Bänderstrasse, Leipzig, Germany.
 The Librarian, "Owens College," Manchester.
 The Librarian, "Yorkshire College," Leeds.
 The Librarian, "Firth College," Sheffield.
 The Librarian, "Royal College of Science," Stephen's Green, Dublin.
 The Librarian, "Anderson's College," Glasgow.
 "Manchester Technical School," Manchester.
 "Monatshefte für Chemie der Kaiserliche Akademie der Wissenschaft zu Wien" (Herrn. G. Stephan, Secretary, Vienna).
 "Zeitschrift für Angewandte Chemie" Herrn. Julius Springer, Verlagsbuchhandlung, Montbijon Platz, 3, Berlin, N.
 "Chemical Club," Victoria Hotel, Manchester.
 Library of the British Museum.
 "Technological Museum," Sydney, New South Wales.
 "Mittheilungen der Tech. Gewerbe Museum," Herrn. Director Exner, Technologisches Gewerbe Museum, zu Wien, Austria.
 Dr. Quesneville, "Moniteur Scientifique," 12, Rue de Buci, Paris.
 "Patent Office Library," Southampton Buildings, W.C.
 Chemical Library, University College, Gower Street, W.C.
 Berichte der Oesterreichischen Gesellschaft zur Förderung der Chemischen Industrie, Prof. Dr. Gintl, Deutsche Technische Hochschule, Prag, Austria.
 Signor R. Nasini, Direttore della Laboratorio Chimico Centrale, Piazza Mastai, Roma.
 Dr. Fischer, 9, Alleestrasse, Germany, "Wagner's Jahrsberichte."
 Prof. Dr. Fresenius, Wiesbaden, Germany.

THE JOURNAL OF THE Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 1.—Vol. VIII.]

JANUARY 31, 1889.

[Non-Members 30/- per annum; Members
21/- per Set; Single Copies 2 6.]

The Society of Chemical Industry.

Past Presidents:

Sir H. E. Roscoe, M.P., LL.D., V.P.R.S.	1881—1882.
Sir Frederick Abel, C.B., D.C.L., F.R.S.	1882—1883.
Walter Weldon, F.R.S.	1883—1884.
W. H. Perkin, Ph.D., F.R.S.	1884—1885.
E. K. Muspratt	1885—1886.
David Howard	1886—1887.
Prof. James Dewar, F.R.S.	1887—1888.

COUNCIL FOR YEAR ENDING JULY, 1889.

President: Ludwig Mond.

Vice-Presidents:

Sir I. Lowthian Bell, F.R.S.	David Howard.
R. Forbes Carpenter.	Ivan Levinstein.
Prof. F. Clowes, D.Sc.	E. K. Muspratt.
Sir J. Neilson Cuthbertson.	Sir H. E. Roscoe, M.P., F.R.S.
Prof. James Dewar, F.R.S.	Prof. W. A. Tilden, F.R.S.
Dr. John Evans, F.R.S.	John Williamson.

Ordinary Members of Council:

Alexander M. Chace.	F. J. Rowan.
James Duncan.	Dr. Edward Schunck, F.R.S.
A. E. Fletcher.	E. C. C. Stanford.
S. H. Johnson.	J. C. Stevenson, M.P.
B. E. R. Newlands.	T. W. Stuart.
B. S. Proctor.	Thos. Tyrer.

With the Chairmen and Secretaries of Sections.

Honorary Treasurer:

E. Rider Cook, East London Soapworks, Bow, E.

Honorary Foreign Secretary:

Dr. Ferdinand Hurter.

General Secretary: Charles G. Cresswell.

Offices:

Palace Chambers, 9, Bridge Street, Westminster, S.W.

THE JOURNAL.

Publication Committee:

The President.

Sir F. A. Abel, F.R.S.	Prof. A. K. Huntington.
A. H. Allen.	F. Hurter, Ph.D.
Prof. H. E. Armstrong, F.R.S.	F. Jones, F.R.S.E.
G. H. Bailey, D.Sc., Ph.D.	Ivan Levinstein.
Joseph Bernays, M.I.C.E.	Prof. R. Meldola, F.R.S.
H. Brunner.	E. K. Muspratt.
W. Lant Carpenter.	C. O'Sullivan, F.R.S.
Prof. Frank Clowes, D.Sc.	John Pattinson.
W. Y. Dent.	W. H. Perkin, Ph.D., F.R.S.
Prof. Jas. Dewar, F.R.S.	Sir H. E. Roscoe, M.P., F.R.S.
John Heron.	John Spiller.
D. B. Hewitt, M.D.	A. Norman Tate.
David Howard.	Thomas Tyrer.
Prof. J. J. Hummel.	

Editor:

Walson Smith, The Owens College, Manchester.

ASSISTED BY THE FOLLOWING STAFF OF

Abstractors:

T. L. Bailey, Ph.D.	W. E. Kay.
G. H. Beckett.	A. J. King, B.Sc.
D. Bendix.	P. S. Kipping, D.Sc.
E. Bentz.	Chas. A. Kohn, Ph.D.
E. E. Berry.	F. W. T. Krohn.
E. J. Bevan.	T. A. Lawson, Ph.D.
Bertram Blount.	J. Walter Leather, Ph.D.
Arthur G. Bloxam.	A. Liebmann, Ph.D.
C. H. Bothamley.	D. A. Louis.
E. G. Clayton.	W. Maenab.
Julius B. Cohen, Ph.D.	G. Harris Morris, Ph.D.
C. F. Cross.	J. M. H. Munro, D.Sc.
A. R. Davis.	H. T. Pentemann.
W. W. Haldane Gee, B.Sc.	S. G. Rawson, B.Sc.
C. Napier Hake.	A. Rec, Ph.D.
S. Hamburger, Ph.D.	F. W. Renaut.
Oswald Hamilton.	A. Studer, Ph.D.
John Heron.	Bertram Thomas.
Bertram Hunt.	Eustace Thomas.
C. C. Hutchinson.	V. H. Velez, M.A.
D. E. Jones, B.Sc.	R. Lloyd Whiteley.
	A. Wingham.

NOTICES.

Members who require back numbers are requested to make application only to the General Secretary.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

Notice is hereby given, for the information of subscribers for this Journal, that Messrs. EYRE and SPOTTISWOODE, Her Majesty's Printing Office, East Harding Street, London, E.C., have been appointed sole agents for the supply of the Journal to non-members and the trade.

LIST OF MEMBERS ELECTED, 23rd JANUARY, 1889.

- Ashburn, Wm., 11, Westwood Street, Moss Side, Manchester, agent.
 Bailey, Richard D., City Brewery, Gloucester, brewer and chemist.
 Baldwin, Wm. A., 169, West 97th Street, New York, U.S.A., metallurgist.
 Bloede, Victor G., Patuxent and Dillon Streets, Baltimore, Md., U.S.A., manufacturing chemist.
 Bollough, Thos. A., Helsby View, Ditton, Widnes, engineer.
 Campbell, Jno. D., Crosby House, Thurlow Park Road, West Dulwich, S.E., technical chemist.
 Cliff, Cromwell, 30, Trentham Street, Runcorn, firebrick merchant.
 Coleman, Gurney F., University of Pennsylvania, Philadelphia, Pa., U.S.A., chemical student.
 Cunliffe, Jos., Rook Wood, Chorley, Lancashire, calico printer.
 Cunningham, A. Auchie, 13, Rutland Square, Edinburgh, analytical chemist.
 Curtis, Harry E., 1, Croft Villas, The Croft, Hastings, chemist and druggist.
 Duncan, Arthur W., 69, Market Street, Manchester, analytical chemist.
 Francis, Wm., jun., Chemical Laboratory, The University, Glasgow, chemist.
 Gunter, Evan, Nobel's Explosives Co., Ltd., Stevenston, Ayrshire, chemical engineer.
 Hall, Emile T., 1623, Spruce Street, Philadelphia, Pa., U.S.A., chemical student.
 Hecht, Jos., University of Pennsylvania, Philadelphia, Pa., U.S.A., chemical student.
 Heckmann, C., 9, Gortitzerufer, Berlin, S.O., Prussia, apparatus maker.
 Hooper, H. A., High Laboratory, Newcastle Chemical Co., Gateshead, analytical chemist.
 Horn, Wm., 156, Bath Street, Glasgow, analytical chemist.
 Hough, Oliver, 325, South 16th Street, Philadelphia, Pa., U.S.A., chemical student.
 Howorth, Franklin W., Lyme Grove, Church Road, Urnston, near Manchester, chemist.
 Jenkins, Thos., jun., Laboratory, Rio Tinto Works, Cwmavon, Port Talbot, Wales, chemist.
 Jones, John Arthur, Gijon, Spain, mining engineer and metallurgist.
 Kates, Clarence S., 1937, Spring Garden Street, Philadelphia, Pa., U.S.A., chemical student.
 Kent, Wm. H., Chaumont, Wokingham Road, Reading, Berks, head master.
 Leech, Fred. S., c/o B. G. Lemmon & Co., Cape Town, South Africa, chemist and druggist.
 Leese, Jos., Fylde Road Mill, Preston; and Palace Hotel, Birkdale, Southport.
 McArthur, Jno., 3, Nicosis Road, Wandsworth Common, S.W., chemist.
 McEwen, Jas., 11, Rushion Street, Hulme, Manchester, aerated water engineer.
 Master, Ardesheer B., 679, Tardeo, Bombay, India, manufacturer.
 Miller, Geo., 22, Trentham Street, Runcorn, Cheshire, chemist.
 Miller, Jno., Poynter, Sandilands Chemical Works, Aberdeen, chemist.
 Minatti, Theodore, Kenwood, Broom Lane, Higher Broughton, Manchester, chemist.
 Neilson, Thos., Distington Hematite Iron Co., Ltd., near Whitehaven, analytical chemist.
 Newbury, Spencer B., Cornell University, Ithaca, N.Y., U.S.A., professor of applied chemistry.
 Paterson, Alex., c/o B. G. Lemmon & Co., Cape Town, South Africa, chemist and druggist.
 Pattison, P. J., 11, Park Road, West Ham, E., chemist, colour.
 Peniston, A. H., 31, Disraeli Road, Upton, E., manager (Boor & Co.).
 Plumb, Ben M., Cowles Electric and Aluminium Co., 36, Lombard Street, E.C., managing director.
 Powell, Alf. E., 6, Dryden Street, Lonsight, Manchester, oil merchant.
 Reynolds, H. C., 8, The Avenue, Clifton, Bristol, retired army officer.
 Speckman, Jas., 7, Ward Road, Dundee, jute and oil merchant.
 Spoor, J. L., 30, Hotspur Street, Tynemouth, cement maker.
 Stroud, Walter R., 2035, Mount Vernon Street, Philadelphia, Pa., U.S.A., chemical student.
 Thomson, Dr. Andrew, 1, Blackness Crescent, Dundee, lecturer on chemistry.
 Walker, Jas. S. H., 304, Morningside Road, Edinburgh, chemical student.
 Wilson, Jos. A., Cross-fields, Tottington, near Bury, analyst.

CHANGES OF ADDRESS.

- Abraham, A. C., 10, Oxton; Stanley Rock, St. George's Mount, New Brighton (Journals); and 87, Bold Street, Liverpool.
 Beadle, Clayton, 10, Belvedere; c/o W. Joynson & Sons, St. Mary Cray, Kent.
 Bevan, Jno. W., 10, South View House; Avonmere, Shirehampton, near Bristol.
 Blackwell, G. G., 10, Chapel Street; 26-27, Irwell Chambers West, Fazerley Street, Liverpool.
 Budden, E. Russell; Camelot, Netherhall Gardens (not Terrace), South Hampstead, N.W.

- Byard, A. G.; Journal to Barriere des Minimes, Toulouse, France.
 Crane, Wm.; Journals to c/o Guillermo C. Tripler, Coquimbo, Chili.
 Crow, J. K., 10, West Drayton; Yiewsley, near Uxbridge.
 Divers, Dr. E., 10, College of Engineering; Hongo, Tokyo, Japan.
 Dixon, M. T.; Journals to P.O. Box, Johannesburg, South African Republic.
 Donald, W. J. A., 10, Belgrave Terrace; 27, St. Vincent Place, Glasgow.
 Dunn, Wm. Walton; Journals to 5, Cheapside, Tudhoe Grange, Spennymoor, co. Durham.
 Faulkner, F.; Journals to "The Laboratory," Langley, Oldbury, near Birmingham.
 Frankland, Dr. Percy, 10, London; University College, Dundee.
 Fulton, H. B., 10, Kirkintilloch; 33, St. Dunstan's Road, West Kensington, S.W.
 Grandage, H., 10, Bradford; Calder Dyeworks, Brighouse, near Leeds.
 Green, A. G.; Journals to 54, Thistlewaite Road, Lower Clapton, E.
 Greville, H. Leicester; Journals to 11, Lambton Road, Hornsey Rise, N.
 Hamilton, D.; Journals to 224, Ingram Street, Glasgow.
 Holland, Philip, 10, Albert Road; 3, Leicester Street, Southport.
 Hunter, F. W., 10, Newcastle; Newbottle, Fence Houses, co. Durham.
 Hutchinson, A. H.; Journals to 5, Derwent Grove, East Dulwich, S.E.
 Jenner, E., 10, Arthur Villa; Florence Villa, Murchison Road, Leyton, E.
 Lagerwall, Dr. Ivar, 10, St. Petersburg; 56, Rue de Joncker, Brussels.
 Langbeck, H. W., 10, Bromley by Bow; The Park, Loughton, Essex.
 Laurie, A. P., 10, Bayswater; Chemical Laboratory, People's Palace, Mile End Road, E.
 Leigh, C., 10, Sheffield; Seaham Chemical Works, Seaham Harbour, co. Durham.
 Lucas, Rich., 10, Middleton; 11, Dyne Road, Kilburn, N.W.
 Lunn, Collingwood, 10, Woodsome Lees; Penny Bridge, near Huddersfield.
 McKean, W.; Journals to Incandescent Gas Light Co., Ltd., 3, Victoria Mansions, Westminster, S.W.
 McKechnie, D. M., 10, Olive Mount; Roche Lea, St. Ann's, St. Helens.
 Mander, S. T.; Journals to Varnish Works, Wolverhampton.
 Marriott, Wm., 10, Belgrave Terrace; 88, Halifax Old Road, Huddersfield.
 Marsh, Walter, 10; 4; 83, York Terrace, Northam, Southampton.
 Mitchell, J. W., 10, Burnley Road; Holme Mill, Rawtenstall.
 Newton, A. H., jun., 10, Hampstead; 4, Croftdown Road, Highgate Road, N.W.
 Nishigawa, T., Journals to Go Bancho 14, Kojinachi, Tokyo, Japan.
 Norton, Prof. S. A.; Journals to 363, East Town Street, Columbus, Ohio, U.S.A.
 Palmer, T. C., 10, Haverstock Hill; 98, Commercial Road East, London, E.
 Pearson, Wm., 10, Mellor's Buildings; African Chambers, Old Hall Street, Liverpool.
 Pettigrew, Jno., 10, Stratford; 18, St. Helen's Place, Bishopgate Street, E.C.
 Saint, W. J., 10, Munich; Spitalstrasse 1, II., Erlangen, Bavaria.
 Saito, K., 10, Tokyo; Yosei Shikenjo, Osaka, Japan.
 Scott, G. H., 10, New Mills; 3, Alton Terrace, Fairfield, Manchester.
 Scrutton, W., 10, London; Aurora, Esmeralda Co., Nevada, U.S.A.
 Shapleigh, Waldron, 10, New York; Welsbach Incandescent Gas Light Co., Gloucester, N.J., U.S.A.
 Smith, Fred., 10, Sutton-on-Hull; Laboratory, 106, Queen Victoria Street, London, E.C.
 Smith, J. W., 10, Huddersfield; Massachusetts Institute of Technology, Boston, Mass., U.S.A.
 Stantial, F. G., 10, East Cambridge; c/o Cochrane Chemical Co., Everett, Mass., U.S.A.
 Thomas, Jos. W.; Journals to c/o D. R. Roberts, 10, Park Grove, Cardiff.
 Thomas, S. Percy, 10, Stratford; Chemical Laboratory, Royal Veterinary College, Edinburgh.
 Underwood, G. R., 10, Boston; Box 660, Peabody, Mass., U.S.A.

CHANGE OF ADDRESS REQUIRED.

- James, J. H., 10, 33, Old Broad Street, E.C.

Deaths.

- Bush, W. J., 20, Artillery Lane, London, E.C. January 10th.
 Young, Robt., 3, Radstock Road, Liverpool. September 3rd.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	R. Messel.
H. E. Armstrong.	B. E. R. Newlands.
W. Lant Carpenter.	B. Redwood.
W. Crowder.	T. Royle.
W. J. Dibdin.	John Spiller.
C. Graham.	Wm. Thorp.
S. Hall.	C. R. Alder Wright.
C. C. Hutchinson.	

Hon. Local Sec. and Treasurer:

Thos. Tyrer, Garden Wharf, Battersea, S.W.

SESSION 1888-89.

The Fourth Meeting of the Section will take place on Monday, February 4th, 1889.

Papers to be read by—

Dr. T. L. Thorne. "On some Industrial Applications of Oxygen."

Dr. J. Walter Leather. "Notes on Laboratory Apparatus."

Monday, March 4th, 1889.

DISCUSSION.—"In what direction is State Aid needed to assist Technical Education in Chemistry?"

Messrs. Higgins and Heron's paper on "Cider" is postponed.

Meeting held Monday, January 7th, 1889.

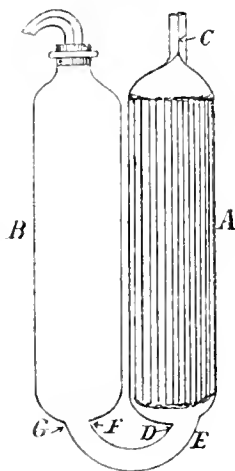
MR. DAVID HOWARD IN THE CHAIR.

ON A MODIFIED "ORSAT" APPARATUS.

BY JOHN RUFFLE.

On pages 47 and 84 of "Winkler and Lunge's Technical Gas Analysis," 1885, are cuts showing Orsat's apparatus for rapid estimation of oxygen, &c. in gases. On page 47 the parts marked *c*, *c'*, *c''*, and on page 84 the parts marked *h*, *d*, *e*, *b*, are bulbs of the shape as in the below Figure No. 1 (side view):—

Fig. 1.



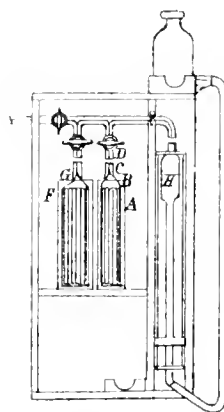
The part A is filled with short lengths of very narrow glass tubing, which, when wetted by the reagent used in the analysis—caustic potash, pyrogallate of potash, &c.—provide a large absorbing surface; B is a reservoir for the solution when it is driven out of A. The gas to be examined enters and is withdrawn through a capillary tube at C. The weight of the glass tubing in A presses on the joints at D and E, whilst the weight of the solution when in B presses on the joints at the bend F and G. These parts are therefore weak, and are, in practice, found to break easily and frequently, especially if the apparatus has to be carried about. Even when used in one place the filling and emptying, cleaning, &c. too frequently results in a breakage; also in manufacturing, the final fixing of the capillary tube C is found extremely difficult, and many bulbs are spoiled through the bulk of the tubing in interior of A prematurely cooling the glass and causing fracture, adding materially to the expense of the apparatus.

To avoid these numerous breakages, and make the whole easier and simpler to manufacture and work, I have adopted the form of bulb in Figure No. 2.

A is an upright cylinder closed at bottom, B is a cylinder-shaped bulb with open mouth at bottom and is at C suspended to D by india-rubber tubing, so that its open mouth is kept about a quarter of an inch from the bottom of A. B is nearly filled with a number of short pieces of narrow glass tubing, C is a capillary tube, and, by it, the gas to be tested is passed in and out.

This form of bulb allows the whole weight of the

Fig. 2.



solution and of the glass tubing to rest on the flat bottom of A, and, this standing on a piece of board, gives the whole a firm support. It is not easy to break, can be carried about without anxiety, and is easily and readily cleaned. The manufacture of such shaped apparatus is easy, so tending to cheapen it.

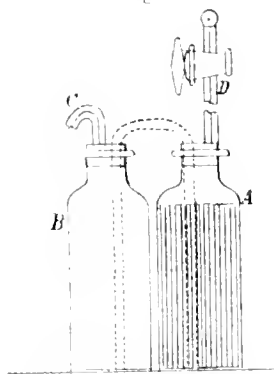
F and G are duplicates of A and B.

H is the usual 100 cc. pipette to measure off the 100 cc. of gas to be analysed. A, B, F, and G, are in due proportion to allow the 100 cc. to be manipulated.

This form of bulb answers very well; the 100 cc. of gas when passed out of H goes through D and C into B, causing the solution of caustic potash, &c. (with which B has been previously filled) to fall in B and rise on the outside in A around B. The gas passing back into H allows the solution to flow back from A into B, which is then ready for the next trial.

However simple an apparatus may be, it often happens that it is broken, and much inconvenience arises through sending to the makers for repairs. In view of this, Mr. James MacLachlan has proposed an arrangement which, as long as its joints are kept tight, is thoroughly efficient and has the great advantage of being easy to find and to replace in any factory. Figure No. 3 is a side view:—

Fig. 3.



It consists of two 4 oz. bottles, A and B, with pieces of glass tubing in A. In the mouth of B is a two-holed cork with an air tube C in one hole, and in the other a syphon tube, the limbs of which are of about equal length; one reaches nearly to bottom of B, the other passes through a hole in the two-holed cork in neck of A, and goes nearly to the bottom of A. The other hole in the cork of A is filled by a piece of capillary tube and attached by a piece of india-rubber tubing to the supply capillary tube D, as in preceding figures. The gas to be examined is forced from the 100 cc. measuring tube into A, forcing out the solution of potash, &c. previously filled in) through the syphon tube into B, and, after due exposure, the gas, on withdrawal, draws back the solution from B into A. These 4 oz. bottles are cheap, easy to obtain, and stand firmly.

It would be to the advantage of sulphuric acid makers if they were to use an "Orsat" or some similar apparatus for examination of their kiln and chamber gases, &c. instead of working by rule of thumb as so many do. Frequently they say "we use as little nitre and are doing as well as so and so," not thinking that by due examination of their gases and use of a little common sense a higher efficiency and economy could be obtained.

Mr. A. E. FLETCHER said he could testify to the utility of the Orsat apparatus. The convenience found in its use made it very suited to the needs of large coal consumers, many of whom were now finding the advantage of making frequent examination of their gases of combustion. Professor Lunge had added to the apparatus originally devised by Orsat, a tube containing palladium-asbestos. The gas remaining after the absorption of the CO_2 , CO , and O , originally contained in it, was mixed with air and passed through this tube, previously heated by means of a spirit lamp. The hydrogen was thus burnt and its volume estimated.

It could hardly be said that the form of the absorbing glasses now shown was new, as the diving-bell arrangement had been in use many years. In the apparatus used by himself the cylinders were kept from the air by means of a rubber cover connected with a small bladder. In some forms of the apparatus the stop-cocks were dispensed with, small beads of glass inside the connecting rubber tubing

taking their place, as in the case of the Mohr's burette. A slight pressure of the fingers outside the tube made a passage for the gas by the side of the glass bead. Thus, all chance of a leaky stop-cock was avoided. Since water and not mercury was used in the measuring vessel, objection might be taken to the possibility of error arising from the absorption of carbon dioxide.

ON THE ESTIMATION OF GLYCERIN IN SOAP LYES AND CRUDE GLYCERIN.

BY OTTO HEHNER.

GLYCERIN in its various stages of purification, as soap lyes, crude, dynamite, and pure glycerin, has of late years become an article of commerce of very considerable importance. There are now, happily, but very few, if any, manufacturers of soap who do not utilise their liquors for the preparation of glycerin in some form or other. Some may prefer to sell their concentrated liquors, others to refine them, but all endeavour to obtain the utmost value for the substance which, until quite lately, was ignorantly thrown away.

With this progress accurate direct processes for the determination of the percentage of the glycerin itself were naturally felt to be required, and the indirect methods of valuing the articles in which glycerin is the essential constituent, became insufficient. The specific gravity, together with the boiling point, or boiling point and ash, sufficient as guides to the manufacturer, gave indications too crude and indefinite to serve as means to arrive at exact commercial values, the specific gravity and boiling point being largely influenced by the quantity of valueless impurities present, such as fatty acids and resinous substances, and by the quality and composition of the saline constituents which are contained in every soap lye to a very large amount.

A number of methods of glycerin estimation have in consequence been more or less worked out, but their agreement among themselves, or in different laboratories, is frequently so unsatisfactory, that disputes between manufacturers and buyers continually arise, occasioning pecuniary loss to the merchants and discrediting the analysts with both parties concerned. It is therefore extremely desirable that some kind of an agreement be arrived at with a view to eliminate processes which do not answer the present requirements. In this hope I venture to bring forward some of my experiences in this matter, without pretence of having exhaustively investigated so difficult a subject.

The chief methods to be considered are the following:—

- (1.) The extraction of glycerin from the concentrated liquors by means of alcohol and ether, and its direct determination by evaporation.
- (2.) The conversion of glycerin into mono-phalbic glycerin by lead oxide.
- (3.) Oxidation by bichromate.
- (4.) Conversion into triacetin by acetic anhydride.

1. Direct Extraction.

The specific gravity of the sample is taken, from 20 to 25 cc. are pipetted into an evaporating basin, then neutralised with dilute sulphuric acid should the liquor be alkaline (which is usually the case), and evaporated on a water-bath to a syrupy consistence. After cooling, a mixture of one part of ether and two of alcohol is added, and the saline precipitate is well broken up by means of a small pestil. Filter into a

weighed beaker, and well wash the precipitate with ether-alcohol. The solvent is then evaporated on the water-bath, and the residue is heated to 110° C. until the weight is as constant as possible. In this residue the ash must then be determined, and subtracted from the total weight, the remainder being taken as pure glycerin.

The defects of the method are twofold:—Ether-alcohol extracts not only the glycerin, but a considerable portion of the organic impurities of the crude sample, and these are counted as glycerin. The fatty and resinous matters, as far as they are soluble in the neutralised glycerin, are so counted. On the other hand, loss by volatilisation cannot be avoided, counterbalancing the former error to a more or less extent, and generally exceeding it, so that the results are, as a rule, too low, as indeed are those of all direct extractions.

On the subject of volatility of glycerin I may here refer to some results of mine which I have previously published in the "Analyst" (Vol. xii., p. 65).

There cannot be a doubt that glycerin is volatile, for on heating concentrated glycerin solutions on a water-bath thick white fumes of glycerin can be seen to be given off, and the weight of the glycerin diminishes considerably and constantly. But it is generally believed that even dilute aqueous solutions of glycerin lose considerably by boiling; that, in fact, glycerin is volatile with aqueous vapour. This belief rests upon no solid foundation. From solutions containing as much as 50 per cent. of glycerin, no glycerin is expelled by two hours' boiling if care is taken that the escaping water is continually replaced. Even a 74 per cent. solution suffers under these circumstances but a most trifling loss, amounting to from 1 to 2 per cent. only. The volatility commences when solutions have obtained a higher concentration than this, and at temperatures beyond 100°, say at 110°, as prescribed and practised in large continental dynamite works, the loss is anything the operator may like to make it.

Unless the final evaporation of the ether-alcohol and water be performed in vacuo, the direct extraction method is therefore quite useless, but against this refinement of the process the length of time requisite for the analysis materially militates.

2. The Lead Oxide Method.

Two grms. of the sample are mixed with about 40 grms. of pure litharge, and heated in an air-bath to 130° C. until the weight becomes constant, care being taken that the litharge is free from such lead compounds and other substances as might injuriously affect the results, and that the heating of the mixture takes place in an air-bath free from carbonic acid. The increase in weight of the litharge minus the weight of substance not volatilisable from 2 grms. of the glycerin at 160° C., multiplied by the factor 1.243 is taken as the weight of glycerin in the 2 grms. of the sample.

In very many cases this method gives very good results, well agreeing with those obtained by the other methods to be considered. In other cases the agreement is not so satisfactory.

In glycerins of fair purity, containing almost exclusively sodium chloride and glycerin, and but little other organic matter, the method operates well. But in samples containing notable quantities of free alkali, of sulphates, or of resinous matters, the results are, in my opinion, faulty. From such samples it is wellnigh impossible to volatilise the whole of the glycerin at 160°, even by very long continued heating. Consequently there is a tendency to obtain results which are too low. On the other

hand, it being all but impossible to construct an air-bath in which there is no carbonic acid, which is absorbed by the free caustic alkali either naturally contained in the article or formed by the action of the lead oxide upon the sulphates, there is a counterbalancing influence.

The method enjoys extensive use, but it is so slow, and open to so many objections, that I cannot consider the results obtained by means of it as absolutely trustworthy.

3. The Bichromate Method.

Pure glycerin, heated with bichromate and sulphuric acid, is quantitatively oxidised to carbonic acid, as I have shown by numerous experiments previously published (Analyst, XII., p. 44). In the case of very strong and pure glycerins the carbonic acid evolved may be measured or weighed, as proposed by Cross and Bevan, and Legler, but in impure and crude glycerins previous preparation of the sample and removal of impurities is necessary, causing such dilution of the sample that the carbonic acid evolved cannot be conveniently estimated. I prefer to operate as follows:—

Solutions required:—

1. Bichromate, containing in each litre about 74.86 grms. of bichromate and 150 cc. of strong sulphuric acid. The exact oxidising value of the solution must be ascertained by titration with solutions of known quantities of iron wire, or pure ferrous ammonium sulphate.
2. Ferrous and ammonium sulphate solution containing about 240 grms. per litre.
3. Bichromate solution ten times more dilute than the above. The ferrous solution is exactly standardised upon the chromate solution, and the glycerin value of the chromate (contents of bichromate divided by 7.486) is calculated.

With pure glycerins the oxidation is absolutely quantitative.

Crude glycerins must be treated as follows:—For the removal of chlorine and of aldehydic compounds some oxide of silver is added to a weighed quantity of the sample (about 1.5 grms.), which is placed into a 100 cc. flask. After slight dilution the sample is allowed to stand with the silver oxide for about ten minutes. Basic lead acetate is then added in slight excess, the bulk of the fluid made up to 100 cc., and a portion is filtered through a dry filter. 25 cc. of the filtrate are placed into a beaker, previously well cleaned with sulphuric acid and bichromate to remove all traces of fat, from 40 to 50 cc. of the standard bichromate solution are added, accurately measured, then about 15 cc. of strong sulphuric acid, and the beaker, covered with a watch glass, is heated for two hours in boiling water. After that time the excess of bichromate is titrated back with ferrous ammonium sulphate solution.

As the bichromate solution is necessarily a somewhat strong one, the measuring must be done with the greatest care; some attention must be paid to the temperature at the time of measuring. I find that a bichromate solution of the strength indicated expands for each degree C. .05 per cent.

The results upon repetition agree well. Instead of basic lead acetate, copper sulphate and potassium hydrate may be used for precipitation of organic impurities, but I prefer, and always use, the former.

Practically the method is rapid and presents no difficulty whatever. It is open to the objection that by precipitation by lead the impurities may not be perfectly removed, anything left being oxidised and counted as glycerin. All higher fatty acids and all resinous acids, as well as albuminoids, sulphides,

sulphocyanates, and aldehydes, are, however, completely removed, and the lower fatty acids, such as acetic and butyric, are not attacked by bichromate. The filtrates after precipitation are perfectly colourless.

In the earlier stages of my experience with this method no special precaution was taken to guard against the evolution of chlorine during the oxidating. Indeed, experiments made to test the influence of free hydrochloric acid, although giving results slightly too high, seemed to show that free hydrochloric acid was without influence on the result.

Later experiences caused me to modify my opinion, as in the case of crude glycerins containing much sodium chloride an odour of chlorine could sometimes be observed. This loss of chlorine is slight when the liquor is heated, as described, in boiling water, but becomes notable when it is boiled over the naked flame. Thus two oxidations of the same sample, without silver oxide, furnished 82.69 per cent. of glycerin on the water-bath, and 83.83 per cent. over the naked flame. The addition of oxide of silver removed this possible source of error.

Nevertheless, the force of the theoretical objection that the precipitation of impurities, which might increase the result, is incomplete, must be allowed. I will, however, show subsequently that the objection is a merely theoretical one.

4. The Acetin Method.

This method, quite lately published by Benedikt and Cantor, depends upon the conversion of glycerin into triacetin and the saponification of the latter, and reduces the estimation of glycerin to an acidimetric operation.

About 1.5 grms. of the crude glycerin are heated to boiling with 7 grms. of acetic anhydride, and 3 to 4 grms. of anhydrous sodium acetate under an upright condenser for 1½ hours. After cooling, 50 cc. of water are added, and the mixture heated until all triacetin has dissolved. I prefer not to boil, as described by the authors, because triacetin rapidly hydrolyses.

The liquid is then filtered into a large flask, the residue on the filter is well washed with water, the filtrate quite cooled, phenolphthalein is added, and the fluid exactly neutralised with a dilute (2—3 per cent.) alkali solution, the strength of which need not be exactly known. 25 cc. of a 10 per cent. caustic soda solution, which must be accurately standardised upon normal acid, are then pipetted into the liquor, which is heated to boiling for 10 minutes to saponify the triacetin, and the excess of alkali is then titrated back with normal acid. 1 cc. of normal acid corresponds to .03067 gm. of glycerin.

The method is rapid and extremely simple. With certain precautions the results are quite concordant.

These precautions are:—

The heating at the various stages of the operation must be done under the reflux condenser, the triacetin being somewhat volatile.

The sodium acetate used must be quite anhydrous. The salt purchased as anhydrous has never by me been found to be so. It must therefore be freshly and cautiously heated before use. If this be not done the conversion of the glycerin into the triacetyl compound is imperfect. Thus a sample of pure glycerin, containing 98.5 per cent. of real glycerin, yielded the following results:—65.9, 72.2, 74.4, and 66.0 per cent. of glycerin; another sample, of crude glycerin, with 79.2 per cent. of real glycerin, gave 67.6 per cent., imperfectly dehydrated acetate being used before my attention had thus been drawn to the importance of the precaution.

Triacetin in contact with water gradually decomposes. Hence, after acetylation is complete, the operations must be conducted as rapidly as possible. This necessity is illustrated by the following figures. A crude glycerin by the acetin method, properly carried out, was found to contain 80.9 per cent. of glycerin. When 15 minutes were allowed to elapse, after addition of water to the mass containing acetic anhydride, only 78.3 per cent. were found; after one hour only 76.9. In the case of another sample, with 79.7 per cent. of real glycerin, 77.7 per cent. were found after one hour's standing. And, lastly, in a sample with 84.0 per cent., only 79.6 were found after one hour.

More marked still is the action of alkali upon the triacetin, and it is necessary therefore to neutralise the free acetic acid after acetylation as cautiously as possible, and with rapid agitation of the diluted liquor, so that the alkali may not be locally in excess more than is unavoidable. The determination becomes quite inaccurate if the fluid is over-neutralised, even if the excess be titrated back as rapidly as possible. A sample of concentrated soap lyes, which, when properly analysed, gave 50.9 per cent. of glycerin, showed but 40.9 in an experiment where over-neutralisation was allowed to take place for a very short time.

It is seen that however perfect the method may be theoretically, practically it has a tendency to yield results somewhat below the truth.

I need not in detail refer to the permanganate method, originally proposed by Fox and Wanklyn, and afterwards modified by Benedict and Zsigmondy, which depends upon the oxidation of glycerin into oxalic acid by means of alkaline permanganate. The method has been abandoned by Benedict himself in favour of the acetin method, and has never, in my hands, given anything like accurate results.

I have compared the bichromate method, as used by myself, and the triacetin method in a large number of cases, and give, in the following table, some of the results:—

	Bichromate Method.	Acetin Method.
Pure glycerin.....	98.48	98.5
" "	98.58	
" "	98.53	
Crude glycerin, without use of Ag_2O	80.25	97.9
" "	80.39	
" "	80.39	
Same, with Ag_2O	79.19	79.25
" "	79.14	
" "	79.56	
Crude glycerin, with Ag_2O	83.14	83.3
" "	82.79	
" "	81.53	
" "	78.57	78.9
" "	79.04	
" "	79.04	
" "	80.21	80.9
" "	80.83	
" "	80.83	
" "	80.52	79.7
" "	80.14	
" "	80.14	
" "	79.63	79.2
" "	79.11	
" "	79.11	
" "	82.78	82.5
" "	80.96	
" "	80.96	
" "	80.32	80.25
" "	80.46	
" "	80.46	
" "	83.32	82.3
" "		
" "		

	Bichromate Method.	Acetin Method.
Crude glycerin, with Ag_2O	78.13	78.05
" "	77.81	78.0
" "	80.85	80.75
" "	83.4	84.1
Concentrated soap lye	32.84	31.47
" "	50.352	50.9
" "	50.593	

The general agreement between these results is very marked, the differences in most cases being evidently within the range of experimental errors. This agreement between the results of two methods so widely different in principle shows that both methods measure, as nearly as possible, the real glycerin present. To ensure the greatest amount of accuracy, I advise always to use *both* methods upon any sample to be analysed, and to take the mean of the two results.

In the case of very dilute liquors, such as the unconcentrated soap lyes, previous concentration of the sample to about 50 per cent. of glycerin is necessary with the acetin method, which fails when the proportion of glycerin falls as low as 30 per cent. In such cases I prefer to use the bichromate oxidation only.

The estimation of glycerin in fats and soaps is carried out as follows:—Saponify about 3 grms. of the fat with alcoholic potash solution; do not drive off the alcohol, but dilute the soap solution to about 200 cc.; decompose with dilute sulphuric acid, filter off insoluble acids, which may be estimated as usual. Then vigorously boil the filtrate and washings, amounting altogether to about 500 cc., in a covered beaker down to one-half, then add sulphuric acid and standard bichromate as described. A few results thus obtained are as follow:—

	Glycerin.
Olive oil.....	10.26
Cod liver oil.....	9.87
Linseed oil.....	10.24
Margarine.....	10.01
Butter.....	12.4
"	11.96

It may be worth while to refer to two other points on which manufacturers of crude glycerin generally desire information, namely, the percentage of salts and the specific gravity.

Both determinations should and do not present any difficulty, yet wide discrepancies not unfrequently occur when the same sample is placed into the hands of different chemists. This is a matter of some importance, because the sale contracts generally contain some clause limiting the admissible percentage of salts.

A sample, drawn from bulk, yielded me 11.26 per cent. of salts, to a well-known firm of chemists, Messrs. Teschemacher and Smith, only 9.00 per cent. Another sample, from the same manufacturers, to myself, 10.75, to Messrs. Teschemacher, 10.05 per cent. Duplicate samples were then placed into the hands of Mr. Norman Tate and Mr. Bernard Dyer, who found 10.78 and 10.85 per cent. respectively.

The obvious precaution in estimating percentage of salts is never to allow the platinum dish in which the sample is burnt to become red hot, but to burn over an Argand burner at the lowest possible temperature. 1 to 2 grms. of crude glycerin generally burn white in from one to two hours, if the dish

be covered with a platinum lid: frequently much more quickly.

Mr. H. D. Richmond estimates the ash more expeditiously and hardly less accurately, by carbonisation of the sample, and the addition of a little strong sulphuric acid, the residue being burnt white over a good Bunsen flame. The sulphated ash, multiplied by .8, closely agrees with the ash found without sulphating, although in the products of different manufacturers slight variations in this respect may be observed, as is seen from the following table of results:—

CRUDE GLYCERINS.

Sample.	Ash.	Sulphated.	Multiplied by .8.	Difference.
1	12.29	15.40	12.32	+ .03
2	11.06	13.96	11.12	+ .06
3	11.37	14.08	11.26	— .11
4	10.90	13.40	10.72	— .27
5	11.08	13.76	11.51	— .07
6	10.63	13.46	10.77	+ .11
7	9.24	11.41	9.13	+ .11
8	9.71	11.70	9.36	— .35
9	10.60	13.62	10.20	+ .30
10	9.38	10.52	9.22	— .16
11	8.83	11.05	8.84	+ .01
12	8.74	10.92	8.74	..
13	8.81	10.52	8.42	— .39
14	8.89	11.19	8.95	— .06
15	9.88	12.31	9.87	— .01
16	9.62	11.97	9.58	— .04
17	8.75	10.87	8.70	— .05
18	10.18	12.63	10.10	— .08
19	10.55	13.00	10.40	— .15
20	9.18	11.83	9.48	..
21	11.74	14.72	11.77	+ .03
22	10.78	13.32	10.65	— .13
23	10.66	13.44	10.75	+ .09
24	10.78	13.54	10.83	+ .05
25	9.22	11.52	9.22	..
26	10.30	12.88	10.31	+ .01
27	10.10	12.54	10.13	+ .03
28	16.07	19.26	15.41	— .66
29	10.68	12.90	10.32	— .36
30	10.76	12.98	10.38	— .38

The theoretical factor, assuming that the whole of the ash consisted of sodium chloride, would be .824.

The factor for glycerins made by one and the same manufacturer is fairly constant, most of the above samples which furnished low figures by the sulphuric acid method coming from one works.

The specific gravity is generally taken in glycerin works by means of the specific gravity balance. An excellent form of instrument is made by Sartorius, of Göttingen. In consequence of the great viscosity of glycerin the balance works, however, very slowly, and variations in the reading, amounting up to .002,

are observed. For these reasons I prefer the use of a Sprengel tube, which is filled by means of an air pump with the glycerin previously heated, to reduce viscosity, in a closed flask, on the water-bath. The tube is then immersed in water of 15.5°. Should the temperature be not exactly 15.5°, a correction in the gravity may be made of .00058 for each degree C.

The specific gravity of pure glycerin, of course, is a measure of the glycerin itself. A number of very contradictory tables have been published; the one which, according to my experience, is of satisfactory accuracy being that of Lenz (Zeits. Anal. Chem. XIX., page 302). Lenz, however, took his specific gravities at temperatures varying from 12°—14° C. By means of the above factor Mr. H. D. Richmond has recalculated Lenz's table to 15.5° C.

Percentage.	Sp. Gr. at 15.5°.	Percentage.	Sp. Gr. at 15.5°.
100	1.2674	87	1.2327
99	1.2647	86	1.2301
98	1.2620	85	1.2274
97	1.2594	84	1.2248
96	1.2567	83	1.2222
95	1.2540	82	1.2196
94	1.2513	81	1.2169
93	1.2486	80	1.2143
92	1.2460	79	1.2117
91	1.2433	78	1.2090
90	1.2406	77	1.2064
89	1.2380	76	1.2037
88	1.2353	75	1.2011

I will illustrate the discrepancies, by no means uncommon in the analysis of glycerin, by a recent case, which may be taken as a typical one.

A consignment of crude glycerin sent from England to Hamburg was analysed by five different chemists, all operating upon identical samples.

	Glycerin.
	Per Cent.
1. The purchaser's chemist found.....	71.9
2. Dr. Fresenius.....	73.74
3. Schalkwyk and Pennink, Rotterdam.	76.63
4. N. Tate.....	77.24
5. Hehner	(a) 80.32
	(b) 79.35
	(c) 79.29

Chemist No 1 uses the direct alcohol-ether extraction; Professor Fresenius the permanganate process; Schalkwyk and Tate the lead oxide method. My own figures, higher than any of the other chemists, were obtained (a) by oxidation by bichromate without the use of silver oxide; (b) by bichromate with silver oxide; (c) by the acetic process. No agreement, except of the two latter estimations, is observable in the above series of analyses.

I hope that my observations will lead to something like agreement between different analysts as to the mode of procedure to be adopted. My own recommendations are—

The use of both bichromate and acetic anhydride methods, taking the average of the results.

The sulphatising of the ash, as this excludes almost all possibility of difference between two observers.

I gladly express my thanks to my assistant, Mr. H. D. Richmond, who has carried out most of the analyses, the results of which are given in this paper, and who has aided me throughout my investigations on the subject.

DISCUSSION.

The CHAIRMAN said it was most useful and interesting to have such papers as that presented by Mr. Hehner, throwing light upon rare methods of analysis. It was a striking evidence of the advance of industrial chemistry that such analyses as Mr. Hehner had described should be called for; not many years ago they would have been quite needless, for the industrial use of glycerin had begun well within his memory. As out of the way products, such as glycerin once was, were introduced into industrial work and grew in importance, it of course became necessary that really accurate methods of analysing them should be discovered. The two methods described by Mr. Hehner had this great advantage, that while producing thoroughly concordant results, they were of a totally different nature. By merely varying the same method, one might without much difficulty get results according with each other, but in such cases there was always ground for suspecting that there might be the same source of error in each analysis and therefore remaining undiscovered. But when the two methods employed were so essentially different, the probability of the common result being correct was enormously increased. He thought, therefore, that Mr. Hehner had demonstrated the superiority of the two methods which he proposed.

Mr. W. F. REID, having had considerable experience of the practical tests used by the largest consumers of glycerin, the dynamite manufacturers, thought it might interest the meeting to hear some account of those processes. In the first place, all scientific analytical tests such as Mr. Hehner had described were regarded as almost useless in the dynamite factory. They used such methods as far as possible, but they mainly depended on a series of practical tests. The first step was to ascertain the amount of chlorine in the glycerin. If a sample showed much chlorine, it was at once rejected, chlorine being one of the greatest sources of danger in a dynamite works. The next test was to gently warm the glycerin with sulphuric acid. If it discoloured the acid much, the glycerin was rejected as being likely to cause heating in the nitrating vessel. For the detection of the fixed substances they heated the glycerin in a platinum capsule. They did not take the great precautions indicated by Mr. Hehner during this evaporation, and no doubt small portions of the mixed substances passed off with the glycerin. But they did not trouble about that. If they found an appreciable residue they rejected the glycerin, not on account of the danger, but as containing impurities in themselves useless. Of course crude glycerin was not used for nitrating purposes, as it would be dangerous. They tested that body practically by distilling it in superheated steam. That was the best test of its suitability for manufacturing purposes. There might be a certain percentage of pure glycerin in a crude glycerin; but there were also complex organic bodies present which destroyed a proportion of the glycerin on distillation, and thus prevented the manufacturer from getting the yield of pure glycerin which analysis indicated as being obtainable. The final test of the pure glycerin was nitration. Nitration was done in the ordinary way and with the usual acids used in the factory. He

had tested a number of the analytical methods mentioned by Mr. Hehner, and had found them all wanting. He hoped that Mr. Hehner's new methods would prove more successful: in the meantime, however, he should adhere to the old practical tests of the dynamite makers.

Dr. C. ALDER WRIGHT said that he could not claim much acquaintance with the most recent processes for the analysis of crude glycerins and distilled glycerins, his own experience having been chiefly confined to glycerin extracted from soap lye in the ordinary way, and examined by the older methods. In one respect, however, his own experience agreed with Mr. Hehner's, namely, that a dilute solution could be evaporated down without any appreciable loss of glycerin—though without doubt volatilisation did take place when glycerin was concentrated. He would like to ask the last speaker (Mr. W. F. Reid) what was the relation between the practical yield of nitroglycerin obtained by nitration after the purification of crude glycerin by distillation, and the values given by accurate analytical processes. To a manufacturer he supposed that, as a rule, it was a matter of less interest to know what was actually contained in his crude material than what could practically be got out of it; just as an alkali maker would not so much want to know for ordinary purposes the total sodium carbonate in his black ash as how much could in practical working be dissolved out by water; the proportion retained undissolved as double carbonate of sodium and calcium being of less moment to him. Similarly in the case of the preparation of quinine, he thought the Chairman would agree with him that usually it was the amount of quinine that could be extracted by practical working processes that was important rather than the determination of the absolute quantity of quinine in the bark by some method not available in actual manufacture. He was, therefore, desirous of learning what relation the results of these rough practical tests bore to those of the refined methods described by Mr. Hehner.

Mr. W. F. REID said that with the permission of the Chairman he would answer Dr. Wright's question at once. The practical yield was always lower, because of the solubility of the nitroglycerin in the acids which were used to nitrate it. They had tried to precipitate the nitroglycerin from the acids by dilution with water, but had found it to be also to some extent soluble in the acid water; so that only a small proportion of the dissolved nitroglycerin could be recovered in that way. The best method was to freeze the solution. He was quite aware that the tests he had described could not be considered accurate quantitative methods; but they were tests which enabled manufacturers to know what results to expect in actual working, those results being always considerably below the theoretical yield of pure glycerin,—roughly speaking, he would say at least 5 per cent. below it.

Mr. S. HALL (E. Rider Cook and Co.) said that he could confirm Dr. Wright's remark that there was very little loss of glycerin in evaporating dilute solutions—up to about 75 or 80 per cent. That was his experience of working on the large scale. He had tested large quantities of lyes, and determined the glycerin by the lead method, and had usually found the loss from an 80 per cent. solution to be under 1 per cent.

Mr. HEHNER, in reply, said that his paper was strictly confined to the estimation of glycerin in crude glycerides, whereas the remarks of Mr. Reid related almost entirely to the testing of dynamite

glycerins, which was quite a different matter. The fitness of a glycerin for dynamite manufacture depended upon its *purity*. Such glycerins should not contain more than mere traces of salts, whereas all the glycerins he had spoken of contained about 10 per cent. of salts. He might thus dispose of Mr. Reid's remarks as being founded on a misconception of the purpose of his paper. But apart from that, he felt bound to protest against the idea that the practical results of distillation should override the scientific methods of estimating the glycerin itself. If he, as an analyst, was required to state the amount of loss of glycerin which every manufacturer would incur in working, he would prefer to give up glycerin analysis altogether. The amount of loss must depend upon careful or careless working; in the one case it might be very low, in the other case very high; but that was the manufacturer's business and not the analyst's. It must be remembered that the glycerin industry was comparatively new. If they allowed the theory to take root that although there was a certain percentage of glycerin present, manufacturers could only expect to get out so much less, improvement would be stopped and the whole industry would go to sleep. Manufacturers ought to get *all* out if possible, and therefore he endeavoured to tell them exactly how much was present.

Mr. A. H. HUTCHINSON inquired whether Mr. Hehner's crude glycerins were alkaline, acid, or neutral. To which Mr. Hehner replied that they were generally alkaline; but that their condition in that respect depended on the stage at which they were received from the manufacturer.

The CHAIRMAN, in proposing a vote of thanks to the author, said that he sympathised with the views of both Mr. Hehner and Dr. Wright. It was desirable that the manufacturer should be informed on both points:—What the crude material he bought consisted of, and what he ought to get out of it; and the nearer he got his practical results to agree with what they ought to be the better for him. There were certain analytical processes which were not commendable theoretically, but which were useful because manufacturers knew what they meant; and in his opinion it was better to have even an imperfect analysis of *constant* inaccuracy than to have an uncertain analysis of theoretical accuracy.

Mr. CROWDER then opened the discussion of which he had given notice, and in doing so, said that he had introduced the subject in this way rather than by the usual method of reading a paper, he having noticed in the *Engineer* that such a course was being pursued by one of the American Societies, in which any member was at liberty to raise a question of general interest to the Society, and to have it discussed under certain regulations. It was for the members to say whether they thought it desirable that questions should be raised and discussed in a similar way in this Society. He had selected this particular subject, having experienced considerable irregularity in the working of sulphuric acid chambers in summer time. Some manufacturers had assured him that if the acid was cooled, say to 40° or 50° Fah., before going down the Gay-Lussac tower, a better absorption would be obtained than with an acid at 120° Fah. But on reflection the matter did not appear to be quite so certain. If hot

hydrochloric acid was run down a tower, and ammonia passed in, the acid and ammonia would combine, probably as well as if a cooler solution were used. On the other hand, if carbonic acid was passed into the tower with hot water, no absorption would result, whereas an absorption *could* be obtained by using cold water. He thought the difference arose from the fact that in the one case nothing but a weak solution occurred, whereas in the other a fixed substance (ammonium chloride) was formed. In passing nitrous acid through sulphuric acid one got a similar result, viz., a fixed and stable substance. That it was stable he thought there could be no doubt. Lunge so stated it, and he had himself made experiments confirming Lunge's statement. He had taken strong nitrous acid solution in SO_2 from the Gay-Lussac tower, and heated it to about 220° Fah. for nine hours. He had tested the acid before and after heating, and found no difference in the quantity of nitrous acid in it, thus showing that nitrous acid was held with great tenacity. If he had raised the temperature of a solution of carbonic acid to any extent the acid would have passed off at once. He therefore asked whether any members had experience as to the *maximum* temperature at which acid could be economically absorbed in the Gay-Lussac tower; and if a much better absorption could be got at a very low temperature, then what was the best way of producing that temperature. Under ordinary circumstances the cooling water was taken from the ground or from the water company's mains, and was at about the same temperature as the atmosphere at the time, so that under such conditions one could not get a temperature lower than that of the water—indeed, the difficulty was to get it even as low as that.

The CHAIRMAN hoped that any members who had practical experience on the subject would give the meeting the benefit of it. The question was one of considerable interest and importance. Of course, there was a distinction to be made between mere solution and combination, whether molecular or chemical. In fact, the whole question of successful condensation depended upon whether one was dealing with a mere solution or a combination of a closer and more permanent character.

Mr. B. E. R. NEWLANDS regretted that his friend, Mr. Crowder, had chosen this method of raising the question of acid absorption. It was, he thought, an undesirable course to take, because it placed members who had special knowledge of the subject in an awkward and false position. If Mr. Crowder had read a paper on the subject and had given the Society the benefit of a full description of his own work in connexion with it, there would probably have been a large meeting and an ample discussion, by which all parties interested would have profited. But he felt sure that those members who were best qualified to speak were adverse to imparting their knowledge in this way. With respect to Mr. Crowder's own remarks on the subject, he did not think that the experiment on hot nitrous vitriol had much bearing on the question at issue. The fact that vitriol could contain certain compounds of nitrogen in a combined state was admitted. It was not a case of mere solution, and it was well known that such compounds were not decomposed by moderate heating. But whether or not nitrous gases could be absorbed by vitriol at a high temperature was quite a different matter, which had not, he thought, been decided by Mr. Crowder's experiment. He had himself a strong belief, founded on experience, that the acid could not be got too cold. He also thought

that the method now generally used for cooling the acid, by circulating it through channels having partitions of lead dividing the acid from a current of cold water, was by no means a good one. The mere fact that lead possessed only about one-fifth the heat-conducting power of copper showed that it was a bad material for such a purpose. Although the water often entered the apparatus at the freezing point and was in contact with acid of about 290°, it seldom left it at a higher temperature than 150°. If the end of the apparatus were made of copper, and the acid at 140° or 150° were made to pass through it, the operation of cooling would be greatly facilitated and the acid would be reduced to a temperature approaching that of the water used for cooling it.

Mr. C. C. HUTCHINSON inquired how the nitrous acid would act on the copper tubing, to which Mr. Newlands replied that inasmuch as he was speaking of acid which had left the Glover tower, he assumed it to be sulphurous and not nitrous.

Mr. C. C. HUTCHINSON said that copper tubes were now obtainable up to 9 inches in diameter, and he hoped in a few years' time to see brazed copper tubes go out of existence altogether.

Mr. B. E. R. NEWLANDS further remarked that it was well known, too, that sulphuric acid could be, and was, at ordinary temperatures, safely carried in copper drums.

Mr. CROWDER, in replying, thanked Mr. Newlands for his valuable contribution to the discussion. He regretted that so few members had taken part in it, but supposed that was due to the feeling suggested by Mr. Newlands. With regard to what had been said about copper tubes, he must confess that he would be somewhat afraid to pass warm sulphuric through them. He knew that acid, after cooling, could be conveyed by railway in copper vessels, and had himself used large copper tanks on wheels for that purpose. But then the copper was from $\frac{1}{4}$ to $\frac{1}{2}$ inch thick.

Mr. NEWLANDS said that there was no action on such drums, and their thickness affected only their strength.

Mr. CROWDER, continuing, said the great difficulty was to continue the cooling of the acid below 100° or 120° Fah. The nearer the temperatures of the acid and the water approached, the more difficult it became to further reduce that of the acid.

Liverpool Section.

Chairman: F. Hurter.

Vice-Chairman: A. Norman Tate.

Committee:

E. Bibby.	H. Gaskell, jun.
J. Campbell Brown.	S. Hamburger.
H. Brunner.	J. W. Kynaston.
E. Carey.	E. K. Muspratt.
H. Deacon.	G. Shack-Sommer.
T. Fletcher.	James Simpson.

Hon. Local Sec. and Treasurer:

W. P. Thompson, 6, Lord Street, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

*Meeting held Wednesday, 9th January 1889, at
University College, Brownlow Street.*

DR. F. HURTER IN THE CHAIR.

THE PARNELL AND SIMPSON ALKALI AND SULPHUR PROCESS.

BY E. PARNELL, F.C.S.

THE subject of the paper I have the honour to read before this Section of our Society this evening is a process for the manufacture of alkali by means of carbonic acid gas from brine and ammonium sulphide, with the recovery of the sulphuretted hydrogen evolved in the reaction, the ammonium sulphide being produced by the distillation of the ammonium chloride produced in the process with Leblanc alkali waste. The first patents in connexion with this process were taken out early in 1885, since which time the practical development has suggested several important alternative methods and improvements, and the total number of patents now amounts to about 15.

The process closely corresponds to the well-known ammonia-alkali process, bicarbonate of soda being precipitated from the brine and ammonium sulphide by the action of the carbonic acid in the same way as it is from brine and ammonia in the ordinary process, while calcium sulphide or Leblanc alkali waste takes the place of lime in the distilling operation.

In order clearly to explain the working of our process, and also for purposes of comparison, it may be well to first briefly describe the most successful method of working the ordinary ammonia process, namely, the system introduced by M. Solvay, which is now so largely used in this country, on the Continent, and in America.

The ammonium chloride liquor is introduced in a continuous flow into the top of a vertical tower of wrought or cast-iron, about 8 feet diameter, and about 40 feet high; this tower is divided into compartments, communicating with each other by suitable openings. Milk of lime at the same time is continuously fed in such proportion as to decompose the whole of the ammonium chloride, and steam is admitted at the bottom. The ammonia liberated by the lime passes off in the form of gas from the upper part of the still, and is condensed in brine in a suitable cooling apparatus. By the time the liquor reaches the bottom of the still it is thoroughly freed from ammonia by the ascending steam, and is from time to time drawn off and allowed to run to waste. This comprises the distilling operation.

The next operation in the process is the carbonation of the ammoniated brine, and it is with the method of carrying out this that the name of M. Solvay is specially associated. The ammoniated brine is fed into the top of vertical towers made of cast iron rings, 5 or 6 feet in diameter, and of a total height of 50 or 60 feet. These towers are divided into compartments by iron plates, with a central hole about 6 inches in diameter; in each compartment is placed a large dish-shaped perforated "mushroom," as it is generally termed, with its convex side uppermost. Carbonic acid gas, from the lime kiln in which the lime for the distilling operation is burnt, is forced in at the bottom of the tower by means of a pumping engine, and as will be readily understood from the construction of the apparatus, is brought

into the most intimate contact with the liquor in its passage up the tower, being alternately drawn towards the centre in its passage through the holes in the plates, and distributed in each compartment by the perforated mushrooms. The carbonated liquor with the sodium bicarbonate in suspension is drawn off from time to time from the bottom of the tower, run on to filters, and the bicarbonate washed; the latter is then ready for the drying operation of which I shall speak later. The liquor, consisting chiefly of ammonium chloride, is used in the distilling operation before described. Fresh ammoniated brine is periodically introduced into the Solvay tower, so that practically the carbonating operation is a continuous one. The proportion of carbonic acid absorbed in the passage through the tower varies with the speed at which it is forced through, but I believe that the latter is so regulated that about 90 per cent. shall become available, the kiln gas, containing say about 30 per cent. carbonic acid on entering, while the escaping gas contains about 3 per cent. These latter gases are impregnated with gaseous ammonia taken up from the ammoniated brine, to arrest which they are passed through a wash-tower containing brine, which latter is employed subsequently in the absorbing apparatus connected with the still.

The sodium bicarbonate produced in this operation cannot be altogether freed from ammonia by the simple process of washing, a proportion of the latter invariably existing as ammonium bicarbonate, which is not much more soluble than the sodium bicarbonate itself.

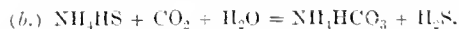
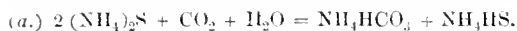
In order to recover this ammonia, the material is heated in a suitable drying apparatus, when the sodium bicarbonate loses one of its two equivalents of carbonic acid, and the ammonium compounds are driven off in the gaseous state. The escaping gases are cooled, washed with brine to arrest the ammonia, and, when care has been taken to keep them of suitable richness in carbonic acid, are again employed in the carbonating operation. The sodium carbonate, thus freed from ammonia and excess of carbonic acid, is then ready for the finishing furnace. This, briefly described, is the Solvay system of manufacturing alkali by the ammonia-soda process. Now, in carrying out our process, we have first of all a different class of material to deal with in the distilling operation; and secondly, we have so to conduct the carbonating operation as to obtain sulphuretted hydrogen of suitable strength for the manufacture of sulphur or sulphuric acid.

To describe in detail the various steps by which we arrived at our present plan of working would occupy too much of your time this evening. We began by following tolerably closely the methods adopted by M. Solvay, but soon found that great changes were necessary. In order to make use of a vertical still it is necessary to subject the waste to some preliminary treatment. The distilling system we are now employing has not this objection, and so far has worked satisfactorily. It consists simply of four wrought-iron vessels 20 feet by 8 feet, so arranged and connected that steam can be admitted to any one of them and passed in succession through the remainder in series. A charge of ammonium chloride and waste is introduced into each vessel in turn, the system being worked on the principle of vats, so that the steam always enters the vessel containing the charge nearest being finished. The ammonium sulphide vapour, with sufficient steam to prevent the condensation of solid crystal, passes from the final vessel of the series, and is conducted through cooling pipes to a vessel in

which it mixes with brine. The cost of this distilling operation, as far as I can ascertain, corresponds very closely with that of the ordinary process; we save the labour of the preparation of the milk of lime incurred in the ordinary process; that of raising and filling in the Leblanc waste is no greater than this, but on the other hand the weight of the residue to be finally disposed of is reduced by about 45 per cent.

The condensed ammonium sulphide and brine is passed into vessels for final saturation with common salt, and after settling is ready for the carbonators. The proportion between the salt and the ammonium sulphide is carefully adjusted to a constant point, which latter will vary somewhat, as in the ordinary process, with the relative value of the materials employed; if the proportion of ammonia is increased the waste of the latter rises, while the amount of salt used per ton of ash made is reduced. The proportion we use is about 65 grms. ammonia as ammonium sulphide to 240 grms. salt per litre. If these figures be compared with the corresponding ones of ammonia and brine, it will be seen that they are weaker; this, however, is simply due to the volume being increased owing to the presence of sulphur, so that the composition of the finished liquor can be made the same in both cases.

We now come to the carbonating operation. As before explained we have to conduct this in such a manner as to obtain all the sulphur in the form of sulphuretted hydrogen of suitable richness for the manufacture of sulphur or sulphuric acid, the strength we aim at being from 30 to 35 per cent. This strength cannot be reached with a single carbonator of the Solvay design when only ordinary kiln gas is used, not only on account of some of the carbonic acid passing through unabsorbed, but owing to the formation of bicarbonate of soda being necessary, so that only one equivalent of sulphuretted hydrogen is evolved for two equivalents of carbonic acid absorbed. We found, however, that by careful working it was possible to carbonate the liquors to a considerable extent without any evolution whatever of sulphuretted hydrogen or escape of carbonic acid with the inert gases, and that subsequently sulphuretted hydrogen of a richness suitable for our purpose could be obtained. This action may be represented as, first, the conversion of two equivalents of ammonium sulphide into one equivalent of ammonium bicarbonate and one equivalent of ammonium sulphhydrate, and, secondly, the decomposition of the sulphhydrate—



In applying this principle we employ a plant consisting of nine vessels or carbonators with connexions, so that gas may be forced into any one of them, and from it through the remainder in series. Besides the outlet leading to the next vessel, each one has two other outlets into two mains connected with two washers for arresting ammonia; all these connexions can be opened and closed at pleasure. The carbonators are small Solvay towers 24 feet high, provided with plates and mushrooms. Eight carbonators are in operation at the same time in two sets of four, one set preliminary carbonating, and carrying out the action represented in the formula (a), and sending inert gases into one main, while the other set is constantly sending off sulphuretted hydrogen as shown in formula (b), kiln gas being admitted to the first carbonator of each series. The connexions are so changed in the progress of working that each carbonator, from the time it is

charged with fresh liquor to the time it is finished and ready for running off, passes through the whole of the two series, beginning with the fourth of the preliminary series, and so on to the first, and then from the fourth to the first of the final series, the first of the series in each case representing the one at which the gas enters. With this plan of working there is no occasion for any carbonator at any time to be standing idle, except for the purpose of emptying and refilling, and further we have not the disadvantages of the varying pressures that we should have on the system if we varied the number of vessels through which the gas had to pass. The change in the composition of the liquor in a carbonator due to the action of the carbonic acid as it passes through the two series may be explained by this diagram. The eight rectangular spaces represent the composition of the liquor in each vessel from the time it is first connected to the next change, that on the left being the fresh liquor, and that on the left the finished. The horizontal lines represent the lengths of equivalents. Since each tower becomes in turn the fourth, third, second, and first of the preliminary series, and then the fourth, third, second, and first of the final, we may regard the liquor as travelling from left to right. When first connected the liquor contains one equivalent of H_2S and no CO_2 ; for a time the proportion of the former increases, and then again falls until, on leaving the preliminary series, it is the same as starting. The carbonic acid entering at the first vessel practically never reaches the fourth, being almost entirely absorbed in the first and second; on the point of the change from the preliminary to the final carbonating, the proportion stands as in the case of the sulphuretted hydrogen, at one equivalent, which represents the theoretical composition of the liquor regular supplied to the final series.

This diagram represents the action of pure carbonic acid on pure ammonium sulphide. In practice the latter always contains some carbonate, and rather less than an equivalent of sulphuretted hydrogen; also, owing to the presence of inert gases with the carbonic acid, the practical maximum point of saturation is rather less than the two equivalents theoretically possible. The nine towers we have now at work with kiln gas 30 per cent. give a steady flow of sulphuretted hydrogen of 25 per cent., and are able to produce 16 to 18 tons 58 per cent. ash per 24 hours. When the kiln gas is supplemented by the strong carbonic acid from the decomposers, the sulphuretted hydrogen is proportionately stronger, and the turn-out of the towers greater. The gases on leaving the carbonators are passed through wash-towers to arrest ammonia, as before mentioned. The wash-towers we employ are divided into two compartments, each containing brine to a depth of about 6 feet, and connected so that the gases pass first through the lower one and then the upper one. The lower compartment from time to time is emptied, the liquor in the upper one run into it, and fresh brine introduced above.

The finished liquor from the carbonators with the sodium bicarbonate in suspension is run on to filters, washed with water, and dried, as far as practicable, with a vacuum pump.

The next operation is drying and decomposing this crude bicarbonate. This is done in a circular iron vessel with a flat bottom made of cast-iron plates. It is provided with powerful stirring apparatus, with scrapers so adjusted as to keep the bottom clean and free from scale, which is very apt to be formed if the bicarbonate is at all too wet. Heat is applied underneath and around the vessel.

The escaping gases and steam are drawn off by means of a pump through a cooling apparatus and washer, where the ammonia is caught. The carbonate of soda, when dry, is ready for the finishing furnace.

In the ordinary ammonia process the carbonic acid evolved in this operation, after being freed from ammonia, is generally of such strength that it may be advantageously employed again in the carbonating towers. The admission of a certain amount of air to the vessel is desirable as it facilitates the drying, so that undiluted carbonic acid is not obtained. In our process, however, any admixture of air with the gases going to the carbonators must be avoided, the result of which would be oxidation of the sulphide, and contamination of the final ash with sulphate. In order to utilise the carbonic acid from our decomposers, therefore, we are arranging to admit a certain proportion of kiln gas instead of air, and so prevent any access of oxygen.

In comparing the working of our process with that of the ordinary ammonia one, it will be seen that as far as labour is concerned we are under no disadvantage. In some particulars it may be a trifle higher, but this is compensated for by our having no milk of lime to prepare, and also by our having a reduced quantity of final residue to dispose of, as compared with ordinary Leblanc waste. The proportion of fuel must evidently be the same in all the operations but the distilling one. In this we save the steam that is required to counteract the mixing that occurs in the vertical still, to which I before referred, while more steam is required for the decomposition. The net result I believe to be about the same.

The proportion of salt used is the same in both cases, and the waste of ammonia should be no greater. This loss of ammonia is the terrible presence at the threshold with which the ammonia-alkali makers have most successfully warned off others from following. No doubt every manufacturer in starting an ammonia process, unless ably assisted by some who have already gained experience, has had to pay dearly for it; but with proper guidance and careful management, and, of course, a carefully-erected plant, no unreasonable loss should take place. The strictly chemical losses, such as the ammonia carried off by the escaping gases, and in the spent liquor from the still, can easily be checked and determined. In my experience, however, unreasonable losses have been chiefly due to accidental leakages and overflows, mainly due to carelessness and inexperience on the part of workmen. Arrangements should therefore be made to render such losses impossible, such as having efficient means for catching drippings from the pumps, taps, &c., preserving them from contact with the air, and returning them immediately to the process. The great principle to be grasped by all connected with the management of the process is that no loss of ammonia is so trifling that it may be disregarded, and when once this idea is grasped, the most ordinary intelligence will suggest means of arresting it.

In the ordinary process, the loss, I believe, corresponds to about three parts of ammonium sulphate per 100 of 58 per cent. ash.

I spoke before of the importance of preventing oxygen from coming in contact with our sulphide liquors, the result of which would be precipitation of sulphur with the sodium bicarbonate and, finally, formation of sodium sulphate in the soda ash. To prevent this we work our lime kiln so as always to have a little carbonic oxide, and can easily manage to keep the oxygen under .2 per cent. Our

stock tanks and saturators are connected, through a scrubber, with the gas holder, so that gas, and not air, shall enter them when liquor is drawn off. A little sulphate is always found in the finished ash, but with careful and regular working this can be kept down to about 0.25 per cent.

The wear and tear of plant seems to be inconsiderable; a short time ago we took down a Solvay tower that had been worked very irregularly for about 12 months. The interior surface of the rings did not show the faintest sign of any corrosive action, the sharp edge of a run-off connexion, for example, being as perfect as when fresh from the foundry; should, however, any liquor come in contact with the outer surface, oxidation of the iron takes place very rapidly. We, therefore, are particular about tarring all vessels on the outside. The action on the wrought iron in the distilling plant seems also very trifling; we have had one vessel employed steadily for about nine months, and can detect no sign of wear and tear.

We are now, therefore, in a position to clearly demonstrate to the Leblanc makers the immense value to them of this process. For years past we have had to face a ruinous competition with the ammonia-alkali makers, in which they have severely suffered; with the help of our process, however, the conditions of the struggle are entirely altered. We have an ammonia-alkali process, practically identical with the ordinary one as far as consumption of salt, fuel, and ammonia, and expenditure on labour are concerned; we have an entire saving of lime, used in the ordinary process; and we obtain the sulphur from our Leblanc waste in the form of sulphuretted hydrogen, absolutely free of cost. A simple calculation will show that by it, if we credit the alkali produced with the sulphur we can recover, and the lime we make, and allow amply for the excessive price we have now to pay for salt, this alkali can be made at a price far below what is possible by the ordinary ammonia process worked under the most favourable conditions.

I have so far only described the method of working this process in which the calcium in the alkali waste is utilised to the full extent in the distilling operation; in this case the proportion of soda ash to sulphur made seems to be about $3\frac{1}{2}$ to 1.

Under certain conditions it might be desirable to extract the sulphur from alkali waste without making alkali to such an extent as the above proportion represents. We have two alternative methods of working our process so as to accomplish this. In the first of these we preliminarily carbonate the waste itself with kiln gas, without allowing any loss of sulphur as sulphuretted hydrogen, and employ the mixture of calcium carbonate and sulphhydrate produced, or the latter alone in form of solution in the place of ordinary waste in our distilling operation.

It will be at once seen that if the carbonation of the waste is carried out so as to convert the whole of the calcium sulphide into calcium carbonate and sulphhydrate, a double yield of sulphur will be the result. Our second plan is to employ a considerable excess of waste in our distilling operation; in doing so we find that this excess parts with about 75 per cent. sulphur as sulphuretted hydrogen by the simple action of the steam under pressure.

The sulphuretted hydrogen we are converting into sulphur on the old lines of partial combustion with a limited amount of air. The gas and air in regulated proportions are introduced into the upper portion of an iron vessel containing brickwork or other heat-retaining material, and the gases below conducted

first into a brick chamber where much sulphur is deposited, and then into leaden flues where a further quantity falls in a wet and muddy state, the finally-escaping gases being passed through a wash-tower. The wet sulphur in the flues, as well as the liquid from the wash-tower, is invariably found to be mixed with thionio acids, which, of course, represents a loss of sulphur, unless some means be taken to minimise the formation of these acids, or to recover the sulphur they contain.

In order to explain how this may be done, it will be necessary for me to enter briefly into the chemistry of the subject.

If sulphurous acid and sulphuretted hydrogen be brought in contact in water, decomposition takes place, with formation of sulphur and tetra- and pentathionic acids. For a time, the sulphur is held up in the acid solution in a quasi-soluble state, but as the proportion of gases introduced to the water increases, this sulphur separates in a peculiar form, very different from ordinary precipitated sulphur, and capable of again passing into the quasi-soluble state on a further addition of water.

If to this solution a salt be added, such as sodium or calcium chloride, the sulphur at once falls as a curdy precipitate; but even this sulphur is of a peculiar modification, and to some extent capable of being redissolved in water.

If, however, the above acid solution be neutralised by an alkali, sulphur of the ordinary kind is precipitated.

The proportion of sulphur thus obtained represents only about 65 or 70 per cent. of that existing in the sulphurous acid and sulphuretted hydrogen employed, assuming the action to be arrested when the gases cease to unite with avidity. If, however, the acid solution above be subjected for a long time to the action of sulphuretted hydrogen alone, the thionio acids become decomposed, with final formation of sulphur and water. The action of sulphuretted hydrogen on sulphurous acid in presence of water may, therefore, be divided into two stages, the first rapid, with formation of sulphur and thionio acids, and the second very slow, when these acids are decomposed.

If the sulphuretted hydrogen and sulphurous acid are brought in contact in a neutral saline solution, sulphur at once falls; but thionio acids are formed to the same extent as when water alone is employed as a medium.

Thionio acids and thionates are decomposed in presence of water at a temperature of about 300° Fahr., with formation of sulphuric acid or a sulphate, sulphur, and sulphurous acid.

Now we apply these principles in the following manner: we maintain a slight excess of sulphuretted hydrogen in the gases coming from the burner, so as, in the first place, to avoid an excessive formation of thionates; the gases escaping from the leaden flues are passed through a wash-tower fed with water.

At the base of the wash-tower we admit a small quantity of sulphurous acid, produced by the combustion of a little sulphuretted hydrogen, so regulating it that the sulphur in the gases escaping from the wash-tower may be reduced to a minimum. Should the gases from the leaden flues at any time contain an excess of sulphurous acid, sulphuretted hydrogen is introduced to the wash-tower in the same manner. The water from the wash-tower we collect in a wooden tank, settle out the sulphur mud that falls, and use the clear liquor repeatedly in the wash-tower.

The sulphur mud, as well as the mud that collects in the leaden flues, we neutralise with a suitable

base, such as milk of lime, and treat it in an ordinary sulphur melter. The melting is done under steam pressure, at such a temperature that the thionates are decomposed, as before mentioned, with evolution of sulphurous acid, which gas we re-admit to a suitable point of the plant.

We are not yet in a position to speak confidently of the value of this plan of working, but all my experiments indicate that there should be no difficulty in finally recovering 90 to 95 per cent of the sulphur originally existing in the sulphuretted hydrogen in a merchantable form.

In concluding this paper, I think it only right to bear testimony to the energy and ability of a gentleman known to most of you—Mr. John Leith—whose labours both in the construction of plant and in getting the process put in operation, are beyond all praise, and can only be fully realised by those who know him.

DISCUSSION.

The CHAIRMAN (Dr. Hurter), in opening the discussion, said he was very pleased with the extremely clear and able way in which Mr. Parnell had brought forward his most interesting process for the production of alkali and sulphur by combining the ammonia-soda process with the Leblanc process. At their last meeting they had had a new process for the manufacture of alkali, of which most of them could at once see that it had not a very great future before it, and therefore he was afraid it was not very interesting to discuss the points of a process which did not seem capable of living. They had, however, a process from Mr. Parnell which was likely not only to succeed, but, according to Mr. Parnell's own estimation, ought to put manufacturers in a position better than that of either the Leblanc or the ammonia-soda manufacturer, or even of a manufacturer possessing both ammonia-soda and Leblanc soda works separately. By his process Mr. Parnell produced a certain amount of hydrochloric acid, and consequently bleaching powder as cheap as the Leblanc manufacturer did, and a certain amount of ash as cheap as the ammonia-soda manufacturer did. But, in addition to these two, he produced the sulphur for which the Leblanc manufacturer, if he meant to recover it, had to pay extra; and he saved the caustic lime which the ammonia-soda manufacturer needs for the purpose of distilling his ammonia. The paper was full of extremely interesting points, and he hoped that, considering the very important position which the process might attain some day—before long, may be—they would have a good discussion, to bring out further information, that Mr. Parnell, he was sure, would be willing to give if requested to do so. He was glad to see that the members of the Society appreciated the matter by attending so numerously. He wished they could often get so good a meeting, and that some of them would give as good a paper as Mr. Parnell's, which that gentleman had prepared in the short space of four weeks; and he hoped they would fully discuss the paper—it merited it.

Dr. S. HAMBURGER asked how the decomposition of calcium sulphide and ammonium chloride proceeded on the large scale. He had himself made many experiments in this direction, and found that it required a great deal of time to finish the operation; that is to say, however long they boiled, still some ammonium sulphide was given off. He could confirm the fact that even at common temperatures the reaction between vat waste and ammonium chloride took place, and at elevated temperatures the evolution of ammonium sulphide was steady enough. But

it appeared to him there was a difficulty to drive off all the ammonium sulphide, and this was a very serious matter as regards loss of ammonia. He must compliment the inventors on the ingenuity they had shown in devising apparatus for carbonating with dilute carbonic acid. It was, no doubt, true that pure carbonic acid was easily absorbed by an ammoniacal brine solution, but the same could not be said of kiln gases, which contained carbonic acid in a dilute state, and unless all the carbonic acid were absorbed, the sulphuretted hydrogen given off from the last vessel would contain carbonic acid, and sulphuretted hydrogen containing carbonic acid was of no value whatever. He would, therefore, be glad to hear whether the sulphuretted hydrogen contained any carbonic acid, and if so, how much per cent. As regards the mutual decomposition of sulphurous acid and sulphuretted hydrogen, they all knew that Schaffner and Helbig's process was not successful, owing to the fact that they were not able to effect this reaction with good results. The action of the two gases on each other had been investigated by Stengel and Morawski, who came to the conclusion that the formation of thionic acids was inevitable. He understood the inventors meant to avoid the formation of thionic acids as much as possible by a special mode of proceeding. He, unfortunately, did not understand the lecturer at the moment he mentioned the details. There was another point which he ought to have mentioned in discussing the first stage of the process. He always found, on boiling the vat waste with ammonium chloride, that more sulphur was distilled over than was equivalent to the ammonia, or, in other words, the vapour was a mixture of ammonium sulphide and polysulphides. He would like to hear whether the same had been noticed on the large scale, as this fact had an important bearing on the sulphur recovery. Again, looking at the process as one for the recovery of sulphur from waste, what percentage of sulphur could be obtained from the alkali waste?

Mr. E. CAREY said he was sure they had all listened with very great interest to Mr. Parnell's paper. The process was one which had been anxiously watched by the trade for some time past, and he was sure that all who had watched it had felt that the process was an extremely ingenious one, and that whatever success Mr. Parnell and his colleagues achieved in the working out of the process—a success which they all hoped they would achieve—it was a success which they most richly deserved. There were a great many points which he did not quite understand, but there were one or two about which he should ask Mr. Parnell a question. Mr. Parnell stated that in his process the waste is 45 per cent. less than the waste by the Leblanc process; he (Mr. Carey) did not see why the waste should be reduced any more than by the amount of sulphur that is taken out of it. Then Mr. Parnell also spoke towards the end of his paper upon the commercial aspect of the process, and mentioned the fact that he considered that he got his sulphuretted hydrogen for nothing. He (Mr. Carey) did not see how he got his sulphuretted hydrogen for nothing. The only source of sulphuretted hydrogen must be alkali waste, and that waste was produced from Leblanc soda, and that Leblanc soda he presumed Mr. Parnell did not make cheaper than the rest of them. Again, he should like to know if Mr. Parnell was prepared to tell them what was the actual proportion between the amount of alkali he makes by the Leblanc process and the amount he expected to make by the ammonia process. He (Mr. Carey) understood it was less than at first supposed.

Mr. HAWLICZEK, speaking on the mode of distilling adopted by Mr. Parnell in his process, said that distilling ammoniacal liquor in intermediate stages, that was to say, in vessels or stills charged and finished individually, must involve a considerably greater loss of ammonia compared with a continuous distilling operation as now practised in the well-known ammonia-soda process. The loss of ammonia in Mr. Parnell's mode of distilling, which resembled the old style of distillation in Solvay's process, would be about from 4 to 5 per cent. of sulphate of ammonia more per ton of 58 per cent. ash than in the ammonia-soda process. This loss meant an extra expense of about 8s. to 10s. per ton of 58 per cent. ash. Mr. Parnell had drawn attention to the saving of lime by the use of alkali waste without comparing the cost for the extra loss of ammonia to be debited to his process as against the saving of lime. Taking the figures as they were, a saving of 10s. for the lime per ton of 58 per cent. ash would no doubt mean a considerable gain over the present way of manufacturing alkali by the ammonia process, but this saving became immaterial if they gained on the one hand 7s. or 8s. for the lime, and lost on the other hand 8s. or 10s. worth of ammonia.

Mr. Parnell further stated that he found great difficulty in obtaining sulphuretted hydrogen of constant strength by carbonating his sulphide-ammoniated brine in Solvay towers, in consequence of which he was obliged to make extensive alterations in his former plant. The present arrangements seemed to resemble the mode and plant adopted in Chance's sulphur recovery process. But arrangements in plant which might be suited for the Chance's process might not be satisfactory for the process in question. In the alkali process, where a volatile substance, such as ammonia, was employed, the success lay more or less in the simplicity of the apparatus used, provided that the efficiency of the apparatus was the same. Mr. Parnell's system of carbonating towers seemed to complicate the process, both in plant and working, and might, with the view of obtaining strong sulphuretted hydrogen, be greatly simplified. In experiments he had carried out on a large scale with crude sulphide of sodium liquor, he had obtained a satisfactory yield of strong sulphuretted hydrogen in the Solvay towers. The sulphohydration of the mono-sulphide was at the time carried out at an intermediate stage, and this liquor then supplied in the ordinary way to the Solvay towers. To conclude, he should be obliged if Mr. Parnell would explain the first point of his question, that was with reference to the loss of ammonia due to his way of distilling the chloride of ammonium liquor.

Mr. T. GAMBLE asked whether any of the ash had been sold on the market, and how it had turned out; whether it was liked or whether there was any difficulty in getting rid of it?

Dr. HURTER said that Mr. Parnell had now been working at his process since 1886; during that time he had taken out 15 patents. That meant that he had encountered a great many difficulties, and had to find means to overcome them. At first he thought he had to use pure carbonic acid gas for the purpose of carrying out his process, and he (Dr. Hurter) should ask him how he gradually came to the conviction that the pure carbonic acid gas was not necessary? During the manufacture of that pure carbonic acid gas Mr. Parnell must have gained some experience of the behaviour of the various alkaline carbonates, and their properties of absorbing carbonic acid, and he should have been pleased to

have heard something about them. It was, of course, from a paying point of view, very important that there should not be too much ash in comparison to the chlorine products obtained, and from this point of view the remarks which Mr. Parnell made towards the latter end of his paper, that when employing an excess of waste not only is the sulphur of the waste obtained which corresponded to the equivalent of ammonium chloride introduced to the still, but also of a great proportion of that excess. Such behaviour of the waste in the still would of course enable the manufacturer to reduce very considerably the amount of ammonia-soda ash to be made in order to recover the sulphur from the alkali waste, but if the production of this additional sulphur from excess of waste introduced into the still were to be of any value, they must know whether such driving out of sulphuretted hydrogen from this excess of waste did not involve an additional loss of ammonia in the distillation; whether it did not too much prolong the operation of distillation, and whether the quantity of steam thus used was not so great as to make the sulphur not worth having? Another point of great interest was this: he understood Mr. Parnell to say that when employing lime kiln gases containing 30 per cent. of carbonic acid, he could obtain a steady flow of sulphuretted hydrogen of only 25 per cent. Now, if the principle of sulphydration were employed, and nitrogen be thrown away, he did not quite see how it was that from the 30 per cent. of carbonic acid originally employed they did not, to say the least, get back 30 per cent. hydrogen sulphide, because they ought to get more than that. There were two series of carbonators, one working into the atmosphere the other working into the gas holder; the whole of the sulphuretted hydrogen passed into the gas holder, but only half the nitrogen, therefore the strength ought to be increased. With regard to the sulphur process, Mr. Parnell had explained that he had not a chance to work it out regularly; that owing to the difficulties of the ammonia-soda process, the working had been rather interrupted, and it had not given him a chance. Nevertheless, the samples which he had brought forward were encouraging, and he thought from what he had seen done at Mr. Chance's works, Mr. Parnell would also succeed in doing. They did not hear from Mr. Chance anything about thionates, at any rate, not much, and he thought Mr. Parnell employed some similar process, so as to only burn the hydrogen and leave the sulphur. He would therefore ask, of a given quantity of sulphuretted hydrogen supplied to that kiln of his own construction, how much was really changed into these thionic acids, was it a great proportion or only a small one?

Mr. SHAPE said he understood that Mr. Simpson had some observations to make.

Mr. SIMPSON said he had merely come to listen, not to speak. The process had been a success; it gave definite advantages, as set forth by Mr. Parnell, and he thought there could be no question about that, as they obtained the sulphur from sulphuretted hydrogen as a by-product, and Chance's process recovered it as a main product. As regards the quality, they had had no complaints from customers, so he presumed it was all right. Their ash was a little less dense than ordinary ash.

Mr. LEITH said he had tried a cask the other day, and had got 1 cwt. less ash into a cask of about 17—18 cwt. than of ordinary soda ash.

Mr. E. W. PARNELL, replying, said with regard to Dr. Hamburger's question as to the facility with

which ammonium chloride could be decomposed in distillation with Leblanc waste, there was no difficulty whatever about this. The stills that he had shown might be charged and finished off in about six hours working in series, one every 1½ hours, and the residual liquor contained in 50 cubic centimetres one milligramme of NH_3 , which was pretty satisfactory working.

With regard to the presence of carbonic acid in the sulphuretted hydrogen, the escaping gas very seldom contained more than one per cent. of carbonic acid, and if it should do so they knew there was some leakage, and they looked until they found it.

The next question about the formation of polysulphides in the distillation. This must have been due (in the case that Dr. Hamburger spoke of) to partial oxidation of the Leblanc waste. A very slight oxidation would produce polysulphide, and the sulphur would produce polysulphide of ammonium.

Mr. Carey asked how sulphuretted hydrogen was to be obtained for nothing. Of course it all depended how one looked at this process. Suppose they compared it with an ammonia alkali works situated in Widnes. Such works would have to pay for salt, fuel, ammonia, limestone, and coke for their limekiln at exactly the same rates as they (the speaker and colleagues) would have to pay. They would use Leblanc alkali waste where the lime was used. The consequence was that they should have lime from their limekiln for sale, their ash for sale. They could get sulphuretted hydrogen coming off the top of the carbonators where the nitrogen would have gone into the air in the ordinary process, so that they should have sulphuretted hydrogen for nothing! They simply used their Leblanc waste in the place of lime in a process that uses lime. They got the same article, namely, soda-ash, and consequently their sulphuretted hydrogen at no cost.

The proportion of alkali that they could get was about 1 to 3 tons of alkali waste, possibly that figure would be sufficient to answer the question of the proportion of alkali made by this process against that made by the Leblanc process.

Dr. Hawliczek spoke about the loss of ammonia. In their present form of stills, with care, this was very small, not more than 0.1 ammonium sulphate per 100 parts ash made. The opening, a manhole, was perfectly tight, and they could walk round this and could not detect the faintest trace of ammonia. The run-off taps at times were apt to get leaky, but could very quickly be repacked and made tight.

Dr. Hawliczek also mentioned that he found no difficulty in getting strong sulphuretted hydrogen from sulphide solutions in the ordinary Solvay tower; probably he was not aware that this had been their ordinary method before they adopted the plan of a series of towers. They had two Solvay towers, one in which they preliminarily carbonated, and a second one in which they finally carbonated, but they found such difficulty in transferring from one to the other that they had adopted the present system as an improvement on the old.

As to the quantity of the ash they had sold, he must ask Mr. Simpson to reply to that. (Mr. SIMPSON: About 600 tons.)

As regards the amount of sulphur that was lost in the waste with careful working, he had found that the residue in the waste would contain about .5. The final residue represented about 55 per cent. of the waste originally employed. The consequence was that they had .3 per cent. against 12 per cent. in the original. Thus, when out of 12 per cent.

they extracted 11·7, which they obtained in the form of sulphide of ammonium, with good work in the towers the sulphate in the finished ash could be kept down to something like ·2 or ·3 per cent., so that the amount of the sulphur lost was very small. He thought there was no difficulty at all in getting about 95 per cent. in the form of sulphuretted hydrogen. Many of them had recently investigated to what extent sulphur could be made from sulphuretted hydrogen, and he thought that there was no question whatever about recovering 80 per cent. in a merchantable form.

Dr. HURTER asked why it was that they had abandoned the preparation of pure carbonic acid. Well, they had no difficulty in manufacturing pure carbonic acid, but, before they had perfected their plant, he found it was possible to work entirely with kiln gas in the manner described, and obtain sufficiently strong sulphuretted hydrogen without the preparation of pure carbonic acid, so they were induced to abandon it. In making pure carbonic acid he had only operated on soda solutions. He had carbonated in the ordinary Solvay tower about 65 feet high, and ran off the bicarbonate, steamed it, and returned it again for bicarbonating. The only difficulty about that method was that there was very great dilution due to the manner of steaming, which could easily be modified. As a method for producing carbonic acid cheaply enough for any manufacturing process he really thought it would be hard to beat.

With regard to the extra cost of using the excess of waste, he had never appreciated that the charges had taken longer to finish when they had a moderate excess of waste, so that he did not think that the extra cost of working with an excess could be very serious, and if they would consider the very small proportion of ammonia that could be left in this final still liquors, even if doubled or trebled it still would be very small in proportion to the total loss. The total loss which they ought not to exceed was something like 3 parts of ammonium sulphate to 100 of soda-ash. Dr. Hurter also asked about the 25 per cent. obtained; he could hardly have made himself sufficiently clear. This diagram represent the action of pure carbonic acid. With pure carbonic acid they could get the true mixture of sulphhydrate and bicarbonate. Thus they had one equivalent of carbonic acid to the one equivalent of sulphuretted hydrogen. When they preliminarily carbonated with lime kiln gas they could not reach that point. Suppose the carbonic acid only comes to ·8 equivalent and the sulphuretted hydrogen, say, 1 equivalent, the proportion on leaving the series being the same as on entering, to complete the carbonation to bicarbonate, 1·2 equivalent of carbonic acid is required, while only 1 equivalent of sulphuretted hydrogen is obtained. Consequently, only about 25 per cent. H_2S is obtained when kiln gas of 30 per cent. CO_2 is employed.

The final question was as to the proportion of sulphur they obtained in the form of thionic acids.

This was rather a difficult question for him to answer. They had been working very irregularly, and in starting they would have a large excess of sulphurous acid, while the plant would be upset again on stopping. When this had been the case they had always found that a very large amount of these thionic acids had been formed, but with regular working, as they knew, they could get down about 60 or 70 per cent. of sulphur in the ordinary reaction in the wet way from sulphurous acid and sulphuretted hydrogen. He thought that there could be no doubt that they showed a higher yield of pure

sulphur with a kiln, that is if in the wet way they got 35 per cent. sulphur as thionic acids with the ordinary methods, with the kiln they should not get more than 20 per cent.

Dr. HURTER: But in the kiln you are supposed to mix just sufficient air to burn the H_2 of the H_2S , and it is only an excess of air that may now and then produce the sulphurous acid. You produced this sulphur (of which you have two bottles here) in the kiln. Well, that sulphur must represent a given proportion of the H_2S , &c. Therefore the thionic acids cannot be that great proportion. In this case the sulphuretted hydrogen you take is in a great measure turned into sulphur and water, and only a small quantity of it is turned into sulphurous acid, and a small proportion escapes as H_2S with it. It is only on this small proportion that thionic acids are formed.

Mr. PARNELL, continuing his reply, said that was what he believed to be the case, but it certainly appeared as if, when they had the most perfect mixture possible, and passed it through the most perfect burner in existence, that at a certain stage the water and sulphur reacted on each other and again made sulphuretted hydrogen and sulphurous acid, and thionic acids. In fact, if you take sulphur and put it into a flask and boil it with water you can get sulphuretted hydrogen.

Dr. HURTER: Then, although you may write an equation $\text{H}_2\text{S} + \text{O} = \text{H}_2\text{O} + \text{S}$, in reality it does not go by that reaction, but a certain amount of sulphuretted hydrogen burns to sulphurous acid.

Mr. PARNELL: If at any time they do completely form $\text{S} + \text{H}_2\text{O}$ they again had a decomposition of the water.

Manchester Section.

Chairman: Edw. Schunck.

Vice-Chairman: G. H. Bailey.

Committee:

J. Angell.	I. Levinstein.
C. A. Burghardt.	Sir H. E. Roscoe, M.P.
R. F. Carpenter.	C. Truby.
B. Grimsshaw.	D. Watson.
J. Grossmann.	T. Wardle.
P. Hart.	P. Winsor.

Hon. Local Secretary:

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held at the Chemical Club, Victoria Hotel,
Tuesday, December 4th, 1888.

DR. SCHUNCK, F.R.S., IN THE CHAIR.

I.—ON WOOL AND FUR, THEIR ORIGIN, STRUCTURE, CHEMICAL AND PHYSICAL PROPERTIES, AND COMPOSITION.

BY WATSON SMITH.

Lecturer on Chemical Technology in the Owens College.

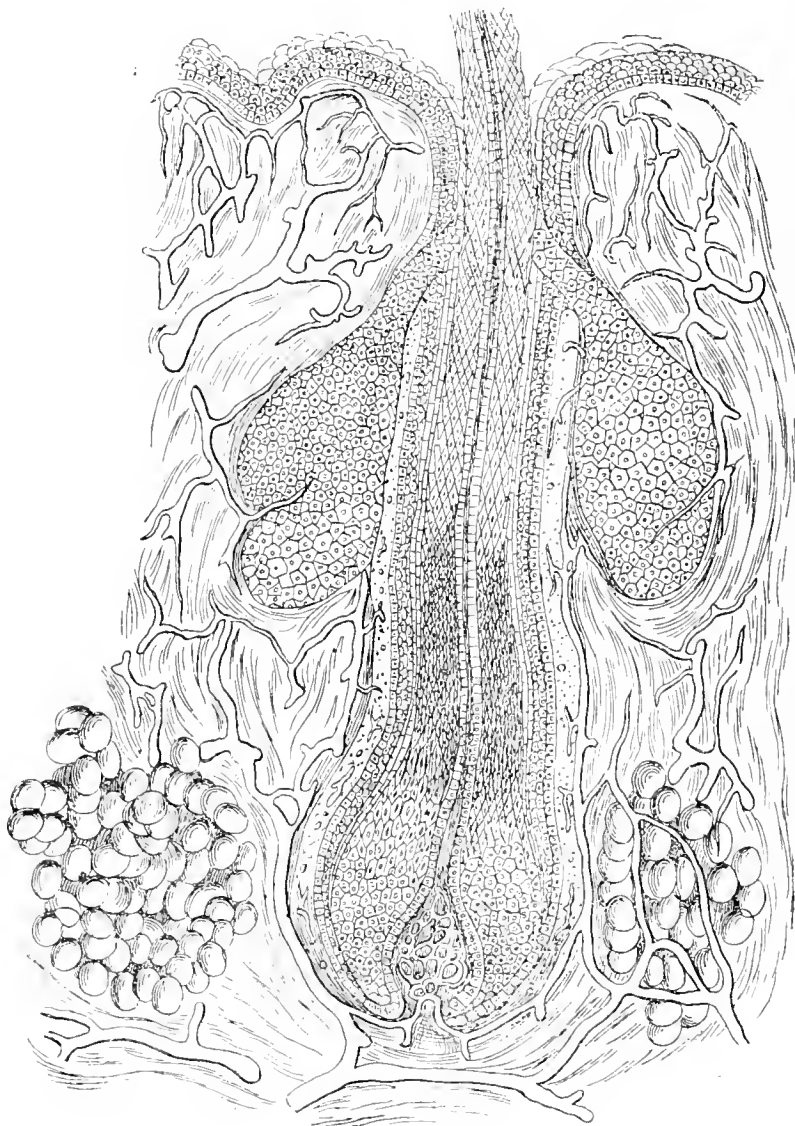
Wool and the different kinds of fur and hair covering certain classes of animals such as sheep,

goats, rabbits, and hares, we may generally discriminate from one another in that wool differs from fur and hair, of which we may regard it as a variety, by being usually more elastic, flexible, and curly, and by possessing certain peculiarities of surface-structure conferring upon it the property of being more easily matted together than are fur and hair. Yet this attempted definition needs to be cautiously advanced, for the fact is, as Dr. Bowman, our greatest authority, observes in his work on the wool-fibre: "The difference between wool and hair is rather one of *degree* than *kind*, and all wool-bearing animals have the tendency, when their cultivation is neglected, to produce hair rather than wool. Wool and hair, fur being intermediate, are simply modifications of the same root-substance, and the scales of the wool-fibre have a much larger free margin than is the case with hair, being only attached to the stem for about one-third of their length, and in many cases the free ends are more or less turned outwards so as to present a much more serrated edge than is the case with hair. The interior portion of the fibre,

however, does not differ in the least from that of hair, and can neither be distinguished from it chemically nor microscopically."

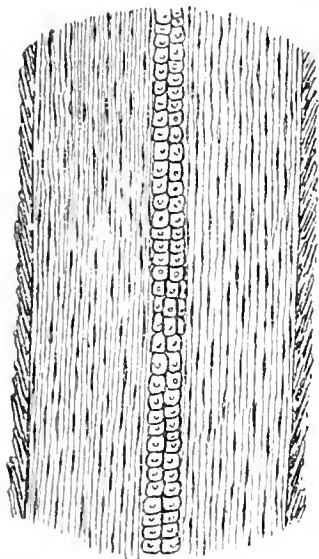
Fig. 1 shows a section of the skin with a fibre of wool rooted in it. Here we see that the groundwork, if we may so term it, is fourfold in structure. Proceeding downwards, then, we have, 1st, the outer skin, scarf-skin or cuticle; 2nd, a second layer of skin called the *rete mucosum*, forming the epidermis; 3rd, the papillary layer; 4th, the lowest or corium layer, forming the dermis. The peculiar globular cellular masses below in the corium are termed *adipose cells*, and these throw off perspiration or moisture which is carried away by the sudoriparous glands, which pass independently off to the surface. Other glands terminate under the skin in the hair follicle, which follicle or hair socket contains or encloses the hair root. Now the complex glands referred to, terminating in the hair follicle, secrete an oily substance, which bathes and lubricates as well as nourishes the hair. As regards its origin, this hair or wool-fibre is formed inside the follicle by the

Fig. 1.



exuding therefrom of a plastic liquid or lymph, and this gradually becomes granular. It is then formed into cells, which, as the growth proceeds, become elongated into fibres, and forms at length the central portion of the hair. Just as with the trunk of a tree, we have an outside dense portion, the bark, and an inner less dense and more cellular, and then an innermost portion, which is most cellular and porous, so with a hair, the central portion is loose and porous, the outer more and more dense. Glancing at the figure (Fig. 2) of the longitudinal section of a human

Fig. 2.

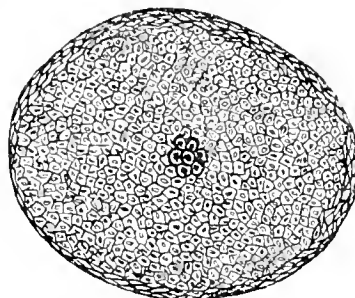


hair, we observe first the outer portion like the bark of a tree, consisting of a dense outer sheath of flattened scales, then comes an inner lining of closely-packed fibrous cells, and frequently an inner well-marked central bundle of larger and rounder cells, forming a medullary axis. The transverse section shows this exceedingly well (Fig. 3). The end of a hair is generally pointed, sometimes filamentous. The lower extremity is larger than the shaft, and terminates in a conical bulb or mass of cells, forming the root (Fig. 1).

In the next figure (Fig. 4) we are supposed to have separated these cells, and above, (A), we see some of the cells separated from the central pith or medulla, and fat globules; between, (B), some of the intermediate elongated or angular cells, and below, (C), two flattened, compressed, horny scales from the outer portion of the hair. Now these latter flattened scales at the surface are of great importance to the textile manufacturer. Their character and mode of connection with the cortical substance below makes all the difference between wool and hair, and so determines the extent and degree of that peculiar property of interlocking of the hairs, known as felting (Fig. 5). We observe that the very structure described indicates the very considerable porosity of wool and fur-fibres, and their capacity for being cleansed by proper agents from all greasy and other matters between scales and pores.

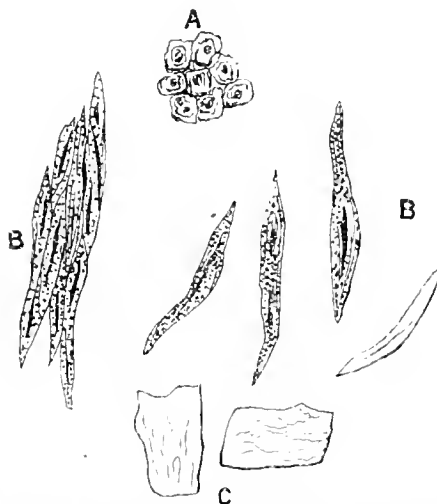
Let us now look at the general external structure of a hair, say a human hair. The upper or free edges of the scales are all directed towards the end and away from the root; in fact, in the case of some of the more perfect wool fibres the appearance under the microscope is almost like that of a number of

Fig. 3.



minute cups inserted and piled up within each other. The fact of the peculiar serrated structure is easily proved by a simple mechanical test. Take a human hair, place it between finger and thumb, and gently rub it by the alternate motion of finger and thumb together. The hair will then invariably move in the direction of the root quite independently of the will of the operator.

Fig. 4.



When a hair or wool fibre is in its natural state, and hence with its pores full of natural grease and its surface more or less lubricated, it feels smooth and soft, also on looking at it through the microscope its scales are not always easily discernible as scales, but look like lines or markings. There are several ways of making this scaled surface perceptible to the touch, and the scales, as scales, perceptible and plain under the microscope. Moreover, since this development of the scaly structure is an important condition for the milling and felting processes, in which it is of equal importance that the integrity of the surface (the smoothness and polish of the scaled surface, the smoothness, too, of the edges of the scales, &c.) be preserved as much as possible, so that that final quality of the woollen or felt goods known as a good finish may be obtained in the highest possible degree—we have to inquire as to the most harmless means of attaining the one without imperilling the other. It is clear that the use of a solvent to remove the grease, oleates, and natural salts, without dissolving or corroding the fibre, is the first natural step.

In the case of wool for spinning and weaving it is the only step necessary, previous to bleaching; for, as we shall now see, the natural development of well cultivated wool is such that the scales project quite

sufficiently for this purpose, whereas in the case of fur for felt hats the fullest development and projection of the scales is necessary to encourage the intimate approach and interlocking needed for a close and hard felt (Fig. 5). This felting is simply a contraction and condensation of the looser fibres to a compact mass by reason of an ever-increased interlocking of inverted fibres, induced by processes of beating, "bumping," vibrating under pressure, &c., and the fuller projection of the scales is brought

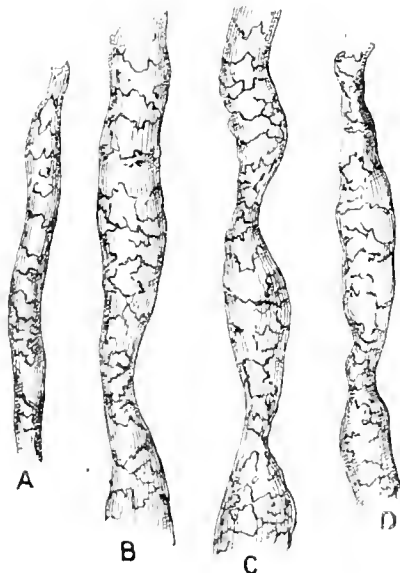
Fig. 5.



about by treatment preferably with acids, since alkalis exert a too considerable solvent and corrosive action. I will now show you on the screen samples of the finest merino wool fibre (Figs. 8, 9 and 10), and of various specimens of fur.

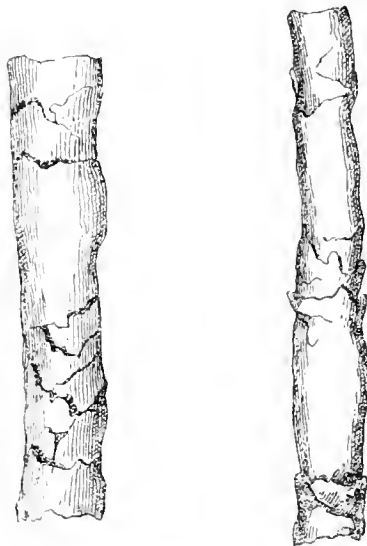
There is a saying amongst felt manufacturers that "dead wool won't felt." By this I understand wool from animals that have died of disease. It is now interesting to observe how diseased wool appears under the microscope, and this I will show you on the screen. (Fig. 6.) You see there the

Fig. 6.



mystery revealed and solved. The fibres are attenuated, irregular, the scale markings and edges almost disappeared in some places, and generally scanty and meagre in development, and hence felting with such fibre must be imperfect. (See Fig. 6.) Such diseased wool is nearly as bad as

Fig. 7.



"kempy" wool, in which malformation of fibre has occurred. In such kemps, as Bowman shows, scales have disappeared and the fibre has become in part or whole a dense non-cellular structure, resisting dye-penetration and felting. (See Fig. 7.)

Let us now consider the chemical composition of wool, fur, and hair. We shall best do this by considering apart: (1) the composition of the pure

Fig. 8.

Fig. 9.

Fig. 10.

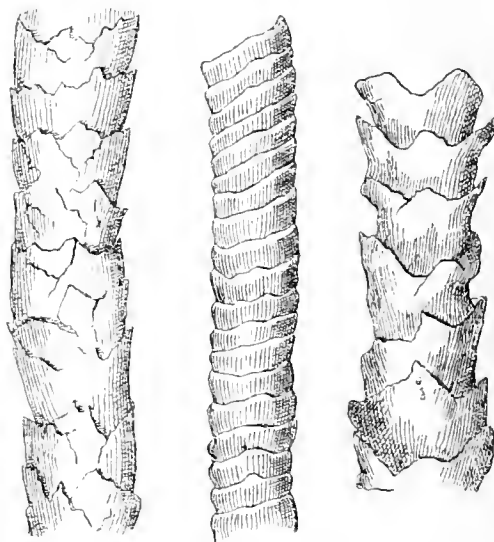


Fig. 8. Finest merino wool fibre.

Fig. 9. Wool fibre showing typical structure.

Fig. 10. Wool fibre from Chinese sheep.

fibre itself; and (2) that of the substances, fats, saline compounds, and grease, associated with it.

Pure fibre of wool has something like this composition in 100 parts: carbon = 49.25 per cent., hydrogen = 7.57 per cent., oxygen = 23.66, nitrogen = 15.86, and sulphur = 3.66 per cent.

As regards the sulphur, it is difficult to look upon this as an integral constituent of pure wool fibre, since it is removed to a greater or less degree by most solvents, and in different wools the variation has been found to be from 0.75 to 3.8 per cent.

Based on the fact of the presence of sulphur, is a method for discriminating wool fibre or fabric from those of silk or cotton.

Plumbite of soda, when boiled with wool, at once blackens it, whilst silk and cotton are not blackened.

Based on this fact, moreover, are the old methods of dyeing the hair black with lead solutions, though at the risk of introducing lead into the system, followed by colics and contractions of the limbs.

For the quantitative determination of wool in presence of silk and cellulose fibres, a useful reagent is basic zinc chloride made by dissolving 100 parts of fused zinc chloride with four parts of zinc oxide in 85 parts of water at a boiling heat until a clear solution is obtained. This solution dissolves silk slowly in the cold, quickly if hot, and forms a thick gummy liquid. Wool, fur, and vegetable fibres are not affected by it. But another solvent is required for removing wool or fur, and that is caustic soda solution, especially if hot. Vegetable fibres remain undissolved. (See this Journal 1882, 64, and 1884, 517.)

Vegetable fibres are easily removed from silk and wool by a mere soaking in dilute sulphuric acid of about 3° Tw., followed by drying. The cellulose fibres are destroyed and converted into mere dust, which can be removed by shaking or beating out the dust. In strong sulphuric acid, cotton and cellulose fibres are dissolved, especially on gently warming; wool is but little affected and certainly not dissolved; silk is at once dissolved, even in the cold. Addition of water to the cellulose and silk solutions causes only dilution of the clear liquid; but addition of tannic acid, whilst leaving the cellulose solution unaffected, precipitates in a curdy form the fibroin from the silk solution. A solution of oxide of copper in ammonia dissolves cotton and silk, but not wool, and from the cellulose solution, a solution of sugar or gum precipitates the cellulose, whilst no precipitation is effected in the solution of the silk. The following solvent finally is efficacious for silk, whilst leaving cellulose fibre and wool undissolved. Sixteen parts of copper sulphate (cryst.) are dissolved in 150 parts of water, and to the mixture are added 16 parts by weight of glycerol. The mixture is then treated with a solution of caustic soda until the precipitate first formed is just redissolved.

From these data, schemes for quantitative estimation in mixture of cellulose fibres, wool and silk, can readily be constructed.

In dyeing certain shades and colours on wool, it is sometimes necessary to remove as much of the sulphur as possible from the fibre, and Chevreul, I believe, introduced the method of steeping in milk of lime, washing with water, weak hydrochloric acid, and water again, with several repetitions of the process. Silk differs from wool, amongst many other things, in containing no sulphur, but it contains about 18 per cent. of nitrogen. Hummel gives the amount of mineral matter in wool, free from yolk, as 0.08 to 0.37 per cent. This consists chiefly of phosphates and silicates of lime, potash, iron, and magnesia.

Wool that has been fully cleansed from foreign matters has a chemical composition very similar to that of feathers or horn. The name Keratin has been given to such substances. Dr. Knecht, of Bradford, has been endeavouring to isolate from wool the substance which unites so readily with coal-tar dyes and other dyestuffs to form apparently beautiful lakes in the fibre. This substance, he argues, is a basic one, since acids and acid coal-tar colours and colour-acids are all absorbed and retained after washing. Moreover, by treatment with sulphuric acid, he has apparently removed this substance by solution. This solution he filtered and found that it forms, with most of the acid coal-tar colours, richly-coloured lakes, or precipitates. By neutralising the sulphuric acid solution with NaOH, he obtained a curdy precipitate of the substance.

But we have been speaking of the purified fibre. Let us now ask what proportion this bears to the impurities associated with it in the raw wool. With such a structure as that which we have seen wool possesses, it can be no matter of surprise if the greasy matters, natural oily substance, saline matters, &c., stowed away behind and around those numerous scaly envelopes, should amount to a very considerable proportion. Such is indeed the case. When dry sheep's wool is treated with very dilute hydrochloric acid (0.13 per cent. HCl), ether, water, and alcohol successively, and then again exhausted with alcohol and ether, all the soluble ingredients are removed and the insoluble matters left can only be separated mechanically. The ether dissolves the fat, the water the wool-sweat, principally consisting of the potassium compounds of oleic and stearic acids, &c., and the alcohol, what of the preceding the other solvents leave.

In some cases the loss thus obtained amounts to from 20 to 50 and up to 70 per cent. of the air-dried wool.

Again, another surmise may be very properly grounded on the peculiar structure of the wool fibre, viz., that such fibre is very likely to absorb moisture readily and retain it persistently. This is the case, and little attention has been paid to it in England, as Dr. Bowman and Professor Hummel point out. On the Continent a manufacturer will not buy water as wool, and official public testing establishments are situated in all the principal centres in Germany and France.

According to Bowman, the water in wool is there in two conditions: (1.) As moisture; and (2.) As water of hydration, or water really belonging to the fibre in its natural state.

He has determined the latter by drying wool at 38° C., and then exposing it to the air at from 10° to 16° C. He then found that the amount of moisture regained was about 8½ per cent. However, though mentioning that the amount of water absorbed depends on the amount in the air, Bowman does not here state the hygrometric condition of the air at the time. I understand that the condition of the atmosphere is so critically considered by practical men, that some wool staplers in Bradford will not sell after an east wind has been blowing for some days. However, the average loss at 100° C. is 14 per cent., but it is not unattended with some decomposition, and the fibre is turned yellow. This means a further loss of 5½ per cent. in addition to the 8½ per cent. This wool exposed to the air regained much of the loss, but not all, showing that injury to the fibre had commenced.

On the Continent it has been found that if exposed to a temperature verging upon that which would

cause scorching of the fibre, it will regain 18 to 18½ per cent. of the moisture.

J. Persoz finds that whilst at 130° to 140° C. wool fibre is completely disintegrated, when moistened with a 10 per cent. solution of glycerol, it remains unaffected at this temperature (Monit. Scient., July 1887).

Chevreul, after determining in wool dried at 100° C., the earthy matter, suint, and neutral fats, found that only 31½ per cent., or less than one-third, of pure textile fibre remained. Dr. E. Knecht finds a similar amount of fibre in a sample of greasy Russian wool.

Chevreul's analysis of raw merino wool, after drying at 100° C., gave him of—

	Per Cent.
Earthy matter deposited by washing the wool in water	26.06
Suint or yolk, soluble in cold distilled water	32.74
Neutral fats (soluble in ether)	8.57
Earthy matter adhering to the fat	1.40
Wool fibre	31.23
	<u>100.00</u>

Generally, it may be said, the finer qualities of wool (merino) contain more yolk ("suint") than the coarser kinds.

Now, as regards this yolk and the part it plays in the nourishment and growth of the wool, Youatt says: "The filament of the wool has scarcely pushed itself through the pore of the skin, than it has to penetrate another and singular substance, which from its adhesiveness and colour is called 'Yolk.' It is found in greatest quantity about the breast and shoulders, the very parts that produce the best, healthiest, and most abundant wool; and in proportion as it extends in any considerable degree to other parts the wool is then improved." The fineness, strength, and lustre of the fibre depends upon this natural defence, lubrication, and nourishment combined.

In a determination of the constituents or analysis of raw wool, Hummel, in his "Dyeing of the Textile Fibres," gives the following outlines:—

(a.) *Moisture* is determined by drying at 100° C. in a stream of hydrogen (inert gas).

(b.) *Wool-fat* by extraction with ether, thereby removing also the oleates, subsequently removed by shaking the ether solution with water. The ethereal solution contains the *wool-fat*, the aqueous the *oleates*.

(c.) Residual wool is repeatedly washed with cold distilled water; more oleates are thus extracted. They are mixed with those from the ether, *see* (b). The wool is then washed with alcohol. More oleates are thus extracted, and their weight is added to those from the aqueous solution. Earthy oleates left in the wool are decomposed by weak hydrochloric acid. The acid is removed by water, the wool dried and treated with ether and alcohol. On evaporating the solvents named to dryness, residues are obtained from which the amount of earthy oleates can be reckoned.

(d.) The wool is finally dried and well shaken, and teased out over paper, to remove dirt, sand, &c. When washed on a fine sieve the wool is dried and weighed, and the sand and dirt taken by difference.

Märcker and Schulz, using the method sketched above, obtained the following results:—

	Wool of Lowland Sheep.	Wool of Full-bred Rambouillet Sheep.	Pitchy Wool.
Moisture	Per Cent. 23.48	Per Cent. 12.28	Per Cent. 13.28
Wool-fat	7.17	14.66	34.19
By successive treatment:			
Soluble in water (wool sweat)	21.13	21.83	9.76
Soluble in alcohol	0.35	0.55	0.89
" in dilute HCl ..	1.15	5.64	1.39
" in ether and alcohol	0.29	0.57	..
Pure wool fibre	43.20	20.83	32.11
Dirt	2.93	23.64	8.38
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

Wool-fat is not a compound of glycerol, and consequently is not a true fat. It is separable into two portions by treatment with boiling alcohol, the lesser soluble and the larger insoluble. The soluble part contains chiefly the at once alcohol-like and fat-like body *Cholesterin*, which is a carbinol, along with *Iso-cholesterin*, whilst the insoluble part contains principally these latter bodies combined with oleic acid, and in small quantity with stearic and other fatty acids.

So called "pitchy wool" contains much wool-fat, which is difficult to remove by scouring with mild alkalis.

A method issued by the Fab. Chem. Prod. Act. Ges., of Berlin, of separating the constituents of commercial wool-fat (C. D. Abel, Eng. Pat. 326, January 8, 1886) is based on the fact that the raw product is soluble in carbon bisulphide, benzine, benzol, xylenes, toluene, isobutyl alcohol, or amyl alcohol, but from its solution in these all the soaps (*sic*) are completely precipitated by the addition of acetone. The fatty acids of commercial wool-fat can be separated from the wool-fat by converting them into alkali soaps by adding alkalis, and then treating the whole with ethyl or methyl alcohol. With the aid of heat all is dissolved, but on cooling the wool-fat separates, leaving the soaps in solution. The easiest plan is to treat the raw wool-fat with ammonia and then with alcohol. The ammonia soaps dissolve and leave the wool-fat, which, after emulsifying with water, forms "*lanolin*." (*See this Journal* 1886, 579.)

A more recent method by Langbeek and Ritsert (Eng. Pat. 6210, May 7, 1886) is to treat raw wool-fat, freed from water and dirt, with boiling alcohol containing about 10 per cent. of ether, the warm alcoholic solution of the free fatty acids, free cholesterin and iso-cholesterin and volatile ethers of the fatty acids containing also a small quantity of cholesterin fats are separated from the undissolved cholesterin fats. The alcohol is removed and the cholesterin fats distilled off by superheated steam. Another way was to dissolve the whole wool-fat in ether and precipitate the cholesterin fats alone by addition of alcohol. This method is applicable direct to the lyes from wool-washing works.

I understand in these methods that raw wool fats which have been already separated from other matters are taken, but I also think the fact called attention to by Hummel, p. 92 of his "Dyeing of Textile Fibres," has been much overlooked by

chemists and inventors too, viz., that soaps (oleates) are not perceptibly soluble in the volatile agents proposed, CS_2 , ether, and petroleum spirit, &c., but only bodies of the nature of fats. Hence washing with water must always follow.

Wool Suint.—The portion soluble in water has been shown by Chevreul, Vanquelin, Hartmann, &c. to contain principally the potassium salts of oleic, stearic, hyenic, and other fatty acids, along with others in smaller quantity of potassium with valerianic and acetic acids, and also phosphates, sulphates, chloride of potassium, &c. Ammonium salts are, moreover, present in small quantity.

It is not necessary to call attention to the great value of the constituents of the suint and salts. 1st. As regards the potash. 2nd. The possibility of making ferro- and ferricyanides from them. 3rd. As a source of lanolin and cholesterin—for this has already been done in papers published in this Journal by Ivan Levinstein, 1886, 578–580, and W. Bott, 1883, 123–124. Hummel also gives a useful account of it in his *Dyeing of Textile Fibres*, pp. 40–43.

Quite recently (*Compt. Rend.* 107 (20), 789–792) A. and F. Buisine have discovered in suint, and isolated from it, glycollic acid and normal pyrotartaric acid, $\text{COOH} \cdot \text{CH}_2 \cdot \text{CH}_2 \cdot \text{CH}_2 \cdot \text{COOH}$ (normal propylene dicarbonic acid) a higher homologue of succinic acid ($\text{COOH} \cdot \text{CH}_2 \cdot \text{CH}_2 \cdot \text{COOH}$). They are contained in the portion of suint soluble in water. These savants have already isolated benzoic, succinic, and malic acids. The following list of acids is given as derived from fermented suint:—The fatty acids from acetic to capric; the hydroxy acids of the foregoing; glycollic and lactic acid, and their acid amides; glycolic, leucin; the bibasic acids, oxalic, succinic, and normal pyrotartaric; a hydroxy acid of one of the preceding bibasic acids; malic acid; with some others as hippuric, benzoic, and uric, &c. These acids exist principally as potash salts.

Acetic acid amounts to 60 per cent. of all the other acids present, and Buisine hopes to recover it industrially. In northern France alone 1,000,000 kilos. should be obtained annually. (*This Journal*, 1888, 220.)

Action of Acids.—Dilute acids have little effect on wool, i.e., sulphuric and hydrochloric acids, whether hot or cold. The scales on the fibre are, however, opened out, and hence felting promoted. The feel also becomes harsher; harshness of feel is often alleged as a criterion of damage to the fibre, but it may not be so at all, for if you cleanse the fibre with CS_2 , or benzol, perfectly, and then with cold water, you get a certain degree of harsh feel simply because the oils and fats are completely removed from the surface of the fibre, and the scale-edges become more sharply developed. A microscopic examination, however, clearly shows when serious modification of the fibre has taken place.

Furriers use as a stimulant to the fibre-scales acid solution of mercuric nitrate, but they often use it so strong that the fur is stained yellow and made excessively harsh. In such cases it is undoubtedly injured, and no good finish can be got upon felt made from such fur. Figs. 11 and 12 respectively illustrate fur fibres from different parts of the same animal (hare) before and after the treatment described. The figures, of course, represent the microscopic appearances.

Cellulose is, of course, very sensitive to sulphuric acid, which disintegrates it. The felt manufacturer removes cellulose particles or burrs from his felt by steeping in dilute sulphuric acid, drying, and then beating out the dust of the disintegrated and partially carbonised cellulose. Nitric acid is also used for

Fig. 11.

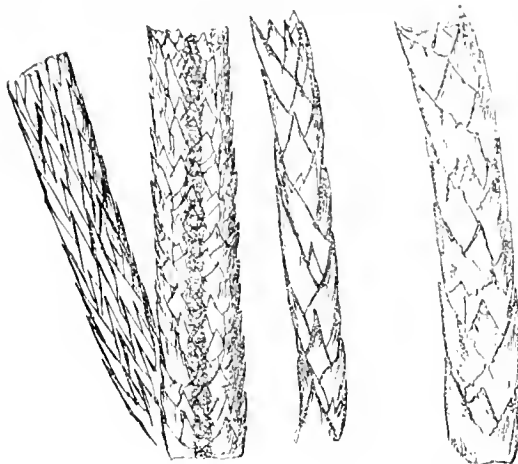
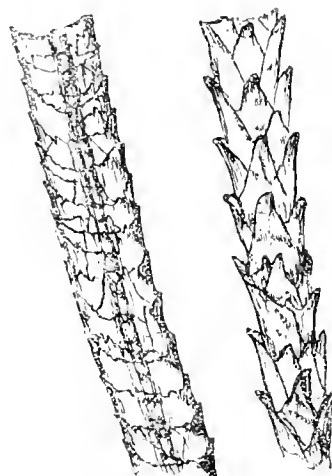


Fig. 12.



stripping wool of its colour previous to redyeing. Thus indigo-dyed wool may be "stripped" with nitric acid of 3°–4 Tw. Sulphurous acid is the best bleaching agent for wool, removing its natural yellow colour. Dr. Knecht has shown that when boiled with dilute sulphuric acid, wool absorbs from 2 to 3 per cent. SO_2 , which are only removed by long continued boiling with renewed quantities of distilled water; part is removed as ammonium salt.

Action of Alkalis.—Alkalis, which have little effect on cotton, have to be used very dilute and with great caution on wool. Alkaline carbonates in solution and dilute, also at a temperature not above 50° C., have little action on wool. Soap and carbonate of ammonia have less injurious action still. If a soda ash with causticity in it be used the damage is certain. The temperature of any solution used in the case of wool is an important matter, for even hot water is injurious. Dr. Bowman finds that "wool which looked bright when well washed with tepid water became duller when kept in the water some time at a temperature of 71° C., and the same wool, subjected to boiling water at 100° C., became quite dull and lustreless." "When the water at 71° contains only very small quantities indeed of

alkali," adds Bowman, "the whole of the surface of the wool, and indeed its substance, is dissolved into a jelly-like mass." Dr. Knecht finds that wool will dissolve in a solution containing less than 5 per cent. of its weight of NaOH at boiling temperature. I have here micro-sketches of a human hair before and after treating with warm dilute alkali (Figs. 13 and 14). You will observe the projecting and jagged edges of the scales (Fig. 14) indicating corrosion and injury. The same fibres that carried before boiling

Fig. 13.



Fig. 14.



Before treatment with alkali.

After the treatment.

with water alone, 500 grains without breaking, broke after boiling with 180 grains.

In the drying of wool in chambers in the carbonising process, 121° C. may be used provided the vapours escape, for the rapid evaporation cools the wool, heat becoming latent in the steam at the expense of the fibre.

We see then that pitchy wools and rich merinos richest, respectively, in wool-fat and yolk, *i.e.*, the very finest wools, will be those needing most care in scouring with alkalis or soaps. Yet they are just the wools requiring most and strongest treatment to rid them of the extraneous matters of the yolk. Thus manufacturers have looked about for other scouring agents.

Carbon Bisulphide.—Amongst them are what are termed the *volatile scouring agents*, such as carbon bisulphide, fusel oil, ether, petroleum spirit, benzol, &c. However, these volatile bodies are solvents for fatty matters, and not for alkaline oleates and soaps. Hence, in conjunction with them, a washing with water must be combined, so as to follow the treatment with volatile liquid.

Bisulphide of carbon has, so far, amongst these agents received the most favour, as it so very readily dissolves the wool-fat, even in the cold.

Bowman says: "Bisulphide of carbon dissolves the suint and fat of wool very easily and completely, without injury to the fibre. The bisulphide may then, when removed from the wool, be driven off at a steam heat, leaving the unchanged fats behind as a residue." However, lime soaps are not removed, and it is a fact that bisulphide of carbon, if hot,

leaves the wool yellow, and bleaching will not remove that yellow colour, for it is due to sulphur deposited in the fibre.

Hummel (p. 101, "Dyeing of Textile Fibres") says the use of volatile liquids has not yet met with much acceptance, but that the difficulties attending their use have been more or less overcome by Da Heyl, Van Haecht, and others, more especially by T. J. Mullings, yet the process of the latter, who employs throughout a low temperature, is not an unqualified success. A friend of mine who has witnessed and inspected it in operation, tells me that the water run off into the river after the washing which followed the CS₂ treatment had a dreadful odour, and made the river smell for some distance. However, if properly purified by rectification from half-slaked quicklime in powder, it has little or no odour.

Benzol and petroleum spirit have the serious objections that they are specifically lighter than water, and so can neither be so easily displaced by water from the fibre, nor be sealed by a layer of water kept above their surface. Combined with this great mechanical and statical advantage of CS₂, we have the additional one of its volatility, though this, as we shall shortly see, is by no means an advantage under some circumstances.

I have in this paper endeavoured to explain the physical and chemical structure and properties of wool fibre and its natural accompaniments, so as to prepare the way for the consideration in the next of the advantages of a rational treatment of the raw wool with a volatile and inert solvent in the cold, along and alternately with water, over the treatment at present in vogue with warm dilute alkalis in the process known as scouring, and I hope to be able to prove to you that a new process just invented and patented by my friends, Messrs. Singer and Judell, fulfils all the demands made by such a rational treatment. The apparatus for this new process is now being constructed by Messrs. Mather and Platt, of this city.

II.—ON WOOL AND FUR, MODES OF CLEANSING THEM FOR THE TEXTILE INDUSTRY, AND ON A NEW PROCESS RECENTLY PATENTED BY MESSRS. SINGER AND JUDELL.

WHEN we remember how that the raw wool fibre is penetrated, encrusted, and varnished as it were with yolk and natural grease and soap-like bodies, as well as occasional actual potash soaps, and that woollen cloth and yarn contain oil (as much as 4 to 5 per cent.), and that such greasy matters repel and resist aqueous solutions like those of dyestuffs, the reason for and necessity of scouring processes will be evident.

Scouring, then, is the process of preparation in which the removal of greasy matters, natural or artificial, is involved. For many years, and from the earliest times, stale urine was used for the wool-scouring process, but more recently it has been replaced by such solvents as ammonia, sodium carbonate in different forms, soaps, and so forth. Stale urine is an unhealthy and nauseous detergent to use, ammonium carbonate is expensive, with soaps there comes the difficulty that soft waters must be used,

or else lime or magnesia soaps will be precipitated in the fibre. Liquor ammonia, used, of course, after dilution, is not without risk, for with wools or woollen goods of light colour spots or stains may be caused when the ammonia is prepared from gas-waters. The liquor ammonia ought to have been made from good sulphate of ammonia. The question will be asked, "Whence do these grey stains arise?" Doubtless from small quantities of aniline or pyridine bases that have been volatilised and driven over with the ammonia. Before using such ammonias, they should be tested (1) by Kupferschläger's method—pouring some of the liquor ammonia into a test tube containing some colourless nitric acid diluted with one-fourth its volume of water, partially saturating with ammonia, and observing if a red colour is produced; (2) by Ost's method of nearly neutralising the ammonia with acid, and noticing if an odour of pyridine is perceptible.

Now as to the use of sodium carbonates for wool scouring. Some beautiful as well as cheap salts have been offered and adopted, such as the crystallised sesqui-carbonate of Brunner, Mond, and Co., and the crystal carbonate of Messrs. Gaskell, Deacon, and Co. The first has the formula $\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 + 2 \text{H}_2\text{O}$, the second $\text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$. With magnesian or calcareous waters the earthy carbonates are precipitated on the wool, but are more easily removed by far than earthy alkaline soaps; however, in very greasy wools there may still be risk of deposit of the alkaline earthy soaps. But there is this difficulty with alkalis. Causticity must be avoided altogether, and the carbonates be used very dilute, or the integrity of the fibre is injured. In the first part of my paper it was pointed out that the very finest wools, the merinos and pithy wools, are just the ones richest in yolk or wool-fat. These need proportionately more stress of alkaline treatment to clean them, and there comes the danger. Thus, the finest wools would encounter the most peril. However, in cases where mild alkaline treatment can be adopted, no forms of alkali can be safer than the two products named.

We now approach another method, the one more specially interesting to us on this occasion, that of scouring with volatile liquids inert to the fibre. It possesses the essential advantage over the alkaline processes that the wool may be deprived completely of its wool-fat without injury to the fibre. However, with all these methods, as so far employed, there are serious objections, either on the score of cost through loss of volatile agent, of modification of the fibre through the manner or under the condition in which the volatile solvent is employed, and through the danger attending the necessity in some stage of the process either for treatment of the fibre or recovery of the spent volatile scouring agent, of the handling of the spent product by workpeople. However, I submit that difficulty and danger are no words to frighten or deter any British manufacturer or workman, when once it is granted that superior results are to be obtained by the use of given means and instruments. Look at our houses furnished with an illuminating agent—coal gas, which, notwithstanding its purification, if let accidentally escape into our bedrooms, would certainly asphyxiate or poison us, and as if that were not sufficient, convert the atmosphere of our rooms into a dangerous explosive to boot. Note also the fact that the immense volumes of coal gas supplied to our cities are safely collected and stored in capacious vessels of wrought boiler-plate, just as the laboratory student collects and preserves his oxygen or hydrogen in the pneumatic trough under an inverted bottle or tumbler.

Do not imagine that I would palliate for a moment any admission of the vapours of bisulphide of carbon, for example, into the atmosphere of sheds or factories or anywhere where they could be breathed by work-people. I know and have specially studied the poisonous action of carbon bisulphide vapours, and I say that slow poisoning by this agent is simply a terrible thing, involving loss of mind and disease of body combined. But I do not hesitate to say that if a method is offered in which the carbon bisulphide is treated as plant, is to act in the cold, is continually recovered and automatically returned; if it is one in which there is no removal of the fetid oil-charged material from the apparatus in which it becomes oil- and grease-charged, and if whilst, in a word, the products are discharged at their proper places, the bisulphide simply circulates—then I would on these *prima facie* grounds throw in my adherence to such a method till I heard worse of it.

Let us see what has been done so far with bisulphide of carbon. Several methods have been proposed, and one of the best of recent date is by T. J. Mullings. The wool is placed in a covered-in centrifugal machine and submitted there to the cleansing action of the bisulphide in the cold. When once saturated with the yolk constituents soluble in CS_2 , the machine is revolved to extract the chief bulk of it, and the remainder left in the fibre is expelled by water admitted into the apparatus. Water being both lighter than and non-miscible with bisulphide, displaces the latter, which sinks to the bottom of the vessel. The action proceeding in the cold, Mullings claims, and rightly so, that the wool does not acquire the yellow tint invariably assumed when heat is used.

The mixture of bisulphide and water is collected in a tank, and, after settling, the former is run off below, and recovered, by distillation, for using again. Hummel, who refers to the process in his "Dyeing of Textile Fibre," says: "It has been recently tried on a large scale, with a certain degree of success."

Now let us glance at a weak point or two in such a process as this. (1.) In centrifugating the wool from the bisulphide containing these yolk constituents which are dissolved, a time will come when the wool, with a minute quantity, but probably still some, bisulphide left in it, must be exposed, in order to withdraw it, for the admission of water will not remove absolutely all bisulphide. (2.) Since the washing with bisulphide is not by a cumulative system, the bisulphide drawn off for redistilling will not be fully charged with yolk constituents. (3.) Either the dirt and insoluble matters remain amongst the wool, or are driven out amongst the bisulphide, or both conditions obtain; this would, in any case, soon necessitate a cleaning out of the centrifugal apparatus, and would increase thus danger and expense.

A modification of Deiss's apparatus for extracting oils from seeds has been proposed. It is a macerating apparatus, in which the wool is treated with warm vapours of bisulphide of carbon. The apparatus is ingenious, but it labours under this disadvantage, that the washing and treatment are not cumulative. Thus the bisulphide in the bulk will not become saturated, and so a proportionately larger volume of this volatile agent must be used for keeping in circulation, per given quantity of wool, than would be the case if a cumulative system were employed.

The annexed figure (Fig. A) represents Deiss's apparatus, which is very much used on the Continent. A store-vessel contains the bisulphide of carbon (covered with a layer of water), and also acts as receiver for the bisulphide when recovered by

distillation from the oil and bisulphide mixture which has reached the retort. By means of a pump, the bisulphide is raised to the macerator, where it comes in contact with the seeds or other materials from which oils are to be extracted. Here it is heated in contact with the seeds or other matters by a dry-steam coil, the bisulphide vapours evolved being caught and condensed in the worm, and so returned to stock in the well. When the extraction is ended, the seeds, &c. remain on the false bottom of the extractor or macerator, whilst the oil-laden bisulphide is passed over to the retort by the pipe shown at the upper part of the extractor, where the specifically lightest layer, that richest in oil, is. In the retort it is heated by closed steam, bisulphide returned to stock, and oil remaining in the retort, to be afterwards drawn off. When the bisulphide of the first treatment is run to the retort, the seeds and macerator must receive a final treatment, resulting in a dilute solution, which must then be treated in the retort.

Not only Deiss's modified apparatus, but many others proposed, suffer from this defect, the force of which you will easily recognise when I compare it, as to its result, to the lixiviation of a quantity of black ash or crude soda, all in one and the same black-ash vat. It would mean non-saturation, a lot of weak liquors, larger consumption of fuel, increased labour.

In many of the processes proposed, a great difficulty again has been the putting in of a charge of wool to an apparatus which must be opened for the purpose, and the withdrawal after washing, which is likely to be just as disagreeable and dangerous.

Not the least of the difficulties is the treatment of the dirt and sand separated from the wool, and containing, at least, some little of the bisulphide. And now, last and not least—and I speak as an old manufacturer of carbon bisulphide—the difficulty of distilling the bisulphide from the oil completely and securely, and moreover of separating, as in the case of Mullings' apparatus, the oily bisulphide from the water with which it is mixed, to do all this safely and without loss, which would mean danger even if but a very modest loss, involves the solution of practical problems of no ordinary magnitude.

I think we now see that if an effective and safe apparatus is to be put into the hands of the wool-scourer, it must in working fulfil conditions something like the following:—It must consume as little bisulphide per given quantity of wool as possible, *i.e.*, it must return nothing but a bisulphide as nearly saturated with yolk constituents as possible. The saturated solvent must proceed direct and covered to the still for regenerating from it the CS_2 , and that carbon bisulphide must be condensed and pass again direct into the washing system. The still must be one that can work automatically, like the rest of the apparatus, and work safely. It must deliver the oil, free from bisulphide, continuously and automatically as it is produced. Hence, and in other words, the carbon bisulphide must circulate through and around the entire system, including the *recovery still*, and drop the oil, so to say, on its way, and at its proper place.

But to this end the very dirt and sand deposited from the wool in the apparatus must also be automatically gathered up, and what is more, it must be as automatically washed with bisulphide (fresh) and then be rid of all traces of carbon bisulphide, which must be returned to circulation in the system, whilst the dirt and sand are automatically and continuously delivered at a specific and proper place.

The washing with water should take place in the same apparatus, and the washing should also admit of the same continuous and cumulative action as with the bisulphide. If possible raw wool must be delivered into such apparatus at one place by some simple process that workmen will easily understand, and the thoroughly washed wool must emerge at another, just as simply as the oil and grease are, and also the dirt and sand. Finally, no direct fire must be necessary anywhere near this apparatus, which may consequently be to a considerable extent isolated.

I shall now describe such an apparatus to you, and it is the one we are assembled to-night to hear about, and recently patented by Messrs. Singer and Judell, of Adelaide. It gives me pleasure to add that Mr. Ignatius Singer is also present, and will be able to answer any questions that I may fail to reply to. It is somewhat singular that seven months ago, being asked by a large woollen firm in Yorkshire to commend to them a good wool-scouring process, and looking through a number of patents, I was at once struck by Singer & Judell's patent, No. 13,699, of October 10, 1887, recommended it, and then advised the London patent agent to write to Adelaide and invite the patentees either to come or send a representative. However, these gentlemen had also been smitten with the idea that they ought to visit the mother-country, and so the letter must have reached Adelaide a day or two after they had set sail. In coming they have brought improvements on the specification referred to of an important character. Let us now examine their apparatus and process, and see if it fulfils the conditions prefigured in the ideal structure already sketched.

The raw wool is first deposited on an endless belt made of wire gauze (Fig. B, also Fig. C, *f*), down upon which comes another belt, forming an upper cover, to hold down the wool just as the belt enters the apparatus, which is a structure of iron, measuring, for an output of 50 to 60 bales per 24 hours, about 35 feet long. All lids, covers, &c. are securely luted in water. It will be observed that the top belt, as the washed wool emerges, becomes the bottom belt bearing the fresh charge of raw wool as the double belt re-enters the apparatus. The double belt, bearing the raw wool clasped in it, now descends into the first of a series of cells or cisterns, which, when the apparatus is in work is empty, when out of work is filled with water to lute the edge of the cover of the apparatus dipping into it (Fig. C). Passing into this first cell the belt passes over a roller, under another at the lower part of the cell, and then rises under the cover-lid and passes between two squeezing rollers. The band with its wool now descends into the first carbon bisulphide vessel (Fig. B. and also Fig. C), and emerging is squeezed between nipping rollers just before entering the second cell. Thus, it travels through and is washed and squeezed in 14 cells containing carbon bisulphide, when it enters five similar but deeper tanks containing water alone, in which it is also washed and squeezed (Fig. B.). The band with wool now ascends to a drying-chamber, and in its upward course is supported and run upon two rollers. In this chamber it passes upwards and downwards over hollow rollers, heated internally with steam, and it is also squeezed between the hot rollers. At length the band emerges bearing washed and dried wool. The top band now departs horizontally to a more distant roller before descending, the lower one bearing the wool passing over one nearer at hand descends sooner and lets the wool fall into a suitable receptacle or shoot, and turning around another

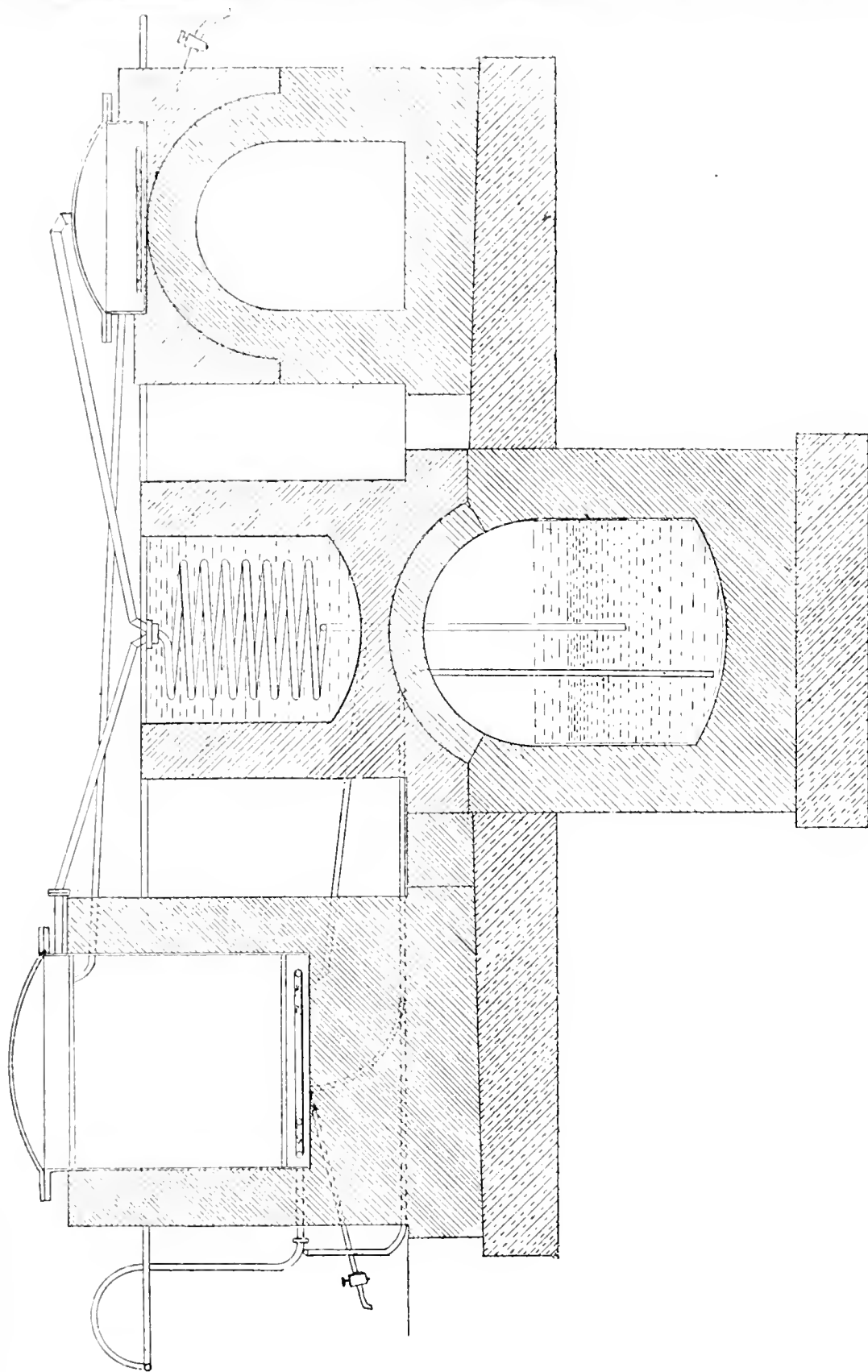


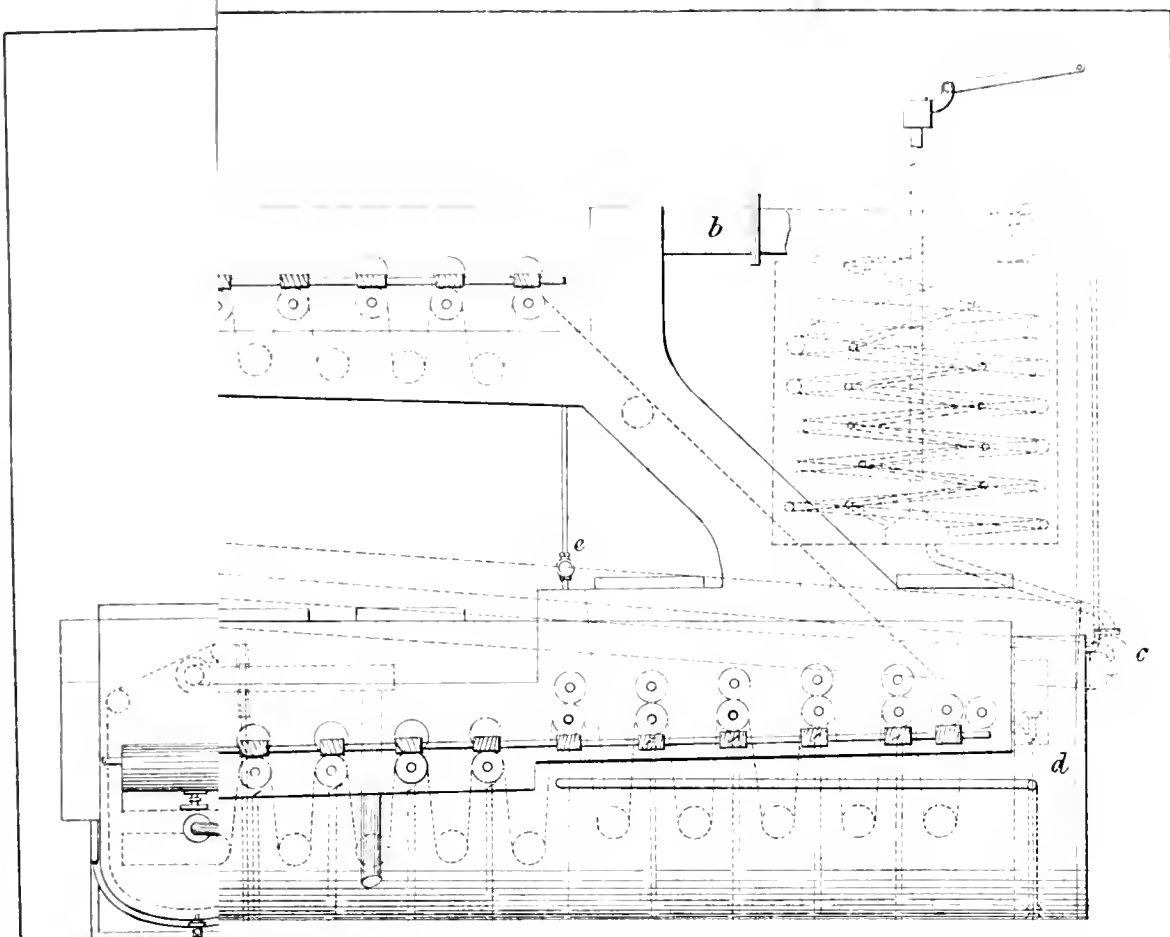
Fig. A.

roller lower down re-enters the apparatus as top band to that band which previously separated, and now re-laden with fresh raw wool, re-enters as bottom band (Figs. B. and C., *f*).

We have thus followed the mere course of the wool and observed that this is characterised by a continuous automatic action. Let us now follow the course of the gaseous currents, for what must immediately strike the imagination is the fact that the first cell is open, and the lid of the apparatus dipping into it is not luted when operating (only luted in water during quiescence of the machinery). Carrying the eye to the drying-chamber above, a pipe wide in its upper part and communicating with a cylindrical worm condenser, is noticed. In that wide pipe a draught is created by the aspirating action of a fine water jet or spray under pressure at *h* (Fig. B.). This draught, however, is but a gentle one, something like that produced in a vitriol chamber system. It is just sufficient to prevent carbon bisulphide vapours from receding and passing under the lid or cover dipping into the empty tank or cell into which the wool-band first enters. It is also sufficient to carry the vapours of bisulphide from the drying-chamber to the condensing worm, where those vapours are condensed and so recovered, and returned to the system. The connexion between the atmosphere of the bisulphide cells and the drying-chamber is by means of a draught-pipe furnished with a tap *e* shown in Fig. B. We notice then the general motion of the atmosphere of the system is in a direction from the entrance of the wire-band, with the same and towards the water-jet and condenser. All carbon bisulphide vapours in the entire system then tend towards and pass down the condensing worm, then returning to the "dividing-eistern," dividing bisulphide from water *d*, Fig. B. Let us now see what becomes of the dirt deposited from the wool. So soon as the carbon bisulphide dissolves out the wool grease, &c. the dirt at once falls out of the wool and sinks to the bottom of the vessel. I will show you how this takes place by a small experiment in a stoppered funnel, in which I have placed some raw wool. I pour in some carbon bisulphide, and whilst this liquid is effecting solution, you may perceive the dirt dropping out of the wool. Now through each of the first six bisulphide cells or tanks (see Fig. C. and also Fig D.), works an endless chain of perforated dredgers. The bottoms or dirt of the cells are thus continuously dredged up, the oily bisulphide draining back into the cells during the upward motion of the little dredging-buckets. These buckets just on their descent and consequent reversal, empty their contents into a gutter of semi-circular section *h*, Fig. D., through which an endless-screw agitator works (see Fig. C., *e*, *e*). The screw works the dirt and sand containing still some oily bisulphide, in a slightly upward direction along this gutter, and meanwhile an isolated dredging system, precisely similar to the six already mentioned, only that it is furnished with non-perforated buckets, and which is fixed to the tenth bisulphide cell, brings up continually a fairly pure bisulphide and empties it into the gutter with sand, dirt, and still some oil (see Fig. B.). The bisulphide runs along by its own gravity back towards the first cell, and in a contrary direction to that of the motion of the sand and dirt, which it continually washes. The washings continually flow into the first tank, which contains the most contaminated or highly charged bisulphide. The washed sand and dirt pushed on by the screw at length enter a down pipe (Fig. B. and also Fig. D., *h*) where they drop into a retort (not visible in the drawings) connected with a

Liebig's condenser. They are subjected to heat in this retort, when the bisulphide passes over and is condensed and returned into the delivery main along with the other supplies of bisulphide at *c*, Fig. B. The retort consists of a long pipe in which works an endless screw. This retort is double steam-jacketed, and the end is connected with an aspirator to draw off the CS₂. The sand and dirt drop out at the end. But let us further follow the course of the vapours to the point of their recovery. I have said that not a steam-jet but a water spray-jet creates the suction or draught carrying the vapours into the worm (*h*, Fig. B.) which commences, according to strictly scientific principles, wide, and gradually tapers down as cooling and condensation proceed. The condensed liquid falls from the worm into a small collecting space, runs by a pipe to the bisulphide main *c*, Fig. B., where it joins the stream coming from the recovery-still to be afterwards described. The bisulphide then falls into the cell or tank at the end of the tank-system, where it settles down as a lower layer under water. The air draughted through the system escapes by the central vertical pipe fixed above the collecting space in which the worm terminates. The minute quantity of bisulphide escaping with the air, it is not considered worth while to collect. The top of this shaft is fitted with a cover-valve which is closed when the apparatus is not working.

Let us now see how the carbon bisulphide is distributed and the water disposed of in the last tank receiving the recovered solvent. The overflow siphon-tube for the bisulphide is one which every tar distiller is accustomed to for separating the bottom water layer in his receivers from the supernatant one of naphtha (Fig. E.). However in such cases the lower layer, the water, is valueless, and is run off to waste, but in our present case the lower layer is the one of principal value. We need, then, an automatic arrangement for preventing the level of the CS₂ from rising above a certain point, or we shall incur the risk of getting bisulphide returned in the upper, the water overflow. Messrs. Singer and Judell have adapted a highly ingenious arrangement for this purpose, so that it is quite impossible for the level of carbon bisulphide- and water-layers to be other than constant. The carbon bisulphide overflows into and supplies the bisulphide tank nearest to the water-tank system, and the water overflows into the water tank next to the receiving or dividing tank with automatic contrivance. This automatic contrivance consists of a float (see Fig. E. and also Fig. B., *d*) which sinks in the water of the receiving tank but floats upon the carbon bisulphide. Through it, above and below, passes a slender rod with swivel joint at either end, connected with the terminals of two levers, whose opposite ends are armed with stoppers closing or opening respectively the water and bisulphide overflows, above and below. It is now manifest that when adjusted for a particular level of bisulphide in the "divider," if that level rose the float must rise, would raise the ends of the two levers connected with its axial-rod, and these levers acting on their fulcrums would respectively close up the water overflow pipe and open the bisulphide overflow siphon (which delivers bisulphide to the bisulphide tanks just as water is siphoned over from a tar-distiller's "divider"). Thus, a compensating automatic adjustment is secured, and, in principle, it is closely analogous to the float adjustment for regulating the steam pressure, and consequently the temperature, in distilling benzene and toluene, &c., in the Savalle's diphlegmating column. The water



tion.

End Eleva

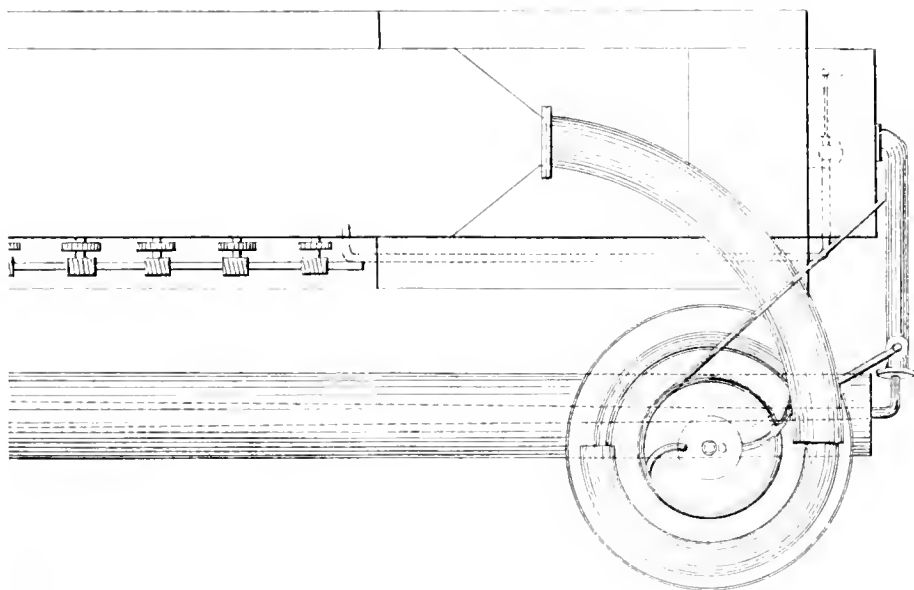
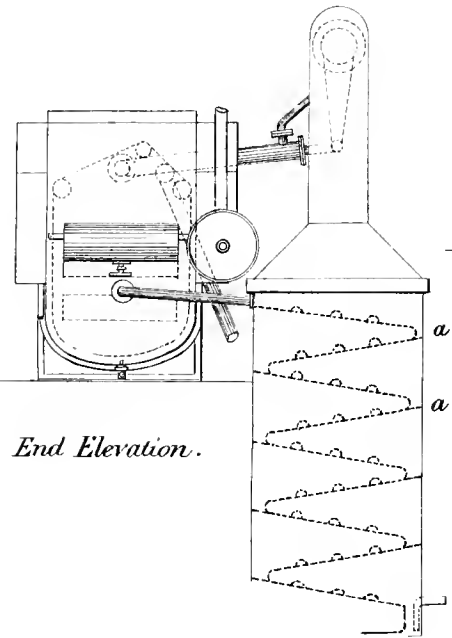
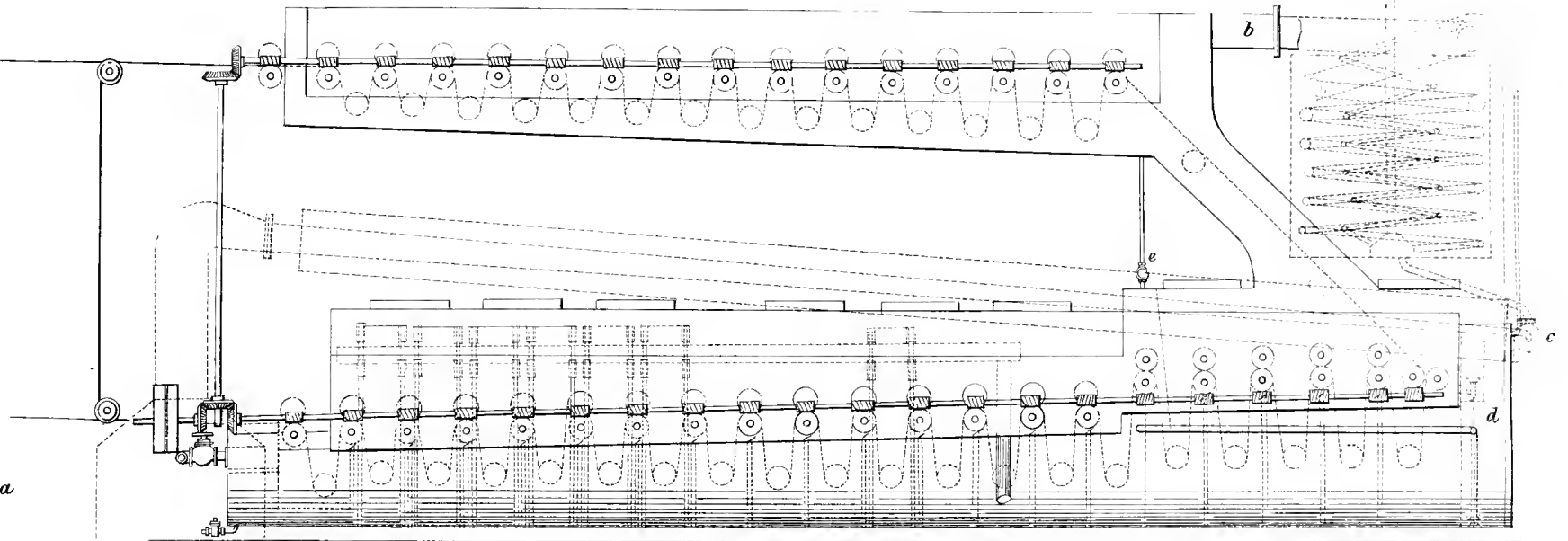


Fig. B.

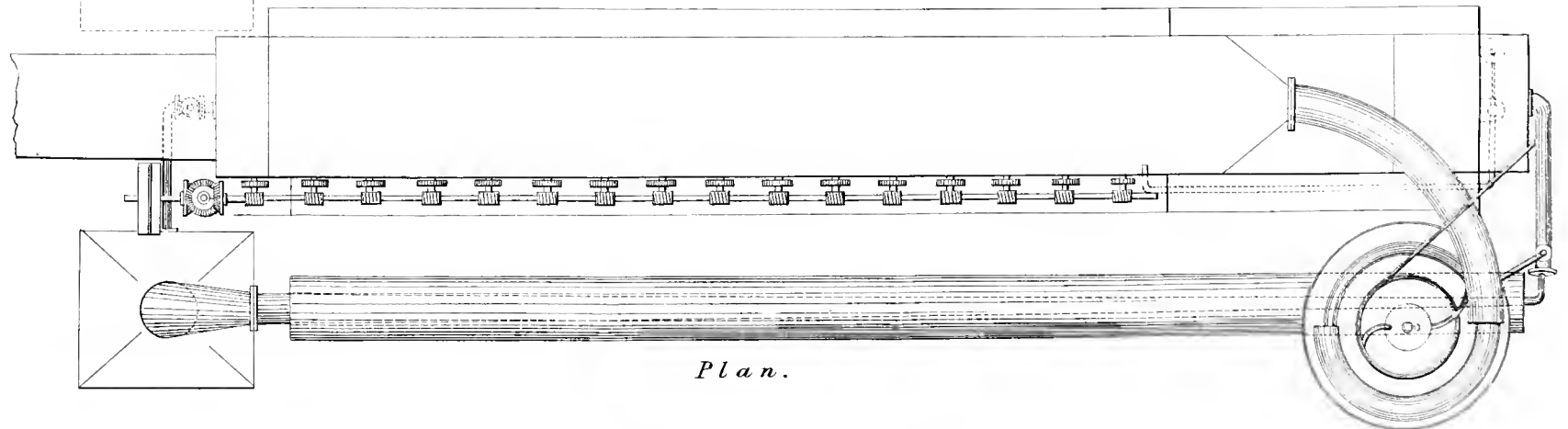
Fig. F.



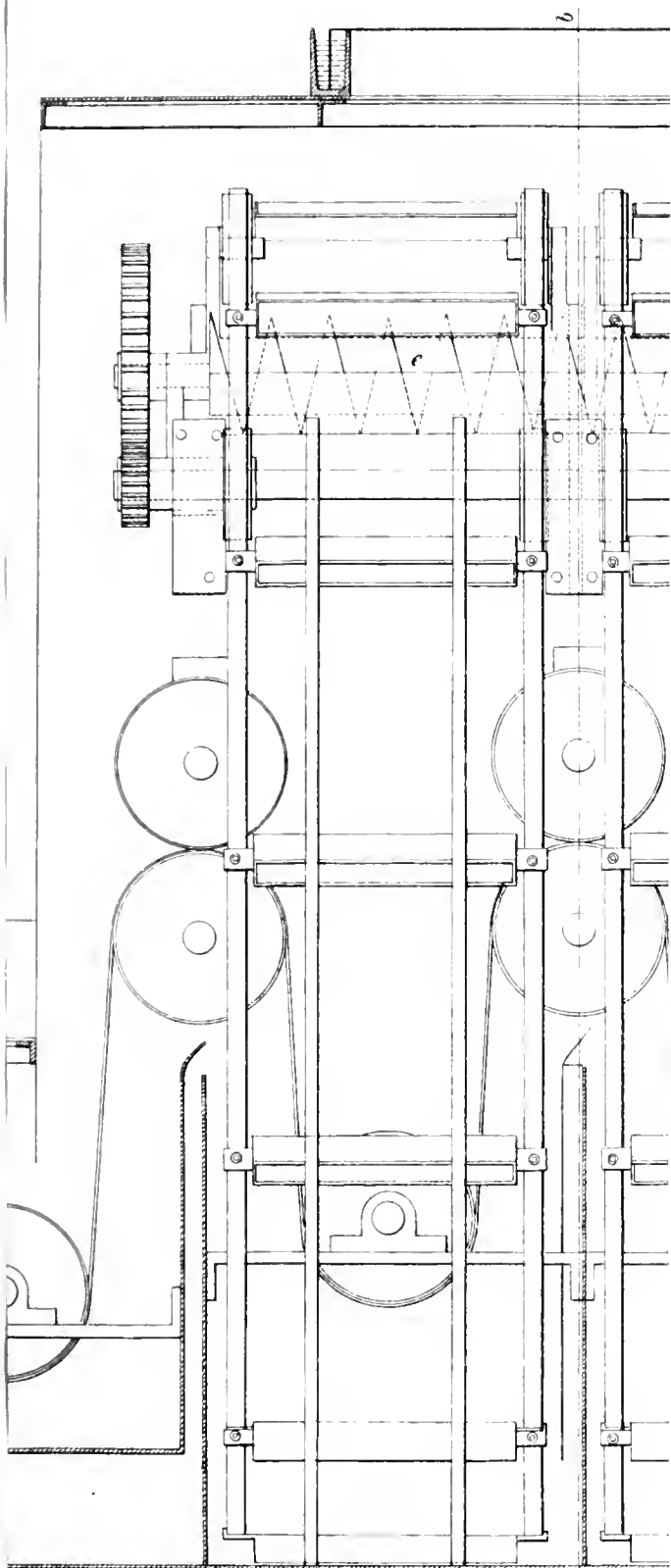
End Elevation.



Elevation.

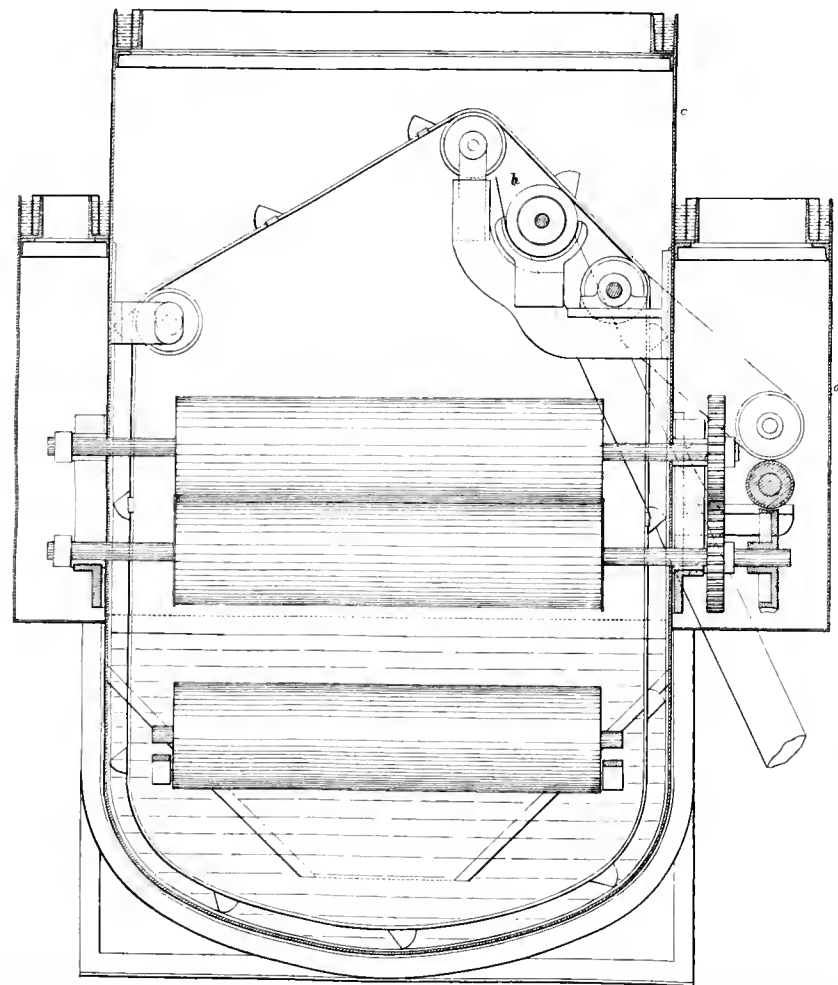


Plan.



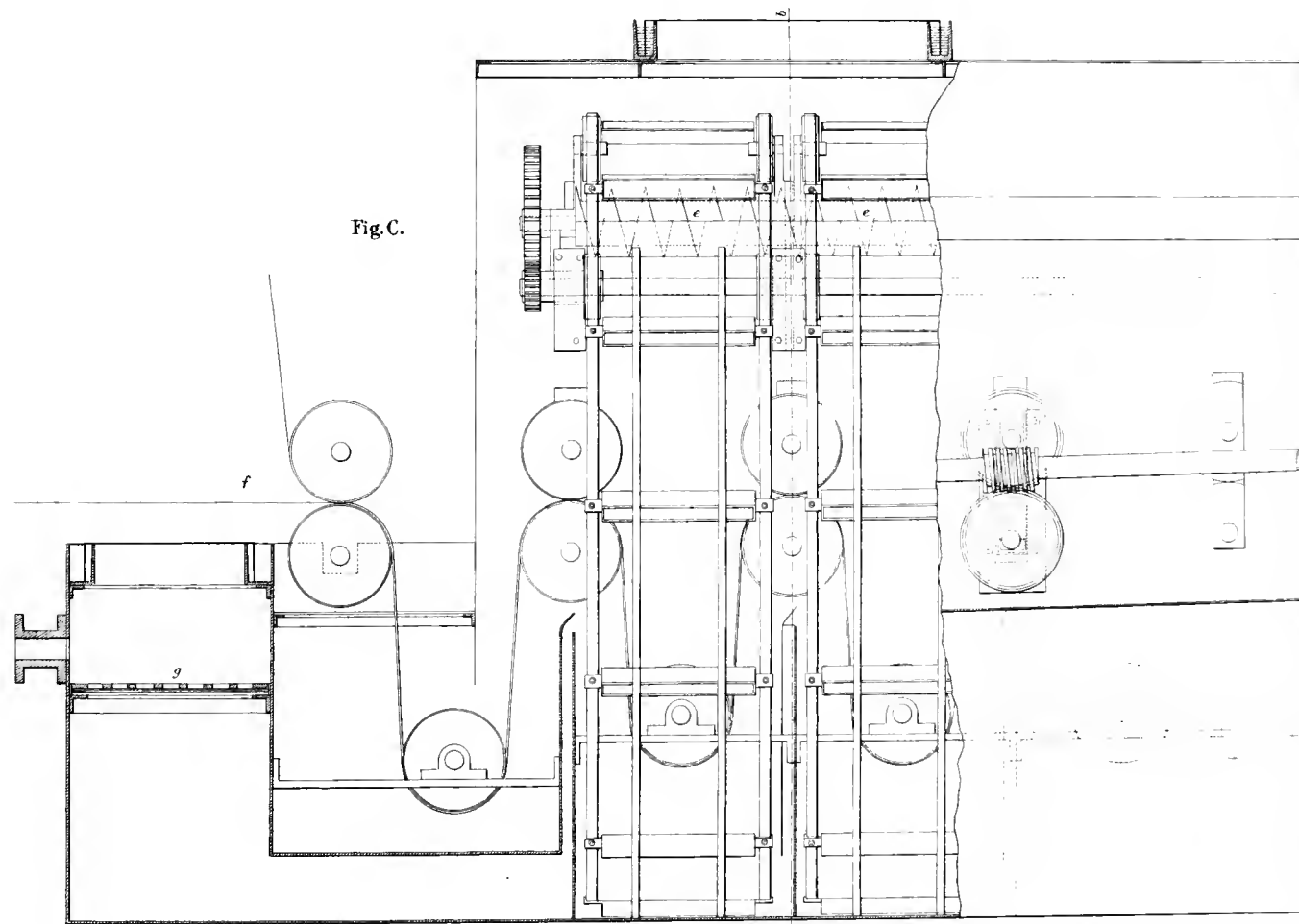
Front elevation with ^a cover

Fig.D.



Sectional elevation on line a. b.

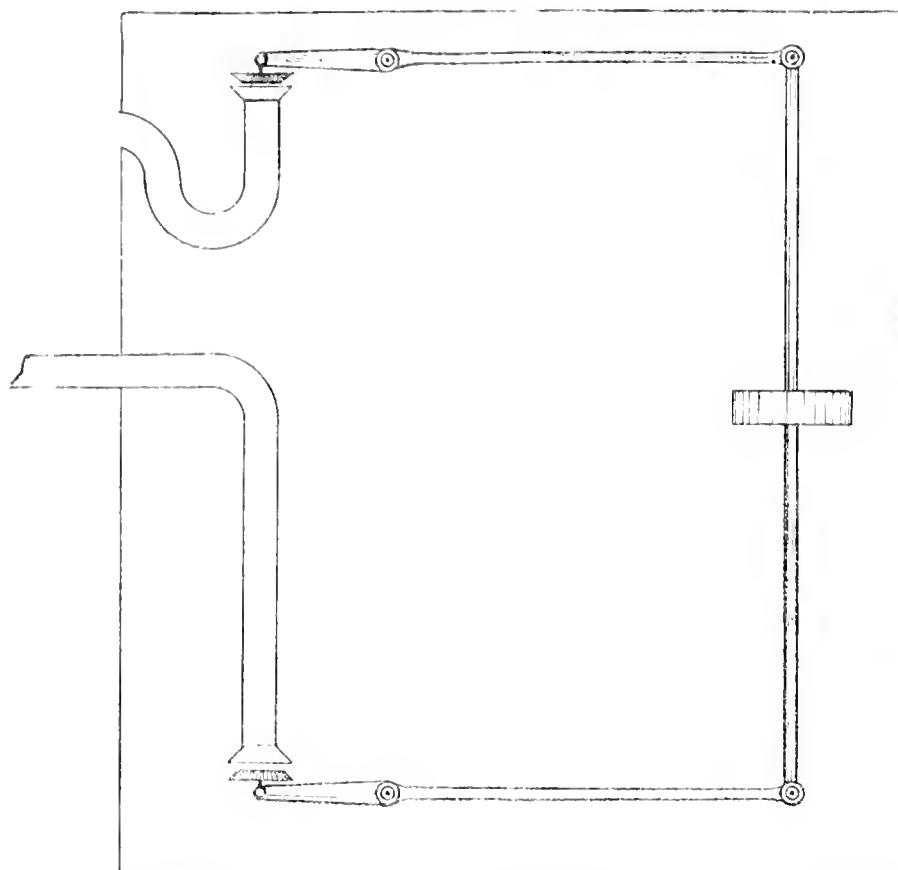
Fig.C.



Front elevation with cover c. removed.

Front elevation with cover d. removed.

Fig. F.



and bisulphide then respectively overflow into the neighbouring tanks for these liquids, and so move in a direction opposite to that in which the double perforated belts with wool are travelling. Hence wool that has become cleaner always meets with a current of bisulphide that is purer still. The same thing is true of the water.

Let us now follow the bisulphide in its course. This overflows from tank to tank till it reaches the first cistern, when, flowing underneath the inner cell holding the band and rollers and passing through a fine strainer of wire gauze (*q*, Fig. C.) it enters through the exit pipe, furnished with regulating tap (Fig. B), and is slowly fed into the retort, of special construction (Fig. F). The interior is so arranged that the oily bisulphide flows down grooved sloping plates, along the bottom of the grooves of which a steam pipe is laid. The oil, free from bisulphide, at length reaches the bottom of the series of plates or trays in the retort, when it collects in the little cistern and overflows by the siphon pipe, as shown in Fig. F. At the sharp, almost angular curve made where one groove joins the next on a sloping tray, the steam-pipe, to prevent obstruction of the flow of oil, making a small arch or bridge, enters the next groove lower down and again lies along the bottom of it. These small arches are shown at *a, a*, Fig. F.

Allow me now to point to two or three apparently trivial devices in chemical engineering which, nevertheless, are calculated to astonish us by the important results achieved by them. Notice first (Fig. B. and also Fig. C.) the sloping summits of the respective inner and outer false sides of the carbon

bisulphide tanks. It will be observed that the slopes increase the depth of the tanks, whilst they guide and drain the expressed liquors from the rollers down again into the proper tanks, so that those tanks containing purer bisulphide are not contaminated by bisulphide drainings from a less pure tank nearer to the final and most highly charged tank. Besides this, by increasing the depth of the tanks in the manner described, an opportunity is afforded for the most highly charged bisulphide in each tank, which is consequently of *lowest* specific gravity, to overflow into the neighbouring tank in the most economically advantageous way, viz., at the top, and with the same advantage, to enter that neighbouring tank at the bottom. In the case of the water tanks, a similar arrangement is devised, but since the water most highly charged with saline matters, &c. will possess the highest specific gravity, and so lie nearest the bottoms of the tanks, the overflow takes place from the bottom of one tank and by the top of the next one into which the liquor runs over. This is made plain in the Fig. B.

This is not an apparatus that has been merely worked out on paper. It has been very carefully operated in Australia for some time by the inventors, and I am assured that in the neighbourhood of the scouring plant no smell whatever of carbon bisulphide can be detected when the apparatus is in full work.

A patent has still more recently been taken out by G. and A. Burnell, of Adelaide, for a very similar piece of apparatus to that of Messrs. Singer and Judell, but it is one in which it is proposed to use benzine or petroleum spirit.

In using petroleum spirit, a rectification would first be needed to free the ordinary spirit of the trade from the partly greasy, partly resinous bodies of higher boiling point which it always contains. I miss in Burnell's specification any account of a continuous distilling apparatus to restore fresh solvent and give a continual supply of oil, and I fear for the security of the leather-lip arrangement to "prevent as much as possible the escape of the fumes."

Messrs. Singer and Judell calculate that the profits derived from the by-products of their process (the wool fats and potash salts, &c.) should pay the whole expense of royalties, apparatus, and bisulphide required.

In conclusion, my best thanks are due to Dr. F. H. Bowman for kindly lending me his lantern slides for the illustration of my papers, and for permitting me to reproduce some of the wood-cuts from his well-known work on the wool fibre, also to Mr. Ig. Singer for drawings of his apparatus and for other assistance in preparing this paper.

Newcastle Section.

Chairman: T. W. Stuart.

Vice-Chairman: P. P. Bedson.

Committee:

Alfred Allhusen.
G. T. France.
G. Gathard.
John Glover.
T. W. Lovibond.
John Pattinson.

H. R. Procter.
B. S. Procter.
W. W. Procter.
W. L. Renoldson.
C. H. Ridsdale.
J. E. Stead.

Hon. Local Secretary and Treasurer:

J. T. Dunn, The School, Gateshead.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

*Meeting held in the Durham College of Science,
Thursday, January 10th, 1889.*

MR. T. W. STUART IN THE CHAIR.

ON THE TESTING OF LARD FOR COTTON-SEED OIL AND BEEF STEARIN.

BY JOHN PATTINSON, F.I.C.

As much attention has recently been drawn to the prevalence of lard adulteration, I thought it would interest some of our members if I described briefly some of the methods by which these adulterations are detected and measured.

Although chemists have only lately been able to speak with certainty as to these adulterations, it has for some years been well known that lard, which ought to consist only of the fat of the pig, is very largely adulterated with cotton-seed oil and beef stearin, and occasionally with water. Some of the

American lard packers are the greatest offenders in this respect; but they are not the only offenders, for well authenticated cases are known in which both English and Irish prepared lards have been found to contain similar adulterations.

The lard trade of America has assumed very large proportions. It was stated in evidence before a Commission recently appointed by the United States House of Representatives to inquire into the question of lard adulteration, that about 270,000 tons are annually produced in America, upwards of one-half of which is exported to other countries. Amongst the American lard packers there are several who prepare and supply only pure lard, but it was stated before the same Commission by one of the largest producers that three-fourths of the American lard was packed by his firm and a few other large firms, and that these firms, "in order to keep up the quality and to meet the demands of the trade, added cotton-seed oil and oleomargarine stearin" to their lard. This lard is all branded and sold as "Refined Lard," "Pure Refined Lard," and other names calculated to lead the purchasers to believe that the lard is genuine pure lard. The cool way in which this perversion of the ordinary meaning of the word "Refined" is defended is amusing. To the question, "Do you think that if there was only 20 per cent. of lard in your compound, it would be right to brand that as refined lard?" the same witness answered, "Yes, sir. After we have been putting up lard for 25 years we claim to become expert in the manufacture of an edible lard for domestic purposes. If we consider that we can make an article that meets the demand of our trade, fulfils the wants of the trade, and is pure and wholesome and valuable, and can put in 50 or 60 per cent. of cotton-seed oil and harden it with 20 per cent. of lard (beef stearin?) to make it firm, it meets the demand of our trade. That is all they want. We know what they want better than they do themselves."

* * * * If we choose to say we are willing to put in our brand of refined lard only about 20 per cent of lard, we consider it perfectly fair to do it."

The beef stearin used is a by-product of the margarine manufacture, and consists of the harder part of the beef fat from which the oleomargarine has been separated by pressure. Its price was recently about 36s. per cwt. The price of cotton-seed oil was about 23s. per cwt. The price of lard was about 47s. per cwt. It will thus be seen that there would be a large margin of profit if a compound consisting of 50 or 60 per cent. of the cheaper cotton-seed oil and beef stearin could be sold at the price of genuine lard; and this is probably the clue to the true explanation of the adulteration.

I do not enter into the question as to whether cotton-seed oil and beef stearin are better or worse than pure lard. I do say, however, that such a compound ought to be sold under its proper description, and not passed off on the public as pure lard. When a purchaser wants and asks for lard he should be able to get it, and not be supplied with another and a cheaper article. The selling of such adulterated lard is also a serious injury to fair and legitimate lard packers who will only supply pure lard, but who are undersold by the makers of the adulterated lard.

To detect cotton-seed oil and beef stearin in lard, and to form an estimate of the quantity, the following tests are chiefly relied on:—Some form of the nitrate of silver test for cotton-seed oil, the microscopical appearance of the crystals formed from an ethereal solution of the lard to detect beef stearin, the iodine absorption equivalent, and the specific

gravity. Useful information is also afforded by an examination of the colour, taste, smell, and consistency of the lard.

The Nitrate of Silver Test.—This is based on the reducing action of cotton-seed oil upon nitrate of silver, the reduced silver imparting a colour to the lard. I have been unable to obtain constant or trustworthy results with this test as applied by Beechi (see "Analyst" of September 1887), who, I believe, first proposed it, nor have I been more successful with the more complicated modification of Milliau (see "Analyst" of May 1888), which consists in applying the test to the fatty acids separated from the lard, nor with the several other modifications of this test which have been published. I obtain, however, very regular and certain results by adding an alcoholic solution of nitrate of silver to an ethereal solution of the lard. The method is as follows:—40 drops of the melted lard are placed in a test tube, and dissolved in 10 cc. of ether, and to the solution 2 cc. of an alcoholic solution of nitrate of silver (1 of nitrate of silver to 100 of alcohol) are added. The tube and its contents are left to stand for five or six hours in a place protected from light. If the lard contains cotton-seed oil the silver is reduced and imparts a maroon colour to the solution—the depth of the colour depending on the proportion of cotton-seed oil the sample contains. By comparing this colour with the colours produced in solutions of pure lard to which known percentages of cotton-seed oil have been added, a close approximation to the amount of cotton-seed oil in the sample can be obtained. Five per cent. of cotton-seed oil in a lard can be readily detected by this method.

Test for Beef Stearin.—The positive evidence of the presence of this substance in lard is best obtained by examining under a microscope the crystals formed from an ethereal solution of the lard, as proposed by Dr. Bellfield, of Chicago, and described in the "Analyst" of April last. For this purpose I use the ethereal solution of the lard mentioned in the last paragraph. Should crystals not form in the cooled solution the cork of the tube is removed and a loose plug of cotton wool is substituted. The solution is then left to evaporate spontaneously until crystals form. It is sometimes necessary to redissolve the crystals, if they have been formed rapidly, by warming the solution, and sometimes adding a little more ether, so as to obtain crystals which have been slowly formed. Some of the crystals are then removed by a pipette, placed under a microscopic slide, and examined. The crystals of beef stearin form curved tufts somewhat of the shape of the short tail of a horse. The terminals should be pointed and hair-like. Lard crystals are usually found in oblong plates, occasionally radiated, and have oblique terminals.

The Iodine Absorption Test.—This was first described by Hübl, whose method is given in the J. Soc. Chem. Ind. 1884, page 641. According to my experience with lards of known purity, I find the iodine absorption equivalent of pure lard when tested by Hübl's method to vary from 57 to 63 per cent., and cotton-seed oil to vary from 105 to 116 per cent. Were the lards to be examined for only mixtures of cotton-seed oil and lard, it would be easy to arrive at a fairly close approximation to the actual amounts of each present from this test alone. This, however, is never the case, as probably all lards which contain cotton-seed oil have also had beef stearin added to make the mixture of a suitable consistency. Beef stearin has an iodine absorption of from 23 to 28 per cent., whilst beef fat, which may

also have been used as an adulterant, has an iodine absorption of about 11 per cent. This, unfortunately, complicates the calculation of percentage amounts of impurity from the iodine absorption equivalents. Most of the adulterated samples, however, have hitherto contained cotton-seed oil in such large quantity, and the iodine equivalent is so high, that a very substantial adulteration can be certified to without taking into account the effect of the beef stearin. When, however, the amount of cotton-seed oil is ascertained by the nitrate of silver test, a near approach to the amount of beef stearin also present can be calculated from the iodine absorption, after making allowance for the influence of the known quantity of cotton-seed oil. If the lard is found to be a mixture of lard and beef stearin or beef fat without cotton-seed oil, the calculation of the proportions of each is simplified; but as at present there are no known means of distinguishing beef fat from beef stearin in lard, it is necessary to calculate from the lower iodine absorption of beef stearin, and thus the amount of beef stearin may be understated. If the iodine absorption of such a lard be found to be 42 per cent., it will be safe to conclude that the lard contains one-half beef stearin and one-half lard, calculating the pure lard iodine equivalent at 61 and that of the beef stearin at 23 per cent., as $61 + 23 = 84 \div 2 = 42$.

The Specific Gravity Test is also a useful corroboration of the other tests, for cotton-seed oil is higher in density than lard or stearin. It is customary to take the gravity at a temperature of 210° Fah. as compared with water at 60° Fah., and this is best done with a Westphal balance. At 210° Fah. pure lard has a gravity varying from 860 to 861, cotton-seed oil is 868, and beef stearin 857. Lard adulterated with cotton-seed oil is usually comparatively high in gravity. Some adulterated samples which have come under my notice have had a gravity of 863.5.

Mr. Jones, of Wolverhampton, has suggested in the "Analyst" for September last, a qualitative test for cotton-seed oil based on the stiffening effect which such oil imparts to a mixture of lard when sulphur chloride is added to it. This is a useful corroborative test.

Should the lard contain water, this is readily ascertained by the crackling effect produced when a portion of the lard is thrown on a red-hot fire, or into a red-hot platinum dish. Its amount is determined by drying at 212° Fah. a known weight of the lard in a flat-bottomed straight-sided dish until it ceases to lose weight.

It is satisfactory to be able to state that in this district, at any rate, the cotton-seed oil adulteration of lard is now seldom or never met with. This is owing to the prompt action which the authorities have taken in the matter, and also no doubt to the desire of wholesale dealers to avoid purchasing such lard now that they know of the existence of the adulteration. There are still many samples to be met with which contain very large admixtures of beef stearin or beef fat.

Glasgow and Scottish Section.

Chairman: R. R. Tatlock.

Hon. Vice-Chairmen: { E. C. C. Stanford.
 { Sir J. Neilson Cuthbertson.

Committee:

J. Addie.	T. P. Miller.
G. Eclby.	E. J. Mills.
A. Crum Brown.	J. M. Milne.
J. Christie.	T. L. Patterson.
W. S. Cuthpley.	J. Pattison.
W. Dittmar.	F. J. Rowan.
D. B. Dott.	D. R. Stewart.
R. Irvine.	A. Whitelaw.

Hon. Treasurer: W. J. Chrystal.

Hon. Local Secretary:

G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Third Meeting of the Session was held in the Societies' Rooms, 207, Bath Street, Glasgow, on Monday, 7th January 1889.

MR. E. C. C. STANFORD IN THE CHAIR.

THE CHAIRMAN said that before commencing the ordinary business of the meeting it was necessary that he should refer to a very mournful occurrence that had taken place since last meeting. The hand of death had been very busy in the Section of the Society with which those present were connected. They had not got over the loss of their esteemed friend, Dr. Wallace, before they had to mourn the loss of one even more closely connected with the Society—their late Chairman.

He could not trust himself to say much about either of these two well-known men. They were very old comrades of his, and he could not look around the benches without being reminded of both of them very much. He would only say, however, that two more practical chemists, and two more amiable men, he had never been associated with, and that when he expressed his deep regret at their being taken away he was sure he was simply expressing the opinions of all who knew them.

ON EVAPORATION BY MULTIPLE EFFECT.

BY F. J. ROWAN, C.E.

THE value of steam as a heating medium, and the fact that the boiling point of liquids varies with the pressure, have been long known, and are the basis of the use of the ordinary vacuum pan. It is only within a comparatively recent period, however, that these principles have been taken advantage of in anything like a complete way in connexion with the evaporation of liquids.

De la Roche and Bérard estimated that the quantities of heat contained in equal weights of water and air at the same temperature are in the ratio of 374.6 to 100; or that the heat which is liberated when water cools down 100° is sufficient

to raise the temperature of 3.74 times as much air to the same extent. Regnault's later results correspond with the factor 4.21, giving even a larger heating value. Moreover, in passing into the state of vapour, water absorbs 5.36 times as much heat as is required to raise its temperature from 0° C. to 100° C. (32° to 212° F.), and this quantity of heat becomes latent, that is, it produces no increase of temperature in the steam, and therefore is not shown by the thermometer, but becomes again sensible when the vapour is condensed. Thus 1 lb. of steam at 212° F. (100° C.), in condensing to form boiling water, will yield sufficient heat to raise the temperature of 5.36 lbs. of water (or 4.21 × 5.36 = 22.6 lbs. of air) to 212° F.

Various devices have been introduced in order to make use of this convenient store of heat, and of those for dealing with liquids. The stills of Dorn, Derosne, and Coffey illustrate the class in which the steam is in contact with the liquor to be heated, whilst the ordinary vacuum pan for sugar making represents a different class, in which the steam is kept separate from the liquid being heated, and some of the energy required for evaporation is transferred to the work of producing a partial vacuum in the vessel containing the liquid.

The lowering of the boiling point of water by diminution of pressure is shown by the following table:—

The temperature of water boiling at atmospheric pressure is ° F.		
	under 5 ins. vacuum is	195
"	" " 10 "	185
"	" " 15 "	160
"	" " 20 "	150
"	" " 25 "	130
"	" " 26 "	120
"	" " 27 "	112
"	" " 28 "	100
"	" " 29 "	72
"	" " 29½ "	52

Other liquids follow a similar rule, but have different normal boiling points; and even water, when containing sugar or other substances in solution, has its temperature of boiling at atmospheric pressure raised. It is apparent from these facts that if in several vessels there are different degrees of vacuum produced, we can have a descending scale of boiling temperatures, so that vapour of comparatively low temperature can be utilised as it is produced. "The different boiling points of a liquid under different pressures can thus be utilised by making the vapour given off in boiling the contents of the first vessel at a certain pressure form the heating agent of the liquid boiling in the second vessel at a lower pressure, the vapour from this second vessel forming the heating agent in the third, and so on."

This principle was applied in what is known as the Rillieux system, and governs all forms of what are now called "Triple-effect" (or triple effect) apparatus. The Rillieux system utilised "the latent heat of the vapour of liquids boiling under a low vacuum to boil a second pan working under a higher vacuum. The usual limit to this system is four pans, thus utilising the latent heat four times and reducing the fuel to nearly one-fourth of that required for open evaporation or single vacuum pans. As generally arranged, all the boiling liquids in the system are under a partial vacuum; the first under about 5 inches, from which the vapour is taken to boil a second under 12 inches vacuum; from this to a third, boiling under 19 inches vacuum, and from this to a fourth, boiling under 27 inches vacuum.

"In liquids liable to injury by heat, the total variation of temperature available under ordinary

conditions is that between the temperature of steam at 5 lbs. pressure per square inch (227° F.) and the temperature of a solution at 30° Baume boiling under a vacuum of 26 inches (131° F.)—a total of 96° F. With a triple effect (or three vessels), however, there is steam at 5 lbs. pressure in the drum or shell of the first effect, and the liquid in the tubes—at atmospheric pressure—boils at 227° F., giving off vapour at 212° F. This vapour at 212° F. passes into the shell of the next effect and boils the liquid in the tubes of this effect under 14 inches vacuum, giving off vapour at 161° F. This again passes to the shell of the third effect and boils the liquid in the tubes under a vacuum of 26 inches, the boiling point of this liquid (supposing it to be a concentrated solution of 30° Baume) being 131° F.

"It is a point worth noting that where the liquid is a solution of solids in water, the vapour will always be at the temperature of boiling water at the pressure to which the liquid is subjected at the time, whilst the liquid itself will be slightly warmer."

The total difference of temperature in evaporating liquids liable to injury by heat being, as mentioned above, 96° F., whilst the amount of heat transmitted through the tubes (and therefore the work done) is practically proportional to the difference in temperature, it is evident that the same work is done whether the whole of this difference is in one vessel or is subdivided among several vessels. In other words, "a double, triple, or quadruple effect can only do the work of a single effect the size of the first vessel of the multiple effect; but it does it with a half, a third, or a fourth of the quantity of steam or fuel respectively."

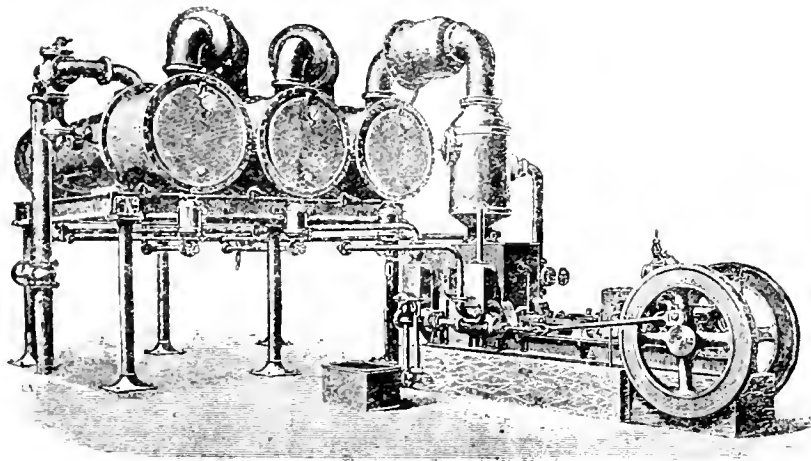
Fig. 1 illustrates the arrangement of triple effect apparatus manufactured by Messrs. A. and W. Smith and Co., of Glasgow, who have been kind enough to furnish the illustration and information concerning

this apparatus. This apparatus is generally composed of three vessels, which may be placed either vertically, as shown in the illustration, or horizontally. Each of the vessels has a calandria, or tube-chamber, filled with small brass tubes, in the lower part of the vessel. The steam, which under ordinary working conditions is merely the exhaust steam from the engine connected with the apparatus, is admitted to the lower part of the chamber surrounding these tubes and acts upon the liquor inside the tubes, the level of the liquor being three-fourths of the height of the chamber. The steam or vapour rising from the surface of the liquor in this first pan enters into the tube-chamber of the second pan and boils the liquor in it. The steam or vapour from the surface of the liquor in the second pan enters the corresponding tube-chamber of the third pan, and boils the liquor which it contains. The vapour from this pan is drawn through the condenser by means of a vacuum pumping engine, which acts on the other pans also.

In its normal working it will be observed that the steam admitted into the first chamber is the actual heating medium for the three vessels. The apparatus is generally fitted with isolating valves, so that any of the pans can be thrown off at pleasure.

The temperature is highest in the first pan and lowest in the third; whereas the quality of the vacuum is arranged in the reverse order, it being highest in the last pan, which is nearest to the condenser and vacuum pump. This distribution of temperature and vacuum is said to be well suited to the evaporation of sugar liquor. The pans are fitted with eye-glasses, gauge-cocks, and other appliances necessary for the manipulation of the liquor from one pan to another, and for testing its consistency during evaporation. The whole apparatus is generally mounted on a cast-iron framework composed of columns and girders in order to render it accessible.

Fig. 1.



Although, in the form of apparatus just described, the liquor being evaporated is inside the small tubes, and the steam used for heating it is outside, in the triple-effect apparatus, as ordinarily arranged, the reverse order has usually been maintained.

The influence of the highly ingenious Yaryan apparatus has doubtless been felt in this and other details, but the action of the Yaryan evaporator is sufficiently distinct to demand separate description. The great objections found to exist against multiple-effect apparatus as usually constructed are the high

temperature to which the liquor is exposed in the first vessel, and the length of time which is required to treat the volume of liquid contained in it. In the manufacture of sugar with the ordinary triple effect the heat of the first effect, which reaches to nearly 200° F., combined with the long time to which the liquor is subjected to it, is a fruitful source of "inversion" of the sugar. With the Yaryan system, however, frequent tests with the polariscope demonstrate that there is no inversion, and consequently no loss of sugar from that cause.

The Yaryan Evaporator.—The ingenious invention of Mr. Homer T. Yaryan, of Toledo, Ohio, U.S.A., has met with a very large measure of success from its first introduction in America in 1886, and has in large measure superseded all previous attempts to produce economical evaporation by machinery. Mr. Yaryan adopts in his apparatus the two principles of "evaporation in a vacuum" and "evaporation by multiple effect." The evaporator itself consists of a series of straight tubes, passing from end to end of a shell or drum, and coupled together by an ingenious arrangement of "pockets" to form coils, the main advantage gained by this design being the great ease with which the straight tubes can be examined or cleaned. As a rule, the coils consist of an odd number of tubes, the inlet being at one end of the evaporator and the outlet at the other. At the outlet end of the evaporator is a separating chamber, in which the liquid discharged from the tubes is completely separated from the vapour. Below the separating chamber is a "collecting chamber" into which the liquid flows, whence it is drawn, by the superior vacuum, into the vaporising coils of the second effect, in which it undergoes a second process of evaporation by means of the vapour which comes, through the vapour pipe at the top of the separating chamber of the first effect, into the shell of the second effect.

This principle of "multiple effect" can be repeated in the Yaryan to an almost indefinite extent, its limit being gauged only by the commercial aspect of the question.

The evaporation in the Yaryan apparatus differs from that which occurs in previous systems in that it takes place in the interior of the above-mentioned vaporising coils, the heating agent being outside the tubes; and as the rate of the feed of liquid to be evaporated is arranged so that it cannot fill these coils, there is never any depth of liquid to be displaced by the vapour in its endeavour to escape from the heating surface. In addition to this, the rapid circulation induced by the formation of the vapour in the interior of the tubes promotes a movement which brings into play the whole of the heating surface in a manner which has never before been effected. Tests taken from Yaryan evaporators

in operation have shown an evaporation per square foot of heating surface of more than double that of any evaporator previously invented, whilst by the new principle embodied in Mr. Yaryan's invention, evaporation by multiple effect can be carried further in his apparatus than in any other.

As an evidence of the practical results obtained by the Yaryan evaporator, over one hundred machines, with a daily evaporating capacity of over 3,000,000 gallons, and concentrating a variety of liquids, have been started during the last two years, and all are giving great satisfaction.

The applications of the Yaryan evaporator are very extensive, as the following list will show, the liquids named having all been successfully dealt with:—Solutions of sugar, glucose, glue, glycerin, beer worts, grape must, waste alkali liquors from paper mills, bark extracts, dyewood extracts, tannin, liquid beef, pure caustic soda, tank waters from slaughter-houses, &c.

It has also been applied to the concentration of milk and to the production of distilled water from sea or impure water. In fact, it can be applied to almost any liquid requiring concentration.

The general arrangement of the apparatus is shown in Fig. 2. As will be seen, it consists of three or more horizontal vessels mounted on a light staging. It is provided with a condenser and pumping engine for maintaining a high vacuum in the last pan, and the engine is also provided with small pumps for feeding the liquor into the first pan, and withdrawing it, after concentration, from the last.

The action of the apparatus will be understood from the diagram, Fig. 3, giving a simplified section through one of the pans and "catch-alls." The heating tubes, surrounded by steam, are divided into units or sections, known as "coils," and consisting of five tubes, coupled at the ends so as to form one passage. One of these "coils" is shown in the illustration. Its action may be taken as typical of that of all the coils in the pan, of which there may be any number proportional to the work to be done. The liquor enters the first tube of the coil in a small but continuous stream, and immediately begins to boil violently. It is thus formed into a

Fig. 2.

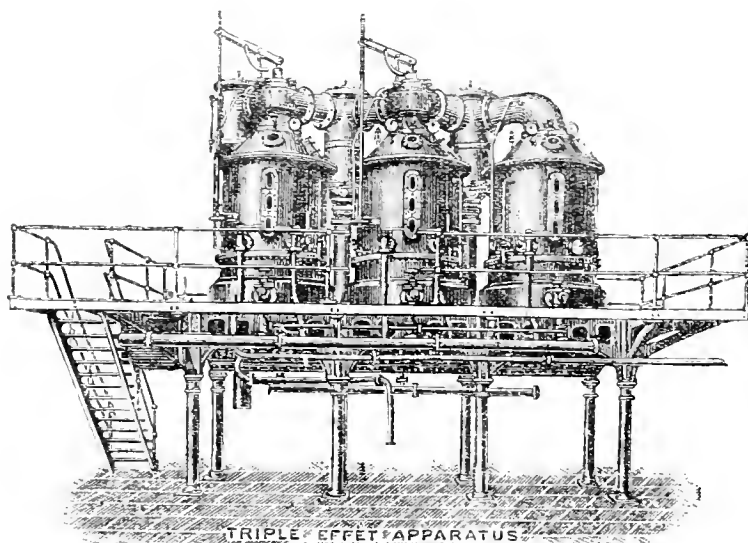
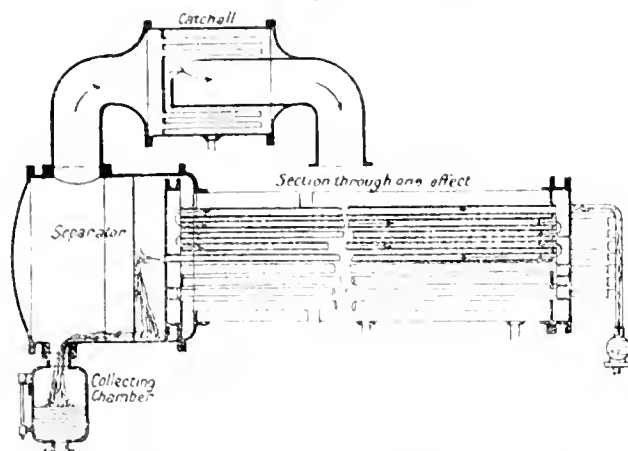


Fig. 3.



mass of foam, which contains, as it rushes along the heated tubes, a constantly increasing proportion of steam. As the foam and steam cannot escape by the inlet end of the coil, and as steam is being continually formed, the mixture is propelled forward at a high velocity, and finally escapes from the last tube into an enlarged end chamber, known as the separator. This is provided with baffle-plates, against which the mixture of steam and liquor impinges on issuing from the tube. The liquor falls to the bottom, whilst the vapour passes on to heat the next pan.

The arrangement described is said to give an almost perfect separation of the liquor and vapour; but to make doubly sure, and to avoid the chance of losing any sugar, the vapour is next passed through the special form of catch-all shown in the illustration. This is also a part of Mr. Yaryan's invention. Here the vapour is divided by tubes into a number of small streams, each of which impinges against the end wall of the chamber, giving up any drops of liquid carried over. The vapour itself escapes by the central pipe. This catch-all is found in practice to prevent any detectable loss even when used for liquors far more liable to foaming than those dealt with in sugar manufacture.

The advantages claimed for the Yaryan apparatus are many and important. The duty of each square foot of heating surface is twice that which can be obtained in apparatus worked in the ordinary method. There is only a small quantity of liquor in the apparatus at any one time, and the circulation is rapid and compulsory. These are both very important points, seeing that the action of heat on sugar is injurious in proportion to the time during which it is applied, as well as to the intensity of the heat. The apparatus is found in use to be practically automatic and requires the minimum of attention. It can be started and stopped in far less time than is needed with the older apparatus, which will contain hundreds or even thousands of gallons of liquor.

The economy of fuel realised in the Yaryan arrangement of multiple-effect evaporation is thus stated by the patentees, to whom the author is indebted for the interesting particulars to which he has referred. A well-proportioned steam boiler, fired with good fuel, should evaporate $8\frac{1}{2}$ lbs. of water per lb. of coal. Each pound of steam condensed in the first effect will evaporate one pound of water, less the heat required to bring the liquid to be evaporated to its boiling point. If the initial temperature of the liquid were, say 50° F., and the

boiling temperature, say, 140° , there would be a loss of 90° . As there are about 966° of latent heat in steam, this loss would amount to nearly 10 per cent. Or, supposing the liquid is at the boiling point when it reaches the apparatus, every pound of steam condensed in the first effect evaporates 1 lb. of water, and in turn the vapour thus produced evaporates 1 lb. of water in the next effect, and so on. There is, of course, some loss by radiation of heat; but, as the vessels are small and easily lagged, this is reduced to a minimum: 16 lbs. of water will, therefore, be evaporated in a double-effect Yaryan apparatus, 23½ lbs. in a triple-effect, 30½ lbs. in a quadruple-effect, and 37 lbs. in a quintuple-effect for each pound of coal burned under the boiler.

With ordinary vacuum pan, or steam pan, boiling, only $8\frac{1}{2}$ lbs. of water will be evaporated per pound of coal used, while with direct firing not more than 5 lbs. of water per pound of coal can be evaporated.

DISCUSSION.

Mr. HAY said he would like to ask Mr. Rowan if he could give any idea of the comparative efficiencies of the different shapes of surface through which the heat was transmitted. In a still which he had at work the copper coil was zig-zag across the flat bottom of the still and the evaporation per superficial foot was $1\frac{1}{2}$ gallons per hour. But in a similar still in which the coil was hung round the sides—and not zig zag across the bottom—the evaporation amounted to $2\frac{1}{2}$ gallons. He should like to know whether there would be any advantage gained by using vertical tubes. He did not understand if the triple effect had a definite circulation. Mr. Rowan had said that the liquid within the tubes only reached three-quarters of the distance up the tubes, and that there was no liquid in the large upper space. Now, if the liquid did not reach the top of the tubes, how could it circulate in the apparatus? He had been unable to find out any means of calculating the efficiency of heating surfaces. Molesworth in his book of formula says that if a horizontal heating surface has an efficiency of 100, a vertical heating surface has only an efficiency of 50, while a horizontal surface with a downward aspect has no efficiency. Now he wished to know if this formula could be applied to tubes, as they are in the inside of the still.

Mr. R. A. ROBERTSON asked how the treatment of the juice in the ordinary triple-effect apparatus, diagrams of which was exhibited, could be described as similar to that in a Yaryan apparatus, and said

that the boiling of sugar liquors in ordinary multiple-effect apparatus, having the heating tubes partially filled with liquor was old and well known, and differed essentially from the system introduced by Mr. Yaryan, which consisted in feeding the liquor in limited quantities into a series of horizontal tubes, one end of each series of which was closed except to the extent of the inlet aperture, say $\frac{1}{4}$ in. to $\frac{1}{2}$ in. diameter. These partially-filled tubes being surrounded by steam, the vapour formed from the liquid within them, unable to escape in any other direction, rushed to the open end carrying with it the liquor in the form of foam or spray, and this mixture of liquid and vapour traversed the lengths of the apparatus as many times as found necessary to produce the required effect. In ordinary apparatus such as described by the author of the paper, although the partially-filled tubes threw up the liquor in something the same condition as existed in the tubes of the Yaryan, the evaporation at each discharge being very trifling the liquor had to circulate many times before any appreciable concentration was effected, whereas in Yaryan's apparatus the liquor flowed continuously through horizontal tubes of considerable diameter, and the desired degree of concentration was very rapidly effected without return to the inlet ends of the same heating tubes.

Another peculiarity of the Yaryan system was that, owing to the liquor going through the heating tubes in the form of spray, it was exposed to the heating surface in very thin films, and consequently such apparatus could be worked with lower temperature differences than so far appears to be possible with any other evaporating apparatus.

In a Yaryan apparatus working in London, the separate chambers of which were lit up by means of electricity, the violent spray discharge from each tube could be seen and fully verified the inventor's statements as to the condition in which, when his apparatus was properly worked, the liquor and vapour traversed the heating tubes.

The action of the Yaryan "catch-alls" or "safes," as sketched on the black-board by the author of the paper, had proved most efficient, as is shown by the fact that in the case of Yaryan apparatus employed for the concentration of spent alkali liquors in paper works, a few drops of which liquor would colour many gallons of water, the water of condensation coming from such apparatus is colourless and free from alkali.

Foaming liquors, such as those containing glucose, glue, glycerin, &c., which are most difficult to concentrate in ordinary apparatus, are from this very peculiarity amenable to successful treatment in the Yaryan apparatus, and by means of the separator chambers and "catch-alls," the resulting concentrated liquor and vapour can be separated without appreciable loss from boiling over.

Mr. ROWAN said, in reply to Mr. Haig, he had not had any practical experience of these forms of apparatus, but that having had occasion to collect information as to various methods of evaporation in the course of his work, he thought it would be interesting to the Society to have the subject brought before it. Therefore, as to the relative values of different forms of heating surface for evaporating liquids, he was unable to give the desired information from practical experience.

His experience of evaporating had been gained in connexion with steam boilers, and while he knew it was a fact that the relative value of heating surfaces were reckoned according to the method which had just been mentioned, it must not be forgotten that those values were merely stated in relation to the

travelling of the hot gases in one direction, viz., always tending upwards. Some years ago he had controverted that statement, which had been made by several engineers, because it was apparent to any one that if the direction of the movement of the hot gases was reversed, all the estimates of heating surface would be erroneous. Take the case of passing the hot gases downwards over the heating surface of boilers before these hot gases were allowed to escape. It was well known that in so doing you reduce the rate of travel of these hot gases and allow the colder portions to escape first, and that system might be carried out to any extent, giving complete control over the rate of escape of the gases, and consequently the relative values of the different forms of heating surfaces were entirely altered.

Where the gases were travelling horizontally, and then vertically, it stood to reason that horizontal surface was more valuable than vertical surface, because the gases were delayed in passing over the horizontal surface, whilst their period of contact with vertical surfaces was short. But if the rate of the movement of the hot gases was controlled on the vertical surface, it was just as valuable, and in fact, in his humble opinion, even more valuable, because it was more easily dealt with as regarded the necessary circulation of the liquid.

As regards Mr. Robertson's remarks, he did not say that the triple effect worked on the Yaryan principle, but that the Yaryan invention had evidently influenced the design to the extent of having the liquor contained in the small tubes, instead of its being in a mass with the heating tubes passing through it.

ON A PECULIAR CRYSTALLINE ALLOY OF COPPER, TIN, AND LEAD.

BY A. FRENCH.

OLD furnace bottoms are good hunting grounds for those who have the time, and are imbued with a spirit for inquiry. Unfortunately it too often happens that those who have the opportunity of finding new things or of observing strange phenomena not infrequently lack the time and facilities, and, it may be, the talent and ability to investigate the discovery as fully as it requires, and those who are more favoured with time, apparatus, and learning are mostly always located within the walls of a city laboratory and may never hear of the rare opportunities which they are missing by not being on the spot.

The crystalline alloy which I show on the table was found within a cavity in the bottom of a cupola furnace which was being cut out, after running on material containing oxides of lead, copper, tin, iron, and a little antimony. The cavity evidently had been filled, whilst the furnace-bottom was working, with the ordinary impure lead which was being smelted, and which contained somewhere about 3 per cent. tin, 1 per cent. antimony, and 1 per cent. copper, leaving about 95 per cent. of lead. And when the furnace was cooling down very probably the molecular forces which determine crystallisation would come into play, selecting out the necessary elements in the required proportions to form the greatest quantity of crystalline matter, according to a law analogous to that which determines the formation of crystalline minerals.

A few days after a furnace is put off lead begins to ooze out by cracks which take place in the slag of which the bottom is made, and cavities which are emptied of their liquid contents in this way frequently contain crystalline matter. The same thing may be seen in bull-dog slag from the puddling furnace, the cavities containing beautiful crystals of definite silicates of iron.

The interesting feature of the crystals which I exhibit to you is their resistance to oxidation. They have been exposed to the atmosphere, dry and wet, for several months, and are as bright to-day as at first; strong sulphuric acid, even when boiled, has scarcely any effect in corroding them, in fact it is only after boiling for some time in the acid that the lustre of the crystals is affected. Hydrochloric acid has very little effect on them either cold or hot, and whilst hot nitric acid attacks them, still there are other and smaller crystals amongst them which resist the action of boiling nitric acid for a long time, but they dissolve at once in aqua regia.

The leady crust which forms the matrix or base of the crystals is easily attacked by hydrochloric or nitric acid.

The crystals are in the form of plates and flat lengthy four-sided prisms, the narrow sides bevelled at the angles of about 42° and 138°. They appear to belong to the oblique prismatic system, having the three axes all unequal, and the two shorter or cross ones at oblique angles of about 42° and 138° to each other, but both of these are at right angles to the principal or long axis.

I have already said that there are small crystals present which are attacked with difficulty by nitric acid; these show a much larger proportion of copper and less lead than the average of the specimen, but their quantity is so small that an accurate determination cannot well be made without destroying the whole. The analysis of the whole specimen is not by any means constant, and I can only offer this as the best of three trials on $\frac{1}{2}$, 1, and 2 grms

Lead	65.89
Copper	11.32
Tin	10.22
Antimony	3.70
Iron	0.75
Silicon	2.09
Sulphur	0.53
Insoluble in nitric acid crystalline metallic residue	1.50
	<hr/> 100.00

DISCUSSION.

Dr. MILNE asked if Mr. French had made any trials as to the relative hardness of this alloy as compared with corresponding alloys.

Mr. FRENCH said that from the slight trial he had made, the alloy showed a fair degree of hardness, but he thought it would be best characterised if he called it brittle.

In reply to an inquiry as to what purposes it might be used for, he said that if he could discover a way to make it in quantity, he thought it could be used for several useful purposes, but that was a matter which would require to be investigated.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Steam Boiler Explosions in the German Empire during the Year 1887. Chem. Zeit. 12, 1444—1447.

FOURTEEN explosions took place during the year 1887. The official investigation showed the following results:—(1.) *Explosion of a cylindrical boiler with heater at the paper-mills of Nücklich and Co., Eisenberg.* Cause of the

Fig. 1.



Figs. 2 & 7.

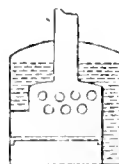
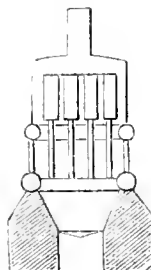


Fig. 3.



Fig. 4.



Figs. 5, 6, & 13.



Figs. 8 & 9.



Fig. 10.



Fig. 11.

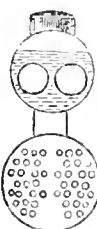
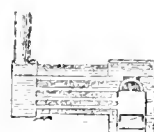


Fig. 12.



explosion was the corrosion of the plates in the bottom boiler. (2.) *Explosion of a vertical boiler with cross tubes, at the flour-mills of H. Bucher, Kaldenkirchen.* The plates were of inferior quality, and of cold-short iron. The explosion was due to an excessive pressure of steam. (3.) *Explosion of a cylindrical vertical boiler in the iron-works*

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	$\frac{1}{2}$ d.
Above 8d., and not exceeding 1s. 6d.	1d.
" 1s. 6d. " " 2s. 4d.	$\frac{1}{2}$ d.
" 2s. 4d. " " 3s. 4d.	2d.

of P. Weber, Dortmund. Cause of the explosion was want of water in the boiler. (4.) *Explosion of a vertical cylindrical boiler with flue-tubes.* The bottom of the boiler had been protected by a cast-iron ring, but on one occasion, before getting up steam, a portion of the ring broke off, which caused an unequal distribution of heat. A fine fissure was thereby formed, through which the boiler emptied itself, thus causing it to run short of water. (5.) *Explosion of a horizontal boiler with heater at the saw-mills of Kolk and Schregel, Haltern.* Cause of the explosion was excessive steam pressure, but how this arose could not be discovered. (6.) *Explosion of a horizontal boiler with heating-tubes, at the brown coal mine, Köttschau.* A patch was put upon the plates of the bottom boiler six or seven years before the explosion. The patch gradually rusted away without being noticed, and the local weakness of the plate at last caused the explosion. (7.) *Explosion of a marine boiler on the steamer "Margarethe."* Want of water caused some tubes to get red-hot, one of which burst. (8.) *Explosion of an elephant boiler at the colour-works of F. Bayer and Co., Elberfeld.* Too hard firing and frequent overheating caused local weakness of the plates, which at last gave way. (9.) *Explosion in the iron-works at Friedenschulte.* Here 22 boilers were placed in one row, all of which were destroyed by the explosion. The quality of the plates was presumably not very good. The boilers were heated by gases from the blast-furnaces, and opinions are divided on the question whether an explosion of these gases may not have caused a concussion in the first instance, which gave rise to the explosion of the boilers. (10.) *Explosion of a Cornish boiler at the whiskey distillery of A. Winkler, Kleinmilkau.* The flue-tube collapsed and was torn. The points of rupture showed a thick layer of oxide, which pointed to a fracture of long standing, and excessive pressure of steam at last had overcome the resistance of the weakened plates. (11.) *Explosion at a paper-works.* A plate in the shell of the bottom boiler became red-hot, and ruptured. Ten tubes were bent by the explosion. (12.) *Explosion of a boiler on the steamer "Wilhelm."* Owing to want of water, the roof of the fire-box was heated too strongly, and gave way. (13.) *Explosion of a horizontal boiler at the Lugau Colliery, Zwickau.* A plate of the bottom boiler was weakened by corrosion from the outside. At the point of fracture, the plate was only from 1 to 2 mm. thick.—S. H.

PATENTS.

An Improved Evaporating and Condensing Apparatus for Producing Fresh Water from Sea Water for Drinking Purposes and for Boiler Feed. W. F. Pamphlett, Portsea. Eng. Pat. 15,586, November 14, 1887. 8d.

This invention purposes taking advantage of the application of a vacuum to a liquid that is to be evaporated, for reducing the temperature of evaporation, with a view to the economisation of heat. For the same purpose the pre-heated sea-water used for condensing, as it issues from the hot well of a condensing marine engine, is utilised as the liquid of evaporation. It is circulated through steam-heated, tubular, closed chambers, in which a vacuum is kept up. The vapour given off may be condensed for drinking purposes or for boiler feeding in a tubular condenser of similar construction. The drawings indicate several ways of arranging the apparatus.—B.

Improvements in Apparatus for Distilling Water, applicable also for Heating Purposes and for Feeding Boilers. C. Howe and J. H. Beckwith, Colechester. Eng. Pat. 9548, June 30, 1888. 8d.

STEAM is taken from a steam boiler into a coil placed in a secondary boiler situated above the main boiler, and filled with the salt or impure water submitted to distillation. The water which condenses in the heating coil flows back into the main boiler, and the vapour produced in the secondary boiler is led into a condensing worm in a second vessel, where it is condensed, imparting its heat to the liquid subsequently passed into the secondary boiler. The arrangements for heating purposes are similar.—C. C. H.

Improvements in Evaporating Apparatus. S. M. Lillie, Philadelphia, U.S.A. Eng. Pat. 12,391, August 28, 1888. 8d.

FIG. 2 shows the construction of one of the evaporators E in Fig. 1, which illustrates the combination of three such evaporators and the requisite connections forming a multiple-effect apparatus. Through the pipe v^1 the liquid to be concentrated is introduced, and after distribution by D^1 , passes through the perforated cover-plate p^2 into the feed-chamber G, overflowing into the tubes b in the form of a

Fig. 1.

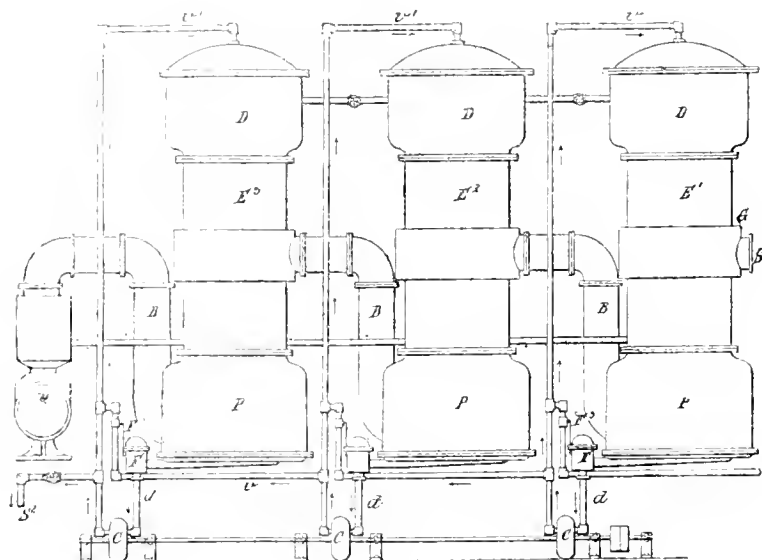
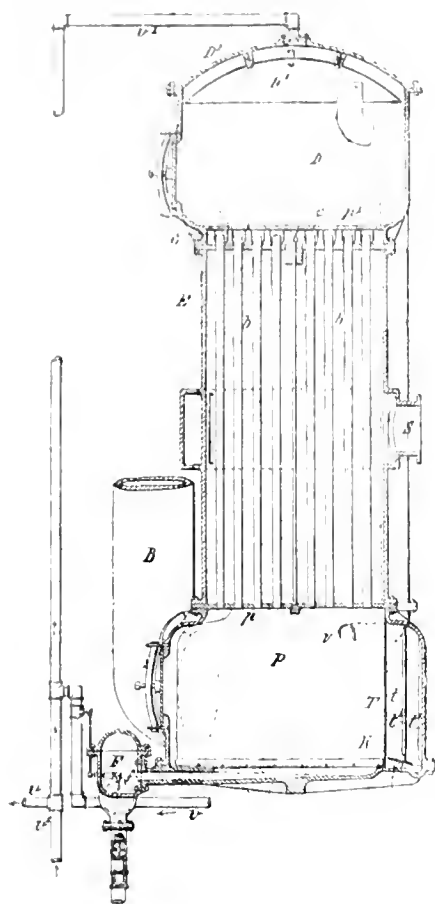


Fig. 2.



film coating the insides of the tubes. The whole tubes are heated by means of steam admitted through *S* into the heating chamber. The concentrated liquor falls into the collector *P* and through the float-trap *F* into the pump *C*, by which it may be returned into the evaporator in the case of a single effect, or, as shown in Fig. 1, into the next evaporator in case of a multiple effect. The vapour passes through the annular spaces *t*, round the exterior of *P*, and thence into the vapour main *B*. As shown in Fig. 1, the vapour from one effect heats the tube-chamber of the next, and finally passes, in the case of the last of the series, into the condenser on the vacuum pump *M*. The flow of liquid through the whole series is regulated by means of the floats *F*. The invention and its details are covered by 28 claims.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

Note on the Petroleum and Native Paraffin of New Zealand. R. W. Emerson MacIvor. "The Gas World," 18, December 1, 1888.

PETROLEUM has been known to exist in several localities in New Zealand since 1866, but it is only within recent years that attempts have been made to ascertain whether the oil occurs in sufficient quantity to have a commercial value. The first discovery was made at Waipatu, Poverty Bay, on the east coast of the provincial district of Auckland, and the second one at Manutahi, Waipatu, East Cape. Many thousands of pounds have been spent in boring operations, and, though fair quantities of good oil are generally obtain-

able, no steady supply has been come upon. The depth of the borings made has exceeded 1,000 feet. The oil obtained from the first locality named much resembles Canadian oil. By several successive distillations, and treatment with acid and alkali, the crude material yields from 65 to 70 per cent. of excellent illuminating oil, having a specific gravity of 0.844 at 15.5° C. The oil obtained at Manutahi has a pale brown colour, is nearly quite transparent, and has a specific gravity of 0.830 at 15.5° C. It contains very little solid paraffin, and on distillation yields about 80 per cent. of illuminating oil, fit for use in ordinary lamps. When subjected to two more distillations, about 65 per cent. of oil of specific gravity 0.812 is obtained.

The natural gas which escapes from the ground in some places consists chiefly of methane, but burns with a bright luminous flame, owing to the presence of higher paraffins in the form of vapour.

Large quantities of a white or grey, somewhat gelatinous, substance occur on the property of the South Pacific Petroleum Company, and examination has shown it to vary in composition. Samples submitted to W. E. Dixon, of Sydney, N.S.W., J. Cosmo Newbury, of Melbourne, and the author, were found to contain a large percentage of solid paraffin, extractable by the ordinary solvents. Later samples, however, were found to be free from paraffin, and to consist of a substance which, when heated, would neither melt nor burn, but simply charred. Skey, the chemist to the New Zealand Geological Survey, examined the material and reported it to be a sort of *dopplerite*, or, at least, a body allied in chemical composition to that mineral. The author found, however, that on charring it "the smell of burning feathers" was perceptible, indicating the presence of nitrogen.—W. S.

A Source of Error in the Determination of Benzene in Gas Mixtures. E. P. Treadwell and H. N. Stokes. Ber. 21, 3131—3133.

See under XXIII., page 64.

PATENTS.

Improvements in Apparatus for the Combustion of Liquid Hydrocarbons. W. M. Chinnery and P. Tarbutt. London. Eng. Pat. 624, January 14, 1888. 8d.

THE apparatus here described is an improvement upon that specified in Eng. Pat. 13,752 of 1886 (this Journal, 1887, 651). The combustion chamber is divided into two compartments by a horizontal partition, the lower communicating with the upper by a central adjustable nozzle. The upper compartment contains liquid hydrocarbon kept at a fixed level (below the delivery point of the central nozzle) by communication with a reservoir, which is supplied automatically by means of a suitable valve. This upper compartment is provided with a conical cover, open at the top, and perforated with a number of small holes near its lower edge. This is surmounted by an outer cover of the same shape, so that an annular space exists between the two. To commence operations a light is applied to the oil in the upper compartment, which undergoes incomplete combustion with the air entering through the perforations in the cover. Compressed air is now forced into the lower compartment, and issues jet-wise through the nozzle-mouth in the upper compartment. It draws away the hydrocarbon vapours here disengaged by the heat of the incomplete combustion, and escapes from the top of the conical cover as an intensely luminous flame. This is fed with air by the heated current continually passing upwards through the annulus between the two covers.—A. R. D.

Improvements in Furnaces for Aiding Combustion. J. Beveridge, Barrow-in-Furness. Eng. Pat. 1871, February 8, 1888. 8d.

HOLLOW grate-bars are employed, open at the front end, and communicating at the back with a chamber of fire-

resisting material inside the fire-box. Air is caused by a natural or forced draught to pass through the hollow fire-bars into the said chamber, whence it escapes by suitable openings to mingle with the fire gases in the flue, and, being in a highly heated condition, promotes a very perfect combustion. The flue is preferably packed with checkered work or regenerative passages.—A. R. D.

Improvements in the Construction of Coke Ovens. A. F. Link, London. From P. T. Bauer, Munich, Bavaria. Eng. Pat. 11,040, August 7, 1884. Amended September 22, 1888. 11d.

THE amendments refer mainly to the flue arrangements for dealing with the hot air supply and products of combustion. The specifications with its drawings should be consulted. (See also this Journal 1885, 486.)—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

On the so-called "Free Carbon" in Coal Tar. H. Köhler. Dingl. Polyt. J. 270, 233–240.

WHEN coal tar is extracted with a suitable solvent until no more is dissolved, a brown-black powder of velvety appearance is left, which is the so-called "free carbon" of coal tar. The author discusses the various views which have been advanced as to the origin and formation of this substance, and agrees with Kunath that it is chiefly produced by the decomposition of heavy hydrocarbons on the red-hot walls of the retorts, only a very small percentage being attributable to coal dust mechanically carried over. Two analyses gave the following figures:—

	I.	II.
	Per Cent.	Per Cent.
Carbon	90.836	91.120
Hydrogen	3.058	3.129
Ash.....	0.398	0.872

and many determinations of the ash of the "free carbon" in different tars gave, as mean, 0.412 per cent. of ash.

The relations between the percentage of "free carbon" and the properties of the tar are next considered, and from a comparison of figures showing the specific gravity and percentage of "free carbon" it is seen that there is a distinct relation between them, the specific gravity increasing with high, and falling with low percentage of "free carbon."

It seems probable that the consistency of tar is decidedly affected by the proportion of "free carbon," one sample, containing 23 per cent. of "free carbon" being very pasty, while another, with only a per cent., had the consistency of thick oil. It was also found in general that tars containing much "free carbon" were richer in heavy oils and naphthalene, and those with little, richer in benzene and light oils.

In regard to the influence of the "free carbon" on the working of coal tar, the author treats of the troublesome property many tars have of frothing during distillation, and ascribes this almost entirely to the "free carbon" contained, and not as has hitherto been supposed, to water. To prove this view he tried two mixtures of a normal tar, the one with 10 per cent. of water added, and the other with 10 per cent. of lampblack, and found that the sample with the added water distilled without frothing, whereas that with the "free carbon" could not be kept in the retort, the greatest care being used in both cases.

In conclusion, he says that to a certain degree the percentage of "free carbon" indicates the worth of a gas tar, a small percentage meaning a larger quantity of benzene and light hydrocarbons, in general, but this is only true up to a certain limit, which is below the "free carbon" percentage for normal tars.

From this point it is often noticed that tars containing the same amount of "free carbon" sometimes produce more anthracene and heavy hydrocarbons, or more benzene and light hydrocarbons, probably depending on the mode of distillation or the nature of the coal used. But when the percentage of "free carbon" considerably exceeds the normal, a bad yield of valuable products may be counted on, and the quantity of pitch will be large.

The author has had ample opportunity of proving that the quantity of pitch can be approximately calculated from the percentage of "free carbon" in the tar, if the percentage of "free carbon" in the pitch of the required degree of hardness be known.

If K be the percentage of "free carbon" in the pitch, and k the percentage of "free carbon" in the tar, then $K : 100 = k : x$.

Good medium hard pitch from most German tar distilleries contains on the average about 28 per cent. of "free carbon," and as the result of many estimations the normal percentage of "free carbon" in tar is 16, so the yield of pitch from a normal tar is found thus:—

$$x = \frac{100 \times 16}{28} = 57 \text{ per cent.}$$

Of course, for each tar distillery the percentage of "free carbon" must be determined before the yield of pitch from the tar can be reckoned. As distillation experiments are only of value when carried out with large quantities (1 to 2 cwt.), and cannot always be easily made, the author points out that the estimation of the "free carbon" in a tar offers the most reliable and easy method of approximately judging of its value.—C. N. H.

IV.—COLOURING MATTERS AND DYES.

The Manufacture of Benzyl-Violet. O. Mühlhäuser. Dingl. Polyt. J. 270, 179–181.

THE commercial product consists chiefly of the hydrochloride of pentamethylbenzyl-pararosaniline. It is generally prepared by the action of 1 mol. of benzyl chloride on 1 mol. of pentamethyl-pararosaniline (methyl-violet). Another method, discovered by Caro and Kern, viz., the action of methylbenzylamine on tetramethyl-diamidobenzenophenone, has not hitherto been used for manufacturing purposes.

Laub is the first who prepared benzyl-violet. It was first produced, on an industrial scale, by Poirrier and Chappat, and their method, as described by Wurtz, is the one which, with certain modifications, is still in use. The manufacture comprises three distinct phases:—

1. *Benzylating.* This is performed in an enamelled cast-iron pan, provided with manhole and the usual metal pipe for the protection of the thermometer. The pan is placed in a water-bath, and can be connected with a condenser either for distilling or for reflux action. The pan is charged with 50 lb. of alcohol (96 per cent.). To this, while agitating, is gradually added 60 lb. of powdered methyl-violet, and the mixture boiled, the downward condenser having previously been shut off by means of a stop-cock. After about half an hour the violet is dissolved, and the pan having been cooled by means of cold water, until the temperature is 60°, 18 lb. of benzylchloride are added, and, after half an hour's stirring, 48 lb. of caustic soda solution of 31° B. The mixture is now heated under the reflux condenser for four hours at 80°. The mass is then treated with 10 gallons of warm water, and the alcohol, as well as other volatile products, distilled off with steam.

2. *Separation of the Crude Violet.* After cooling somewhat, the melt is emptied into a vat filled with warm water, boiled by blowing in steam and neutralised, while boiling, with 6 lb. of hydrochloric acid (sp. gr. 1.18). The solution is passed through a woollen filter after a short time, the residue in the vat boiled with water, filtered, and the combined filtrates, contained in an iron cistern, are treated with brine. After 12 hours, when all the violet has separated, the mother-liquor is removed by decantation.

3. *Purification.* The crude violet is now redissolved in boiling water, and boiled until all soluble colour has been separated from the insoluble portion. After 12 hours the clear liquor may be filtered through a double woollen filter, and further treated in the manner described by the author in the case of the manufacture of methyl-violet (this Journal, 1887, 434). The colour is finally dried in a copper jacketed pan at 55° and ground. The average yield is about 55 lb.

—A. R.

PATENTS.

Improvements in obtaining Colouring Matters for Dyeing and Printing. J. P. Griess, Burton-on-Trent. Eng. Pat. 4726, November 20, 1878. (Second edition.) 6d.

THESE are azo-dyes obtained by the action of the diazo-compounds of phenolic ethers, their sulphonic acids or chlorine-, bromine-, iodine-, hydroxyl- or nitro-substitution products, on the phenols or their sulphonic acids. A dye-stuff capable of replacing cochineal or lac dye, and giving yellow shade scarlets or reds is produced as follows: Anisidine, or an equivalent quantity of any of the higher ethers of amidophenol, is dissolved in concentrated hydrochloric acid of sp. gr. 1.17 and water, and diazotised with a 10 per cent. solution of sodium nitrite. The mixture is then added to a solution of the sodium salt of β -naphtholmonosulphonic acid, caustic soda or ammonia being added from time to time in order that the solution remains slightly alkaline. Part of the dyestuff separates as a dark red precipitate, the precipitation being completed by the addition of salt. Red colouring matters of a bluer shade are obtained by substituting for the naphtholmonosulphonate either β -naphthol disulphonic acid or a mixture of the sulphonic acids of β -naphthol formed in the following manner:— β -naphthol is dissolved in fuming sulphuric acid containing 85 per cent. of sulphuric anhydride, and the mixture heated to 110° C. for five hours. After removing the free sulphuric acid with lime and converting the sulphonic acids into the sodium salts, the latter are dissolved in water and treated with the same quantity of anisidine in the manner described above. The amido-sulphonic acids of the phenolic ethers may be prepared in two ways: 1. Anisidine (or any of its homologues) is mixed with four times its weight of sulphuric acid of sp. gr. 1.84, and the mixture heated to 100° C. for 3—4 hours until soluble in water. It is then treated with lime, the calcium salts decomposed with sodium carbonate, and the solution of the sodium salts evaporated to dryness. 2. Anisidine is dissolved in two parts of sulphuric acid of sp. gr. 1.84 and heated to 100° until soluble in water. The sulphonic acid is then converted as above into the sodium salt, and one part, by weight, of this is mixed with two parts of nitric acid of sp. gr. 1.48, the temperature being kept below 40° C. The nitro-sulphonic acid separates out and can be purified by crystallisation from water. It is converted into the amido-sulphonic acid by the usual reducing agents. Red colouring matters are obtained from these amido-sulphonic acids of the phenolic ethers, prepared according to either of the above processes, in the following manner:—The sulphonic acids of anisidine are mixed with hydrochloric acid of sp. gr. 1.17 and water, diazotised with a 10 per cent. solution of sodium nitrite, and this mixture added to a solution of β -naphthol, water and caustic soda, care being taken to maintain the mixture slightly alkaline. A dark red precipitate then separates out. Bluer shades are obtained by using the sulphonic acids of β -naphthol prepared in the manner described above. Purple dyestuffs are formed when the methyl or ethyl ethers of β -naphthol are

used in place of the phenolic ethers. The colours derived from α -naphthol are inferior to those obtained from the β -derivative.—T. A. L.

Improvements in the Manufacture of Colouring Matters. I. Leviustein, Manchester. Eng. Pat. 5692, November 30, 1882. (Second edition.) 6d.

THESE are yellow colouring matters obtained by the action of nitric acid on the mono- and disulphonic acids of nitroso- α -naphthol. The following is the method employed: 10 parts by weight of α -naphthol are dissolved in 40 parts of sulphuric acid of 170° Tw. at 100° C. The temperature is then increased to 130° for one hour, when the greater part of the α -naphthol is converted into a disulphonic acid. The mixture is then diluted with 30 parts of water and treated with 4.6 parts of sodium nitrite or a sufficient quantity to convert the substance into a nitroso- α -sulphonic acid, care being taken to keep the temperature below 10° C. 24 parts of nitric acid, sp. gr. 1.456, are then diluted with an equal weight of water and added to the above mixture. The whole is then allowed to stand for 2—3 days, when crystals separate out. An alternative method, which does not give such good results, consists in raising the temperature of the mixture to the boil when a separation of crystals takes place. The crystals have acid properties, dye a bright yellow, and may be used as such or converted into salts.

—T. A. L.

Improvements in and relating to the Manufacture of Blue and Bluish Azo-Dyes. B. Willeox, London. From F. Bayer and Co., Elberfeld, Germany. Eng. Pat. 1346, January 28, 1888. 6d.

ONE molecule of the tetrazo-compounds of benzidine, tolidine, or diamidodiphenol methyl or ethyl ether is combined with two molecules of β -naphthol- δ -sulphonic acid or of Schöllkopf's α -naphthol disulphonic acid L; or one molecule of the tetrazo-compound is combined first of all with one molecule of β -naphthol- δ -sulphonic acid or one molecule of Schöllkopf's α -naphthol disulphonic acid L and the intermediate product so formed combined with α - or β -naphthol, their monosulphonic acids, or with β -naphthol disulphonic acid R. The following are examples of the blue dyestuffs thus formed:—31.7 parts (by weight) of the hydrochloride of diamidodiphenol methyl-ether are dissolved in 1,000 parts of water, mixed with 36 parts of hydrochloric acid 21° B. and converted into the tetrazo-compound by the addition of a solution of 14 parts of sodium nitrite in 100 parts of water. This is then added to a soda solution containing 75 parts of the sodium salt of Schöllkopf's α -naphthol disulphonic acid L dissolved in 1,000 parts of water, care being taken that the solution always remains alkaline. The dyestuff is filtered off and dried. It dyes wool from a neutral, or cotton from an alkaline bath, greenish blue. If the 75 parts of the sodium salt in the above example be replaced by half that quantity, an intermediate product is obtained which is capable of being combined with an alkaline solution of α -naphthol or its sulphonic acids, to form blue dyestuffs of a reddish to a greenish shade. If equivalent quantities of benzidine or tolidine be substituted for the diamidodiphenol ether, the dyestuffs obtained are much redder.—T. A. L.

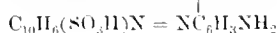
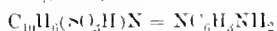
Improvements relating to the Production of Colouring Matters. H. H. Lake, London. From Leonhardt and Co., Mülheim, Germany. Eng. Pat. 2664, February 22, 1888. 6d.

THE action of heat on certain oxidisable inorganic or organic substances when mixed with free caustic alkali and paranitrotoluene sulphonic acid, or its salts "in a dissolving or distributing medium," gives rise to the formation of a number of colouring matters from yellow and orange to brown, which dye cotton without a mordant and are fast

to alkalis. The following oxidisable substances are mentioned: methyl and ethyl alcohols, glycerol, resorcinol, potassium xanthogenate, quinol, orcinol, naphthol, dioxynaphthalene and its sulphonic acid, pyrogallie acid, resorcylic acid, oxynaphthoic acid, gallie and tannic acids, and substances containing the latter, *e.g.*, sumach and catechu, oxyquinoline carboxylic acid, sulphurous acid, arsenious acid, and antimonious acid or its salts. The following serve as examples of the methods employed:—(1.) 10 kilos. of the sodium salt of *p*-nitrotoluene sulphonic acid are mixed with 30 litres of spirit or methyl alcohol, and heated in a vessel provided with an agitator and an inverted condenser. About 8 kilos. of caustic soda (40° B.) are then added gradually and the whole heated to boiling. The colouring matter is filtered off, pressed, and dried. (2.) 10 kilos. of *p*-nitrotoluene sulphonic acid are heated together with 20 kilos. of glycerol, and to this mixture are added 8 kilos. of caustic soda (40° B.) at about 50° C. The reaction is moderated by cooling, and the thick paste formed is stirred into 100 litres of boiling brine, and rendered acid preferably by acetic acid. The colouring matter is then filter-pressed and dried. (3.) 20 kilos. of the sodium salt of *p*-nitrotoluene sulphonic acid and 4 kilos. of resorcinol are dissolved in 50 litres of hot water; 20 kilos. of caustic soda (40° B.) are added, and the whole boiled up until no more colouring matter is formed. The latter is then precipitated by neutralising with an acid and by the addition of salt. (4.) 6.5 kilos. of arsenious acid are dissolved in 150 litres of water. 20 kilos. of caustic soda, and 20 kilos. of the sodium salt of *p*-nitrotoluene sulphonic acid are then added, and the mixture heated as long as colouring matter continues to be formed.—T. A. L.

ERRATUM.

This Journal, December 1888, 839: The second formula should be joined together, thus:—



VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Progress in the Chemical Technology of Textile Fabrics.
O. N. Witt. *Diagl. Polyt. J.* 270, 316—322.

CERTAIN new colours, such as Paraphenylene blue, Rhodamine, Nile blue, are described, of which an account has already been given (this Journal, 1888, 561).

Dinitrosoresorcinol is used much in cotton dyeing and printing for the production of deep bottle-green shades. Tin salt discharges the colour effectually. Those colours which have a direct affinity for vegetable fibre, the so-called substantive azo-dyes, are of great importance, since it has been discovered that they will also dye wool in neutral baths, sometimes after addition of salt or by rendering slightly alkaline with sodium phosphate or borax. The shades thus obtained stand milling very well and hardly "bleed" at all. Cotton may be dyed in the same manner, and consequently these colours are of great value in the dyeing of mixed fabrics. Printing with substantive azo-dyes requires much care. Addition of caustic soda is advisable. The following is a mixture for printing with Chrysamine-yellow:—

Water	10 litres.
Flour	2½ kilos.
Gum tragacanth	5 litres.
Marseilles soap	0.6 kilos.
Chrysamine	0.6 kilos.

Less trouble is involved and very excellent results are obtained by discharging these dyes with tin salt, or, better, a mixture of the latter with sodium acetate. When different colours are required in the pattern, the substantive azo-dye is mixed with such colours as Persian berries for yellow, with Methylene-blue and a little tannic acid for light blue, and for dark blue Alizarin S and acetate of chrome or Indophenol white in preference.

A new class of dyes of a similar kind is that of Primuline, and the colours derived from it, the so-called ingrain colours. A description of these has already been given by their inventor, A. G. Green (this Journal, 1888, 179). On dry distillation Primuline yields the yellow product known as Dahl's thiotoluidine. The ingrain shades are not very brilliant, but they stand milling remarkably well. Their production, however, requires much care on the part of the dyer.

Alizarin-black is a valuable dye, which was first described by Roussin under the name of Naphthazarin, and "The Badische Aniline and Soda Fabrik" have converted it into a marketable article by combining it with sodium bisulphite after the manner of Alizarin-blue. Wool is first cleaned with ammonia and a little soda, then 100 parts of it are boiled with 3,000 parts of water, 3 parts of potassium chromate, and 2½ parts of cream of tartar, for 2 hours. After standing over night the wool is dyed with Alizarin-black S.W.: 20 parts of this paste give a deep and very fast black. By taking less, good fast greys are obtained, which are shaded with Alizarin-brown or blue. Alizarin-black has lately also been used for printing. The method is the same as with Alizarin-blue.

The employment of alizarin-dyes for wool is on the increase; they are both brilliant and fast, and have also been tried for printing on woollen goods. The dyes are mixed with the acetates of aluminium or chromium for the latter purpose. The following shades may be thus produced:—

Dye.	Chrome Mordant.	Alumina Mordant.
Alizarin W.R. (paste)	Yellowish-claret ...	Yellowish-red.
" W.B. "	Bluish " ...	Bluish-red.
" S. (powder)	" " ...	" "
Alizarin-orange	Brownish-orange...	Orange.
Alizarin-blue S.W. ...	Greenish-blue.....	Reddish-blue.
" " S.R.W. ...	Reddish-blue	" "
Cerulean S.W.	Olive	Greenish-olive.
Gallein	Violet	Violet.
Alizarin-maroon	Maroon	Maroon.
Anthracene-brown ...	Brown	Brown.
Naphthazarin	Grey to black	

Oxalic acid is often added to the pastes, as it fulfils its purpose better than acetic acid, *i.e.*, fixing of the colours. A number of recipes are given for making the printing pastes.

The "Farbenfabriken vormals F. Bayer and Co." has patented a method for the direct production of azo-colours by printing on the fibre. The diazo-compound is printed on the fibre with thickening, and then drawn through an alkaline solution of a phenol.

Reverting to the much-discussed question of the fastness or fugitiveness of the various artificial dyes, the author says that much depends on the manner in which the dyes are fixed; generally speaking, the anthracene dyes are very fast, whereas most of the triphenylmethane derivatives are the reverse. The indulines are remarkably fast; the enrhodines and safranines may be regarded as only fairly fast. No general rule can be expressed for the azo-dyes. Whilst some are very sensitive to light, others are extraordinarily fast. Thus Bordeaux S. of the "Berliner Actien-gesellschaft" (the Na salt of the sulphonic acid of

α -naphthylamine-azo- β -naphtholdisulphonic acid) is one of the fastest dyes we possess. Even the most delicate pink dyed on wool with this colour may be exposed to light for a considerable time without fading.—A. R.

Note on some "Conversion Colours." Bull. Soc. Ind. Rouen, 1888, 285—287.

On the 12th April 1877, the late F. Lamy deposited with the Society a sealed note concerning the "conversion colours" obtainable with Gallein and Coerulein in calico printing. In this note M. Lamy records that when a colour composed of Anthraviolet or Coerulein and an excess of chrome mordant, or consisting of chrome mordant alone, thickened with gum, is printed on cloth prepared with oleate of tin, and then another colour containing Gallein and acetate of chrome insufficient in quantity to completely fix it, printed partly over the first colour, a fine dark "conversion" shade is produced, where the two colours come in contact. The colour consisting of chrome mordant without colouring matter, washes away, except where the second colour covers it. The following examples of the composition of such colours are given:—

Medium Violet.—1 litre of Gallein paste; 200 grms. of acetic acid, 12 Tw. Dissolve and add:—1 litre of gum senegal solution (1 kilo. per litre); 55 grms. of acetate of chrome, 15 Tw.

Conversion Violet.—2 parts of Medium violet; 4 parts of gum senegal solution.

From these results it appears that the quantity of chrome mordant necessary to fix a certain quantity of Gallein must be very closely regulated. Shades obtained from printed colours, with a constant quantity of Gallein, but a variable amount of chrome mordant, differed considerably both in appearance and fastness. It is, further, to be noted that, in reducing a dark colour with gum solution or starch paste, an addition of chrome mordant is necessary. Such a reducing mixture as the following should be used.

Gum Solution for Reducing.—3 litres of gum senegal solution (750 grms. per litre); 300 grms. of acetate of chrome, 28 Tw.—E. R.

Report on Lamy's Conversion Colours. M. Mattauoh. Bull. Soc. Ind. Rouen, 1888, 283—284.

SUBSEQUENT experience has fully confirmed Lamy's opinion regarding the necessity for the exact regulation of the quantity of mordant required to fix Gallein, so as to give at once the brightest and fastest shade. This exactness is also required by other colouring matters, especially by Alizarin, Nitroalizarin, and Alizarin-blue. Too little mordant gives a weak shade; too much renders it dull and

poor. This property of the colouring matters of requiring a definite amount of mordant may serve as a means of testing mordants. An example was given by Reher at the previous meeting of the Society. A series of colours, made with excess of alizarin and the samples of acetate of chrome, *e.g.*, to be tested, are printed, steamed and strongly soaped. The fullest shade is obtained from that sample of acetate of chrome which contains most oxide of chrome in a state capable of combining with colouring matters.

The principle of Lamy's conversion style was tried with some of the new colouring matters. The best results were obtained by first printing the colours containing an insufficiency of chrome mordant along with Alizarin blue S. or Coerulein S., and then printing, across them, the colours containing an excess of chrome mordant with Nitroalizarin and Coerulein, Alizarin-black, Coerulein, and Persian berries, or even the chrome mordant alone, suitably thickened, finally steaming and soaping as usual.—E. R.

PATENT.

Improvement in Indelible Ink. C. P. Dimitry, New Orleans, U.S.A. Eng. Pat. 648, January 16, 1888. 6d.

BICHROMATE of potash is dissolved in water, gelatin, also in solution, added, and the whole warmed and allowed to stand in the sunlight for half an hour. "Black aniline powder" dissolved in water is then added, and, after standing and straining, if necessary, a few drops of creosote. The inventor claims that the ink is non-rusting, non-corrosive, and acid and water resisting.—S. G. R.

VII.—ACIDS, ALKALIS, AND SALTS.

On the Constitution of Solutions. F. Rüdorff. Ber. 21, 3044—3050.

THE character of salts and double salts is determined by the acid which is combined with the base. The following experiments on the diffusion of various double salts are, therefore, grouped according to the acids which they contain. It may be premised that the absolute purity of double salts is a *sine qua non* for experiments of diffusion, as the smallest impurity greatly interferes with the result. For the purposes of the experiment, 100 cc. of the solution are subjected to diffusion with 600 cc. of water. The double salts of sulphuric acid yield the following figures:—

	Amount of Salt in 100 Grms. of Water.	Duration of Experiment in Hours.	Per 100 Grms. of Heavy Metal thereare	
			In the Diffusate.	In the Salt.
$K_2SO_4 + CuSO_4 + 6 H_2O$	10	3	268.0	122.4 K
$K_2SO_4 + NiSO_4 + 6 H_2O$	10	12	299.0	133.0 K
$K_2SO_4 + MnSO_4 + 6 H_2O$	10	12	509.0	142.3 K
$(NH_4)_2SO_4 + CuSO_4 + 6 H_2O$	20	3	136.0	56.9 NH_4
$(NH_4)_2SO_4 + MgSO_4 + 6 H_2O$	10	3	124.0	150.0 NH_4
$(NH_4)_2SO_4 + MnSO_4 + 6 H_2O$	15	0.5	188.0	65.7 NH_4
$(NH_4)_2SO_4 + CdSO_4 + 6 H_2O$	12	3	71.4	32.1 NH_4
$K_2SO_4 + Cr_2(SO_4)_3 + 24 H_2O$	15	6	149.0	50.9 K
$(NH_4)_2SO_4 + Fe_2(SO_4)_3 + 24 H_2O$	12	3	102.8	32.2 NH_4

The comparison of the two last columns clearly proves that the sulphate double salts are decomposed into the single salts by diffusion. If bisulphates be subjected to diffusion, they are decomposed into the neutral salt and the free acid. The double salts of oxalic and tartaric acids yield this result :—

	Amount of Salt in 100 Grms. of Water.	Duration of Experiment in Hours.	Per 100 Grms. of Heavy Metal there are	
			In the Diffusate.	In the Salt.
$3 \text{K}_2\text{C}_2\text{O}_4 + \text{Fe}_2(\text{C}_2\text{O}_4)_3 + 6 \text{H}_2\text{O}$	10	6	208·8	208·8 K
$3 \text{Na}_2\text{C}_2\text{O}_4 + \text{Fe}_2(\text{C}_2\text{O}_4)_3 + 6 \text{H}_2\text{O}$	15	6	122·5	123·2 Na
$3 \text{K}_2\text{C}_2\text{O}_4 + \text{Cr}_2(\text{C}_2\text{O}_4)_3 + 6 \text{H}_2\text{O}$	12	8	222·2	222·8 K
$\text{NH}_4\text{HC}_2\text{O}_4 + \text{H}_2\text{O}$	6	1	250·0	253·0 Free $\text{C}_2\text{O}_4\text{H}_2$
$\text{NH}_4\text{HC}_2\text{O}_4 + \text{C}_2\text{O}_4\text{H}_2 + 2 \text{H}_2\text{O}$	10	1	919·0	750·0 Free $\text{C}_2\text{O}_4\text{H}_2$
$\text{NaHC}_2\text{O}_4 + \text{H}_2\text{O}$	6	6	Per 100 grms. of Free Acid, 31·0 30·6 Na	
$2 \text{K}(\text{SO}_4)\text{C}_4\text{H}_4\text{O}_6 + \text{H}_2\text{O}$	6	3	Per 100 grms. of Antimony. 32·8 32·5 K	

These figures show that the salts under examination are not decomposed into their single salts, but remain in their solution as molecular compounds, with the exception of the ammonium peroxalate, which splits up into bioxalate and free oxalic acid. There exist only few double salts of chromic acid suitable for experiments of diffusion. Certain handbooks state that a solution of potassium chromate

yields crystals of bichromate in the first instance, and crystals of chromate of potash in the second instance. If this be so, it is to be expected that potassium chromate will be decomposed by diffusion. However, this statement is not borne out by the facts, as is easily proved by direct experiments with solutions of the pure salt; nor does a decomposition take place by diffusion.

	Amount of Salt in 100 Grms. of Water	Duration of Experiment in Hours.	Per 100 Grms. of Heavy Metal there are	
			In the Diffusate.	In the Salt.
K_2CrO_4	12	5	149·3	148·6 CrO_4
$\text{K}_2\text{Cr}_2\text{O}_7$	10	5	74·3	74·2 CrO_4
$\text{Na}_2\text{Cr}_2\text{O}_7$	15	2	44·7	43·8 CrO_4
$(\text{NH}_4)_2\text{CrO}_4 + \text{MgCrO}_4 + 6 \text{H}_2\text{O}$	10	3	Per 100 grms. of Magnesium. 320·0 166·6 NH_4	

Potassium and sodium bichromate are not decomposed by diffusion, whereas the double salt of ammonium magnesium chromate behaves similarly to the sulphate double salts. The result of experiments with double chlorides and cyanides is very interesting :—

	Amount of Salt in 100 Grms. of Water.	Duration of Experiment in Hours.	Per 100 Grms. of Heavy Metal there are	
			In the Diffusate.	In the Salt.
$2 \text{KCl} + \text{CuCl}_2 + 2 \text{H}_2\text{O}$	16	5	206·0	122·9 K
$2 \text{NH}_4\text{Cl} + \text{CuCl}_2 + 2 \text{H}_2\text{O}$	15	6	148·9	56·9 NH_4
$2 \text{KCl} + \text{ZnCl}_2 + \text{H}_2\text{O}$	12	6	294·6	120·2 K
$\text{KCl} + \text{MgCl}_2 + 6 \text{H}_2\text{O}$	12	6	120·0	162·8 K
$2 \text{NaCl} + \text{CdCl}_2 + 3 \text{H}_2\text{O}$	12	6	98·0	41·2 Na
$\text{BaCl}_2 + \text{CdCl}_2 + 4 \text{H}_2\text{O}$	10	5	53·9	122·5 Ba
$\text{KCl} + \text{HgCy}_2$	15	6	30·2	19·6 K
$2 \text{NaCl} + \text{PtCl}_4 + 8 \text{H}_2\text{O}$	12	2	24·1	23·7 Na
$2 \text{KCl} + \text{PtCl}_4$	10	3	41·9	40·1 K
$2 \text{NH}_4\text{Cl} + \text{HgCl}_2$	10	5	18·7	18·1 NH_4
$\text{KCy} + \text{AgCy}$	8	3	36·5	36·2 K
$2 \text{KCy} + \text{HgCy}_2$	10	6	39·4	39·03 K
$2 \text{KCy} + \text{NiCy}_2$	12	6	130·4	133·0 K
$2 \text{KCy} + \text{CdCy}_2$	15	6	69·8	69·9 K
$6 \text{KCy} + \text{Cu}_2\text{Cy}_2$	10	6	184·3	185·0 K
$\text{BaCy}_2 + \text{PtCy}_2 + 4 \text{H}_2\text{O}$	5	4	70·4	70·4 Ba

Whereas the first six chlorides and the potassium chloride-mercury cyanide are split up into their single constituents, the other double chlorides and all the double cyanides enter into solution as molecular compounds. The first seven salts are double salts, in the strict sense of the term,

whereas the rest may be designated as binary compounds, and, consequently, the sodium-platinum chloride, for instance, should always be expressed by the formula Na_2PtCl_6 (and not 2NaCl.PtCl_4). The result of the diffusion of the three sodium phosphates is thus:—

	Amount of Salt in 100 Grms. of Water.	Duration of Experiment in Hours.	Per 100 Grms. of Sodium there are	
			In the Diffusate.	In the Salt.
NaH_2PO_4	10	3	135.5	131.6 P
Na_2HPO_4	10	3	66.6	67.3 P
Na_3PO_4	10	3	33.0	44.9 P

The mono-sodium and di-sodium phosphate are not altered by diffusion, whereas the tri-sodium phosphate is split up. The corresponding three salts of citric acid are not decomposed, as shown:—

	Amount of Salt in 100 Grms. of Water.	Duration of Experiment in Hours.	Per 100 Grms. of Acid there are	
			In the Diffusate.	In the Salt.
$\text{Na}_3\text{HC}_6\text{H}_5\text{O}_7 + \text{H}_2\text{O}$	12	3	63.1	65.8
$\text{NaH}_2\text{C}_6\text{H}_5\text{O}_7 + \text{H}_2\text{O}$	12	4	16.9	16.4

A. Thomsen considers phosphoric acid a di-basic acid owing to its thermo-chemical behaviour, and for the same reason, designates citric acid as tri-basic. This view receives confirmation from the behaviour of the solutions of their respective salts.—S. H.

PATENTS.

Improvements in the Manufacture of Alkaline Carbonates. W. W. Staveley, Pontretract. Eng. Pat. 17,657, December 23, 1887. 6d.

CRUDE phenols from coal-tar oils or blast-furnace or coke-oven oils are agitated with milk of lime, whereby a solution of calcium phenate and cresylate, &c. is formed. This is treated with a solution of sulphate of sodium or potassium, and as a result calcium sulphate is precipitated, while sodium or potassium phenate remains in solution. After filtration, the solution of the phenate is subjected to a current of carbonic acid—lime kiln or flue gases—when the solution is decomposed with the formation of sodium or potassium carbonate, with some bicarbonate, and free phenol. On discontinuing the action of the gas, the mass is allowed to stand for some hours, when it separates into two layers, the upper one consisting chiefly of phenol, whilst the lower one consists of a solution of carbonate. The supernatant layer is separated and used again in the first stage of the process, whilst the solution of carbonate, which, however, still contains from 1 to 2 per cent. of phenol, is worked up for sodium or potassium carbonate.

—S. H.

Improvements in separating Arsenic from Hydrochloric Acid. M. N. d'Andria, Salford. Eng. Pat. 17,908, December 30, 1887. 4d.

This invention consists in precipitating the arsenic as sulphide by adding to the crude hydrochloric acid precipitated zinc sulphide, preferably in the damp state.

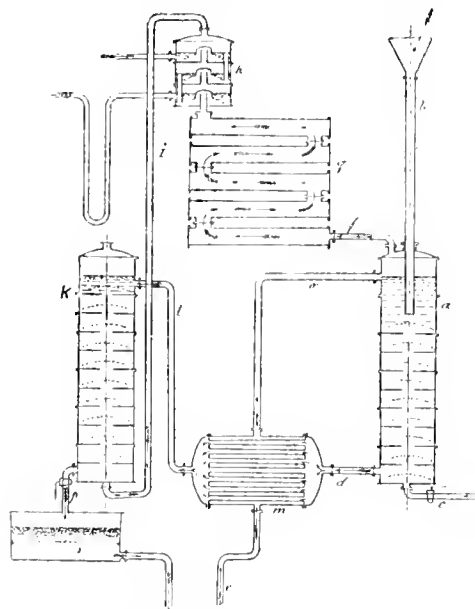
—S. H.

Improvements in Treating Liquid Acid Residues from Galvanising Works to obtain Products therefrom. M. N. d'Andria, Salford. Eng. Pat. 17,909, December 30, 1887. 6d.

See under X., page 52.

Improvements in the Manufacture of Sodium Bicarbonate, and in Apparatus therefor. E. Solvay, Brussels. Eng. Pat. 173, January 4, 1888. 8d.

The object of this invention is the purification of the crude sodium bicarbonate obtained in the ammonia-soda process. For this purpose the crude bicarbonate is dissolved in water,



or in the mother-liquor from a previous operation, by the application of heat; after filtering and cooling, the solution is treated with carbonic acid. Commercially pure bicarbonate is precipitated, which is separated and only requires finishing to be ready for use. The apparatus employed consists of a vertical column *a*, provided at the top with an inlet *b* for the introduction of the crude bicarbonate, and at the bottom with a pipe *c* for the admission of steam. Near the top is a pipe *d* for the admission of water or mother-liquor from previous operations. *f* is a pipe through which the gases resulting from the decomposition of the bicarbonate pass out to enter a refrigerator *g*, and afterwards a washer *h*. The purified gases are then taken into the

bottom of a second column *k*, in which the bicarbonate is reproduced. The liquor drawn off from the bottom of column *a* passes through a pipe *d*, thence through a filter (not shown in the drawing), and is introduced into a cooling drum *m*, whence it is conveyed to the top of column *k*. Here it is treated with the carbonic acid introduced at the bottom through *i*, and the bicarbonate thus produced is drawn off at *p* on to a filter bed. The mother-liquor from the column *k* is forced by a pump through pipe *e* into the refrigerator *n*, and after passing round the pipes is conveyed to the top of column *a*. The refrigerator *n* is thus used both for cooling the liquors obtained in the first operation, and heating those for dissolving the crude bicarbonate.—S. H.

Improvements in and Apparatus for or connected with the Production of Oxygen and Nitrogen Gases from Atmospheric Air. E. B. Ellice-Clark and L. Chapman, Westminster. Eng. Pat. 1844, February 7, 1888. 8d.

In this invention an improvement is contemplated in apparatus as made under a previous patent granted to Messrs. Brin (Eng. Pat. 157, of 1885), the object being to effect the separation of moisture from the air, previous to its being admitted to the retorts containing the anhydrous oxide of baryta, in a more efficient and economical manner than hitherto.

For that purpose the air is first compressed and then cooled, with the result of depositing its moisture as water, which is drawn off. The air is then allowed to expand whilst doing work, whereby the residue of moisture is further deposited and got rid of in the form of snow, at the same time that part of the power used for compression is recovered. The dry air is then heated to the required degree on its passage to the retorts, where it is used as prescribed in the previous patent. The specification is accompanied by a drawing showing one arrangement of the compressing, cooling, and re-expanding apparatus.—B.

Improvements in treating Sulphate of Lime and other Oxidised Sulphur Compounds of Calcium to obtain Sulphuretted Hydrogen, and in Apparatus employed therein. A. M. and J. F. Chance, Oldbury. Eng. Pat. 2495, February 20, 1888. 6d.

SULPHATE of lime or other oxidised sulphur compound of calcium is converted into the sulphide by heating with carbonaceous matter. The sulphide is then ground with water to a thin cream and placed in suitable closed vessels furnished with inlet and outlet pipes and taps. A current of the gases from a closed limekiln, consisting almost entirely of carbon dioxide gas and nitrogen, is then passed through the mixture. Calcium carbonate is precipitated in the first vessels, and the sulphuretted hydrogen liberated passes on to the next vessels, where it forms calcium sulphhydrate. When sulphuretted hydrogen is beginning to issue from the last vessel in the series the outlet tap from one of the intermediate vessels is opened and the issuing gas conducted away, preferably to a gas holder. The gas so obtained contains a large percentage of sulphuretted hydrogen, because by the action of the carbonic gas on the sulphhydrate two equivalents of sulphuretted hydrogen are evolved per equivalent of carbon dioxide absorbed, whereas by the action of carbon dioxide on the sulphide only one equivalent of sulphuretted hydrogen is given off per equivalent of carbon dioxide employed. (See Eng. Pat., 8666 of 1887, this Journal, 1888, 210.)

—S. G. R.

Improvements in Apparatus for the Production of Chlorine. J. A. Just, Syracuse, U.S.A. Eng. Pat. 14,857, October 16, 1888. 8d.

Improvements relating to the Production of Chlorine. J. A. Just, Syracuse, U.S.A. Eng. Pat. 14,859, October 16, 1888. 8d.

This chlorine process is based on the action of a mixture of nitric acid and hydrochloric acid on manganese peroxide.

Fig. 1.

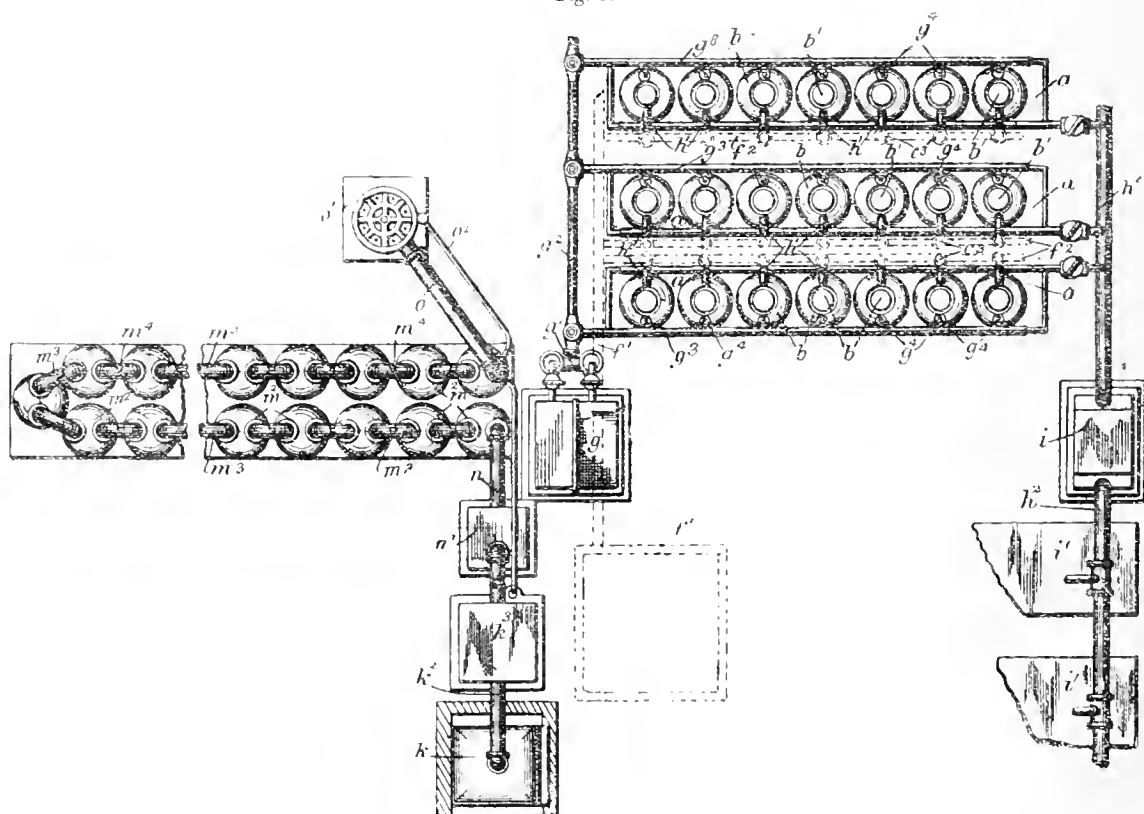


Fig. 2.

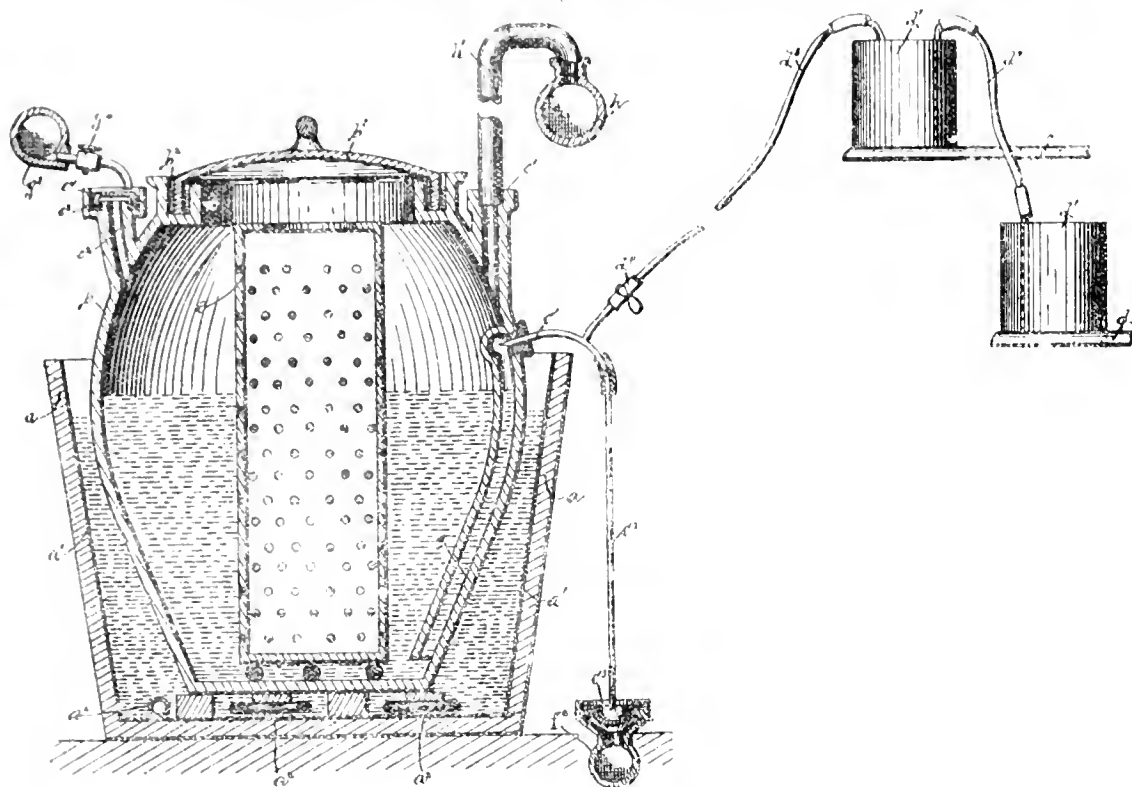
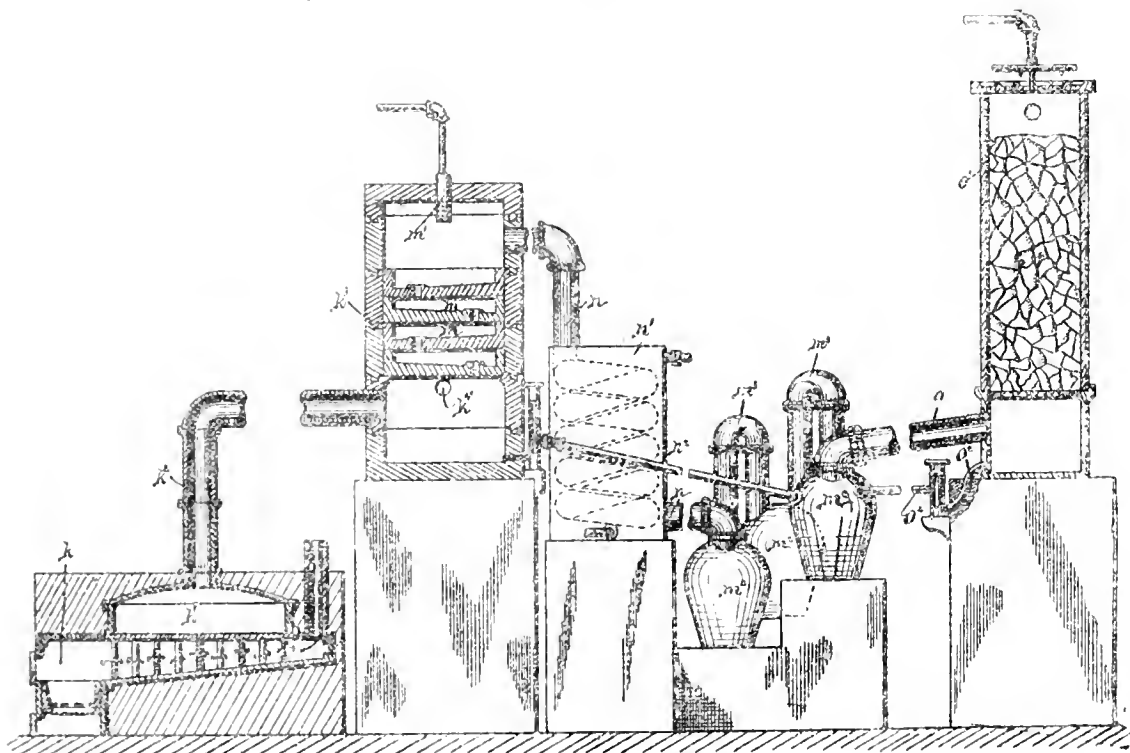


Fig. 3.



The product of the reaction is afterwards treated in such a manner that manganese peroxide and nitric acid are recovered in order to be used over and over again. The apparatus employed consists of a large number of earthenware stills (Fig. 2), arranged in a battery, as seen in Fig. 1. The stills are charged with the acid mixture and manganese peroxide, and being placed in a bath of calcium chloride solution the outward application of heat soon gives rise to an evolution of chlorine gas. The latter is washed and dried and then passes on to chloride of lime chambers. It is usually found that chlorine forms a hard and thick superficial crust on the lime, which crust prevents or at least impedes the further absorption of chlorine. The inventor prevents the formation of this hard crust by mixing the chlorine gas before it reaches the chambers with from 20 to 35 per cent. of air. When the charge in the still is exhausted, the liquid contents, consisting mainly of manganous nitrate, is run off by means of a syphon into a well, whence it is ultimately pumped into a pan k^1 (Fig. 3), for the recovery of manganese and nitric acid. This pan is very gradually heated until a solid residue of manganese nitrate is left behind. This residue is then strongly heated in order to completely decompose it, that is to say, until the residue consists of pure manganese peroxide, which is used in freshly charging the stills. The gases and vapours given off during this decomposition are made to ascend a tower k^2 , through which they rise in a zig-zag course to the top, a pipe, k^1 , at the bottom admitting atmospheric air to mingle with the vapours. On their course they meet with a spray of water, which is introduced at the top of the tower and serves to condense the vapours as they ascend. The solution of condensed vapours so formed is carried off to the last jar of a series, whence it circulates backwards towards the first jar, in the opposite direction pursued by the vapours still uncondensed. These latter pass from the tower through a cooler n^1 to a series of jars m^1 to m^8 , and finally up a second tower o^1 , where they are effectually condensed. The strongest acid collects in the first jar m^1 , whence it is drawn off to supply the stills. By working the stills in a system the whole process becomes continuous.

—S. H.

(For Figs. 1, 2, and 3, see pages 46 and 47.)

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Portland Cement Mortars and their Decomposition by Sea Water. Engineer, 66, 386.

DURAND-CLAYE and Paul Debray have published in the *Annales des Ponts et Chaussées* a memoir on the permeability of Portland cement mortars, and their decomposition under the action of sea water. Until lately, they state, it was too readily admitted that if Portland cement mortars were not completely impervious to sea water, they were at least unaffected by its destructive action until after a long period, and then only in a partial measure. But divers accidents have occurred lately which show that, in order to protect works exposed to the sea from destructive eventualities, it is at all times necessary to take very minute precautions in the composition of Portland cement mortars, as well as in those of hydraulic lime, and to exercise great care in employing them for masonry work.

On the invitation of the Commissioners for experimenting in cements, these engineers proceeded to analyse numerous samples gathered together by local engineers, and endeavoured to explain, by means of laboratory experiments, the accidents to which they are liable:—

Proportion of		Ratio of the Weight of Magnesia to the Total Weight of the Lime and Magnesia.	Sulphuric Acid.
Magnesia.	Lime.		
0.25	13.05	0.02	0.05
0.20	13.30	0.01	0.10
0.25	11.49	0.02	0.50
0.30	10.35	0.03	0.05
0.35	9.75	0.03	0.05
1.60	8.50	0.16	0.30
0.10	10.20	0.01	0.45
0.19	10.10	0.01	0.40
0.45	11.45	0.04	0.60
2.90	5.30	0.33	0.60
3.90	4.70	0.45	0.40
0.35	11.90	0.03	0.95
0.10	9.95	0.01	0.35
0.25	11.35	0.02	0.40
2.70	6.15	0.30	0.60

It is important then that the results of this examination should be known to all constructors.

1. *Analysis of the Samples.*—The preceding table gives the results of the analysis of the samples of sand concrete applied to an equal hypothetical section of quay wall, and classed in this section, descending from the summit to the foundations. This table shows that the proportions of magnesia and sulphuric acid are very variable in the different samples, which can only be explained by the action of the sea water on the basin. The samples containing the largest quantities of magnesia or sulphuric acid correspond to those parts of the quay walls which have been the most damaged. The next table gives the analysis of the mortars extracted from the joints of the masonry of the docks in the places where the cracks were widest.

Proportion of		Relation of Weight of Magnesia to combined Weight of Lime and Magnesia.	Quantity of Sulphuric Acid.
Magnesia.	Lime.		
3.50	7.65	0.31	1.10
2.70	8.45	0.24	0.85
1.65	8.05	0.17	1.20
1.50	6.85	0.20	1.55
7.80	10.20	0.43	0.40
1.05	7.40	0.35	1.00

These results show that, in this case as in the preceding, the Portland cement mortars have been greatly affected by the sea water.

2. *Experiments on the Permeability of the Mortars.*—The experimenters acting on sand samples taken from the upper parts of the works, or from the walls of docks which had not been exposed to sea water, stated that the sand concretes and mortars were not only very porous but very permeable. It should be observed that porosity is the faculty which mortars, that have been exposed to the air, have of absorbing a certain quantity of water when they are immersed in basins and there left for a sufficient length of time; while permeability is the faculty which blocks of mortar may have of allowing a certain quantity of water to

pass through them when one of their sides has been submitted to the action of a charge of water. In order to test the degree of porosity of a mortar, it is sufficient to take a certain quantity of this mortar, to weigh it, either immediately or after having left it for a certain time in a sand-bath heated to a moderate temperature; a weight P is thus obtained. The same sample weighed after complete imbibition gives a weight P^2 , greater than P . The porosity

of the sample is measured by the fraction $\frac{P^2 - P}{P}$, which represents the proportionate increase to the weight of the mortar resulting from the absorption of a certain quantity of water which has been able to penetrate into its pores, filling the spaces previously occupied by air. As to permeability, it may be measured, all other things being equal, by the quantity of water which passes through in a given time.

After having satisfied themselves that the samples of concrete and mortar, presented to them as liable to decomposition under the action of sea water, were permeable, the experimenters produced the same effects by substituting solutions of salts of magnesia for sea water. The strength of the sulphate of magnesia was reduced to 6 per 1,000 in order to equalise the quantity of this salt to the proportion of it which exists in sea water, that the decomposition of the blocks might not be exaggerated. The sand concretes made with divers cements—French, English, and Belgian—were therefore tried, and the same results obtained from all; only that the decomposition took place in different parts with more or less rapidity, according to the copiousness of the filtrations.

Durand-Claye and Debray proceeded to test the filtrations in the following way. They made some truncated cones of mortar, 4 centimetres high, 5 centimetres in diameter at the base, and 4·5 at the smaller end. To the bases of the cones, turned upwards, they attached long glass tubes, uniting the glasses to the cones by means of pure cement. They made thus four series of three cones of the following mixtures:—

- (a) 200 kilos. of cement, 200 kilos. of water to 1 me. of water.
 (b) 200 " " 150 " " 1 " sand.
 (c) 350 " " 200 " " 1 " "
 350 " " 150 " " 1 " "

In each series the cones were first submitted to filtrations of pure water; secondly, to water charged with sulphate of magnesia, in a proportion of 6 per cent.; and, thirdly, to water charged with sulphate of magnesia, in a proportion of 30 per cent. The mortars being very permeable, the glasses had only to be filled to obtain sufficiently copious filtrations. These experiments lasted about 25 days.

It was stated generally that the cones of mortar through which the water charged with sulphate of magnesia had passed were more fissured when the proportion of cement mixed with the mortar was large than when small and the quantity of water employed small, and that the water filtered through was more impregnated with sulphate of magnesia. The analysis of these cones has led to the following conclusions:—(1.) The filtration of pure water had carried off a certain proportion of the lime existing in the mortars and proceeding from the cements. (2.) Under the action of the waters charged with sulphate of magnesia, a part of the lime contained in the mortars disappeared, while the proportion of magnesia and the quantity of sulphuric acid increased. This system of experiment was afterwards abandoned, as it appeared inadvisable to introduce beside the mortars a covering of cement, itself subject to the influences of a nature to disguise the results sought for.

The experiments showed that whatever the nature of the filtering waters was, the filtrations, which were sometimes very abundant at first, diminished rapidly in quantity, and at the end of a short time they became, if not actually *nil*, at least very feeble. But, at the same time, the mass of concrete became swollen.

From the results of these experiments it would appear that there is a certain quantity of water required for each kind of mortar, which corresponds to the maximum of capacity and the minimum of permeability of the mortars. This phenomenon explains itself naturally, if it be observed

that when the mortars are made the grains of cement are in the same state as the grains of sand. Now it is known that sand which is merely damp swells and occupies a greater volume than dry sand, and on the other hand, sinks considerably if any quantity of water is poured upon it. It is the same with the grains of cement; when the quantity of water is great, and the matter lumped together, as in the making of mortar, there remain relatively considerable distances between the grains.

Durand-Claye and Debray have also made a study of the comparative action of the solutions of sulphate of magnesia and chloride of magnesium, in the proportion of 6 per cent. in two series of five experiments, in a mixture of one of cement to four of sand and 10 per cent. of water, made separately, so as to eliminate as much as possible all other influences than those of the solutions employed. The samples submitted to the action of the solutions of sulphate of magnesia broke between the tenth and twentieth day of filtration, while the samples submitted to the chloride of magnesium resisted at least 60 days. The fractures of the samples tried by sulphate of magnesia were more numerous, and denoted that the action of the sulphate of magnesia was more powerful than that of the chloride of magnesium. The chemical analysis showed that the test pieces submitted to the action of sulphate of magnesia contained 0·75 to 0·80 per cent. of sulphuric acid. It is concluded from this that after the phenomenon of the double decomposition between the salts of lime and the sulphate of magnesia pointed out long ago by Vicat, a part of the sulphate of lime formed remains in the mass of mortar.

It is to this production of sulphate of lime that the experimenters attribute the phenomena of the breaking of the masonry composed of Portland cement mortar subject to the action of sea water. This analysis seems to show clearly that the lime produced by the action of the sea on the mortars is not entirely carried off by the water which circulates within the masonry walls, and that it plays an important part in the disintegration of the masonry. While the magnesia produced deposits itself in a state of milky cream, without consistency, unable to exercise any mechanical action on the masonry, the sulphate of lime is consolidated more or less completely into crystals of a nature to produce considerable disintegrating effects.

—W. S.

Composition of some very old Mortars. W. Fahrion. Gewerbebl. Grossh. Hessen, 1888, 361.

THE mortars in question came from some buildings which were built in the third century by the Romans. I. was plaster taken from the ceiling; II. plaster from the wall surrounding the structure; III. plaster from the walls of a cavity; IV. mortar. The analysis showed the following result:—

	I.	II.	III.	IV.
Moisture.....	0·97	1·32	2·41	1·55
Water, chemically combined.....	3·05	2·76	2·90	3·33
Sand (insoluble in HCl).....	73·62	77·02	64·17	76·71
CaCO ₃	12·18	8·41	15·68	5·78
MgCO ₃	0·38	0·12	1·24	1·14
CaSO ₄	0·07	0·32	0·37	0·37
CaO.....	1·21	0·97	2·27	1·39
Soluble silica.....	1·11	1·37	2·46	1·08
Al ₂ O ₃ + Fe ₂ O ₃	7·44	7·35	8·33	8·17
Cl and alkalis.....			Trace.	

The small amount of magnesia is very remarkable, as well as the large percentage of iron peroxide and alumina. The carbonic acid present is not sufficient to combine with magnesia and lime; a portion of the latter is present either as hydrate or silicate. The proportion of lime to sand is

always important for the physical properties of any mortar. In these samples the proportion of lime to sand is 1:8.86; 1:12.65; 1:5.33; 1:13.87 respectively. A good lime-mortar should contain from 13 to 15 per cent. of lime. All these mortars are deficient in lime, and owing to this circumstance the mortars are very brittle and devoid of firmness.—S. H.

Varieties of Clay and their distinguishing Qualities, for making Good Puddle. W. Gallon. Proc. Inst. Civil Engineers, 94, Part IV.

THE author describes generally the well-known physical characteristics of the chief varieties of clay, and broadly designates as clay "any substance formed of minute particles of decomposed earthy material which, when worked up with water, becomes plastic or capable of being moulded." Hydrated silicate of alumina imparts the plasticity characteristic to clay. Most kinds of clay when tempered are found suitable for puddle, and as the essential condition for this purpose is simply imperviousness to water, no special purity is requisite. The most important features of a good puddle clay are its cohesion and its power of retaining water. A sufficient test for the former is to form it by the hand into a roll about 1½ inches diameter and 12 inches long; when suspended by one end the cohesion should be sufficient to prevent fracture. To test the latter property, one to two cubic yards should be tempered by water and rendered plastic; a hollow formed in the centre of the mass should hold 4—5 gallons of water, which, if protected from evaporation, will be retained for 24 hours if the clay be good for the purpose. When used as puddle, clay should be protected against evaporation and consequent cracking; admixture with sand obviates cracking when evaporation cannot be wholly prevented.—C. C. H.

The Instability of Cements rich in Magnesia. From the Inspector, Dr. Böhme, by order of the Minister of Public Works, Berlin.

THE following observations on this subject had been made before the author instituted his experiments. Lechartier had observed instability in cements varying from 21.2 per cent. to 34.72 per cent. of magnesia. He ascribed it to the fact that magnesia combines with water to form a hydrate of great consistency and hardness, and this combination is accompanied by an increase in volume. In the case of cements this increase occurs after a longer time, when they have been burnt at a high temperature, and the change occurs more quickly when the water can act directly on them and penetrate their mass. With a tile 1 metre long, an increase of length of 0.04 metre was observed. The pressure accompanying this expansion was observed to be very great. Large blocks of granite were made to burst, and notable changes were caused in buildings.

Experiments made in the laboratory "de l'Ecole des ponts et chaussées" showed that the destruction of the arches of some bridges was due to cement rich in magnesia. Similar conclusions were arrived at by Hayter, a London engineer.

The following are analyses of the cements used in the assize courts and the principal church of Cassel, in which instability was observed:—

	(a.) Assize Courts.	(b.) Church in Cassel.
	Per Cent.	Per Cent.
Total silica	19.75	14.87
Oxide of iron and alumina	7.39	8.61
Lime	32.05	31.90
Magnesia	22.00	22.06
Loss on ignition	18.72	22.36
Total	99.91	99.77

The magnesia shown by these analyses is much higher than that in normal Portland cement. The magnesia in 32 different Portland cements analysed in the Royal Technical Experimental Station in Berlin varies between 0.47 per cent. and 2.89 per cent.

The following are analyses of cement taken from various places in the assize courts in Cassel:—

	(1.)	(2.)	(3.)	(4.)
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Sand	3.34	12.07	4.65	45.90
Combined silica	11.41	11.14	13.15	7.12
Lime	32.00	29.67	30.43	15.59
Magnesia	21.96	19.56	21.38	10.80
Alumina	4.79	4.40	4.43	2.18
Oxide of iron	1.99	1.82	1.48	0.73
Alkalis	0.45	0.47	0.76	0.73
Carbonic acid	7.39	6.55	6.07	6.74
Sulphuric anhydride	0.98	1.17	0.93	0.66
Water	16.28	13.17	16.42	8.62

Results calculated on the cement free from sand:—

	(1.)	(2.)	(3.)	(4.)
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Combined silica	11.75	12.67	13.83	13.39
Lime	32.97	33.75	32.02	29.33
Magnesia	22.62	22.24	22.49	20.51
Alumina	4.94	5.00	4.66	4.09
Oxide of iron	1.93	2.07	1.53	1.37
Alkalis	0.46	0.53	0.80	1.37
Carbonic acid	7.52	7.44	6.38	12.68
Sulphuric anhydride	1.01	1.23	0.99	1.24
Water	16.77	14.97	12.27	16.22

—W. S.

PATENTS.

An Improved Composition for Fusible Cements. M. Mackay, London. Eng. Pat. 667, January 16, 1888. 4d.

THE cement, which is said to be unaffected by water, acids, and alkalis, to be hard, tough, cheap, and a good insulator, is made by heating together in a copper or iron vessel 3 parts of sulphur, 1 of silicate of magnesia (steatite preferred), and 2 of powdered fibrous asbestos. Any suitable proportion of powdered aluminium silicates or oxide, or slag, may be substituted for the steatite, but the asbestos is an essential constituent.

The proportions may be varied and pigments added if desired. A softer and more adhesive composition may be made by replacing a part of the sulphur by pitch, tar, rosin, or similar resinous or oleaginous matter, and may be used for coating iron pipes inside or outside, and may be applied to the joints of pipes or tanks, allowing as it does of greater expansion and contraction of the articles in question than the original mixture. A paint may also be prepared by adding to the cement a hot solution composed of 2 parts of "turpentine," $\frac{1}{8}$ part of rosin, and $\frac{1}{8}$ part of sulphur, all by weight. The proportions given above for all these mixtures may be varied if found necessary.—B. B.

Improved Fibrous Asphalt Composition for rendering Concrete Roofs, Railway Arches, Walls, and other Structures, Waterproof and Damp-proof, and in the Method of applying such Composition. J. Cliffe, Salford. Eng. Pat. 1294, January 28, 1888. 4d.

ABOUT equal parts of "Limmer rock asphalt, bitumen, sand, limestone, pitch, creosote oil, varnish, tar, cowhair, cotton and fibre waste," are mixed and heated until reduced to a condition of pulp; a layer about $\frac{3}{4}$ in. thick is then floated on the top of the roof or arch to be protected, and covered with sacking cloth, which is caused to adhere by the passage of a roller over the whole while the mixture is warm. A second layer of the composition ($\frac{1}{4}$ in. thick) is then applied, and also covered with sacking cloth, which is, however, laid this time across the first at an angle of 45° , and the roller used as before. A third layer of the composition ($\frac{1}{4}$ in. thick) is then run on and covered with sacking cloth at right angles to the second, and the whole is then completed with another layer of the composition about $\frac{1}{2}$ in. thick.—B. B.

Improvements in the Manufacture of Artificial Stone. W. E. Constable and J. Joseph, London. Eng. Pat. 2641, February 22, 1888. 4d.

LIMESTONE rock, "preferably that found in the county of Derbyshire," is broken into pieces of "about $\frac{3}{8}$ of an inch in size" in any convenient manner, and mixed with Portland cement and enough water to render the mass workable; it is then placed in moulds preferably made of wood lined with oiled steel, and of a shape suited for the use to which the stone is to be put. When set, the blocks of stone are removed from the moulds and placed in dilute sulphuric acid—1 part of acid to 99 parts of water being a suitable strength—in which they may remain for about 21 days. The stone is ready for use about a month after removal from the acid-bath.—B. B.

An Improved Cement or Artificial Stone. C. Waxin and A. Clerj, London. Eng. Pat. 11,750, October 13, 1888. 4d.

SEVENTY-FIVE parts of pulverised stone are mixed with $12\frac{1}{2}$ parts of zinc oxide and $12\frac{1}{2}$ of magnesia; 7 parts of zinc, 5 of borax, and 5 of sal-ammoniac, are then dissolved in 83 of muriatic acid. The two preparations are then mixed in such proportions that the resulting compound may be poured into moulds or be applied with a brush, a suitable ratio for many purposes being 70 parts of the first to 30 of the second. However used the mass speedily becomes hard. If it be desired to imitate any particular stone, that stone, in powder, is used as a basis. When a very hard artificial stone is to be produced the quantities of oxide of zinc and magnesia in the solid compound mentioned above may be increased by 10 or 20 parts, the quantity of pulverised stone being correspondingly reduced, while at the same time the proportions of zinc, borax, and sal-ammoniac in the liquid mixture may be augmented by 5 or 10 parts at the expense of the quantity of muriatic acid used. Alteration of the mixture in the reverse direction will produce a softer stone. The stone may be coloured, or a marbled appearance given to it, by the use of any suitable pigment, which, if solid, may preferably be added to the solid portion of the ingredients, and if liquid, to the liquid part. While setting, the stone may, if desired, be subjected to pressure in any convenient manner.—B. B.

ERRATUM.

This Journal, December 1888, 849: the heading of the second table should be thus:—

Resistance after Seven Days' Hydration	
Without Heating.	Heated to 100°.

X.—METALLURGY, MINING, Etc.

The Effect of Rolling and of Wire Drawing upon Mild Steel. H. Allen. Proc. Inst. Civil Engineers, 94, Part IV.

IN this paper the author describes experiments made in order to verify the statements commonly published that the manipulation of mild steel during its formation into wire increases its tensile strength. Specimens were prepared by reducing billets 2 ins. square by hot rolling to rods of various sizes, and subsequently to wires of various thickness, by cold drawing, in the usual manner. The author finds, in the first case, that the elastic limit is raised in some instances as much as 47 per cent., the breaking stress by about 14 per cent., the reduction of area at the point of fracture being increased by about 25 per cent., and the elongation diminished by about 34 per cent. The specific gravity is also increased by the hot rolling, which may be slightly diminished by subsequent reheating and cooling. Cold drawing of the rods into wire appears to have even a more marked effect in the same direction as in the case of the rods obtained by hot rolling. The paper is illustrated by diagrams showing graphically the physical changes produced, and also comprehensive tables showing the results yielded by the large number of experiments made.—C. C. H.

Water Oil Gas in the Steel Furnace. Engineer, 66, 324.

ARCHER'S patent process for using water oil gas for steel conversion is now used at the Barrow Steel Works, Barrow-in-Furness. The object of the patent is twofold—the reduction of cost, and the complete prevention of the admixture of dust or any foreign substance with the steel in the course of manufacture. The oil used is the coal-tar creosote of commerce in its unpurified state. This is kept in a store tank outside the works, which may be buried in the ground and entirely removed from all risk of fire. From this tank the oil is pumped, and then propelled through tubes, which are surrounded by gas-produced fire. In its passage the oil is converted into gas, and as it leaves the converter—which is a compact brick stack, about 10 ft. by 8 ft. and 8 ft. high—it mixes with superheated steam from the ordinary works boiler or from a small boiler for the purpose. At Barrow a small boiler was used, and the steam was at 80 lbs. in the boiler, and at about 50 lbs. when it entered the converting stack. After reaching this stack it passes through coils of copper pipe, and is raised to a temperature of about 2,000° Fah. The water is by this process decomposed, and the gases produced unite in their passage to the steel furnace—with the creosote gas, the combined gases passing on to the furnace through a 2-in. pipe. The supply conveyed by this pipe is sufficient to feed two steel furnaces with all the fuel they require, the gases being brought into the furnace by the suction of the chimney, and not by pressure from behind. The combined gases were admitted into the furnace in precisely the same manner as in the Siemens gas furnace; in fact, through the same tubes that had been used in the Siemens process, the difference between the small tubes required for Archer's process and the large ones previously used being very striking. The combustion in the furnace was perfect, and the heat obtained very intense. No alteration of the furnace is required in the adoption of Archer's water and oil gas, so that no expense is incurred beyond the actual cost of the conversion stack, which is a small and simple affair. Nor is it liable, as is the case in many fuel-saving processes, to get out of order, and be expensive in repairs. The supplies of the decomposed steam and the oil gas are regulated by valves, under the control of the one man who has charge of the converter. One important claim made by the patentee is, that in the use of water oil gas as a fuel for steel production, a portion of the sulphur is eliminated from the steel. This has been proved, it is said, by repeated trials and analysis; and although all the sulphur is not removed, this fact considerably enhances the value of the process, other

things being equal. In point of cleanliness nothing could be more satisfactory. The oil cost $1\frac{1}{2}d.$ per gallon, and 25 to 30 gallons of oil will produce one ton of finished steel from the furnace.—W. S.

Some curious Properties of Metals and Alloys. W. C. Roberts-Austen, Roy. Inst. Gr. Britain, and Iron, November 23, 1888, 462.

ALTHOUGH the importance of the isomeric and allotropic states was abundantly recognised in organic chemistry, it had been much neglected in the case of metals. Joule and Lyon Playfair showed, in 1846, that metals in different allotropic states possess different atomic volumes, and Matthiessen, in 1860, was led to the view that in certain cases when metals were alloyed they passed into allotropic states, probably the most important generalisation which has as yet been made in connexion with the molecular constitution of alloys.

Instances of allotropy in pure metals are: Bolley's lead, which oxidises readily in air; Schützenberger's copper; Fritzsche's tin, which falls to powder when exposed to an exceptionally cold winter; Gore's antimony; Graham's palladium, and allotropic nickel. Metals can be obtained in chemically active states under the following conditions:—Joule proved that when iron is released from its amalgam by distilling away the mercury, the metallic iron takes fire on exposure to air, and is therefore clearly different from ordinary iron, and is, in fact, an allotropic form of iron. Moissan has shown that similar effects are produced in the case of chromium and manganese, cobalt, and nickel, when released from their amalgams with mercury.

Evidence is not wanting of allotropy in metals released from solid alloys, as well as from fluid amalgams with mercury. Certain alloys may be viewed as solidified solutions, and when such bodies are treated with a suitable solvent, usually an acid, it often happens that one constituent metal is dissolved, and the other released in an insoluble form. A new alloy is one of potassium and gold, containing about 10 per cent. of the precious metal. If a fragment of this alloy be thrown upon water the potassium takes fire, decomposes the water, and the gold is released as a black powder; there is a form of this black or dark-brown gold which appears to be an allotropic modification of gold, as it combines with water to form auric hydride. By heating this dark gold to dull redness, it readily assumes the ordinary golden colour. The Japanese use this gold, released from gold-copper alloys, in a remarkable way, for they produce, by the aid of certain pickling solutions, a beautiful patina on copper which contains only 2 per cent. of gold, while even a trace of the latter metal is sufficient to alter the tint of the patina.

Prof. W. Spring, of Liège, has furnished much evidence in support of the view that polymerisation of metals—that is, the rearrangement of atoms in their molecules, can take place even in solid alloys of lead and tin.

With reference to the passage of metals into allotropic states under slight external influences, Debray has given a case of an alloy in which a simple elevation of temperature induces allotropic change in the constituent metals. It is prepared as follows:—Ninety-five parts of zinc are alloyed by fusion with five parts of rhodium, and the alloy is treated with hydrochloric acid, which dissolves away the bulk of the zinc, leaving a rich rhodium-zinc alloy, containing about 80 per cent. of rhodium. When this alloy is heated in vacuo to a temperature of $400^{\circ}C.$, a slight explosion takes place, but no gas is evolved, and the alloy is then insoluble in aqua regia, which dissolved it readily before the elevation of temperature caused it to change its state. We are thus presented with another undoubted case of isomerism in alloys, the unstable, soluble modification of the alloy being capable of passing into the insoluble form by a comparatively slight elevation of temperature.

Prof. Austen's own experiments have shown that very small amounts of metallic impurities exert an extraordinary

effect on the tenacity and extensibility of gold, and that, small as the amounts of these impurities are, their influence is rigidly controlled by the periodic law of Newlands and Mendeléef, the deleterious action of a metallic impurity being in direct relation to its atomic volume.—W. S.

PATENTS.

Improvements in or relating to the Chemical Treatment or Utilisation of Scrap Tin, or Terne Plates, Scrap Zinc, Galvanised Iron, and the like. A. S. Ramage, Liverpool. Eng. Pat. 16,604, December 2, 1887. 8d.

VARIOUS processes for stripping tin plate by the action of acids, and the recovery of the tin by means of zinc or lime, have been devised, but none of them yields the tin pure or the iron free from tin. The patentee's improvements are said to effect these and other desirable results. The tinned scrap is collected in cages, preferably of paraffined wood, one or more of which are placed in a truck and run under a travelling crane, by which they are lifted and lowered into troughs of enamelled iron, of wood soaked in paraffin, or of some other material unattacked by hydrochloric acid, with which liquid they are filled. (The hydrochloric acid has previously been freed from arsenic by treatment with a little of the liquor resulting from a former operation, which precipitates the arsenic as "arsenite of tin" (*sic*), by virtue of the stannous chloride it contains.)

The action of the acid on the scrap may be hastened by applying heat by means of steam coils, and circulation induced by giving an up-and-down motion to the cage. When the tin is nearly all dissolved off the iron, the cage is lifted and lowered into another tank of acid, and so on as often as may be necessary.

By thus working systematically the tin is completely removed (even the alloy of tin and iron, beneath the layer of tin being dissolved), and the acid is nearly completely exhausted.

After leaving the last tank the iron now remaining in the cage is washed with water, dried, and pressed into bales, in which state it can be sold for reworking, or for precipitating copper, for which purpose the ordinary loose scrap is not applicable. The saturated acid, consisting chiefly of a solution of stannous, ferrous, and lead chlorides, is run into a settling tank, and milk of lime added until nearly neutral; the lead is thus precipitated, and, after settling, the clear liquid run off, scrap zinc or galvanised iron added, and the whole heated by steam. The tin is precipitated and filtered off; being in a spongy state it can either be sold for making "tin crystals," or run down into ingots. In the latter case it must either be compressed before fusion, or melted without access of air, as the spongy metal is liable to oxidise largely during the process.

The mother-liquor of the tin is treated with milk of lime at a boiling temperature until the green ferrous hydrate begins to come down, by which time the zinc is nearly all precipitated, and can be filtered off, washed, and sold as zinc hydrate to alkali works, or dried and sold as zinc oxide. To the filtrate, milk of lime is added until all the iron is thrown down as ferrous hydrate, when it is filtered off, washed, and dried with occasional stirring, until it is converted into ferric oxide, when it is heated to dull redness, and then forms a red oxide pigment.

Among the claims appended to the patent is one for using the crude stannous chloride to precipitate the arsenic from the hydrochloric acid, whereby the tin recovered is obtained pure and tough, while the "arsenite of tin" is of commercial value, and can be sold as such, or roasted to stannic oxide, and the arsenic collected.—B. B.

Improvements in Treating Liquid Acid Residues from Galvanising Works to obtain Products therefrom. M. N. d'Andria, Salford. Eng. Pat. 17,909, December 30, 1887. 6d.

To the acid residues, consisting mainly of a solution of chloride of iron and free hydrochloric acid, is added magnesia or a mixture of magnesia and lime, obtained from calcined dolomite, until all the iron is precipitated. In

order to separate the oxide of iron more readily, either the solution is first concentrated and then diluted with water, when the iron oxide separates in a more dense condition, or air is blown through the mixture during the precipitation, thus forming peroxide of iron, which settles more readily. The ferric oxide is separated by means of either a filter press or centrifugal machine, and roasted to form pigment. To the solution of the mixed chlorides of lime and magnesium, magnesium sulphate is added, the calcium sulphate formed is removed, and the solution now containing only magnesium chloride is concentrated.—S. G. R.

Improvements in Recovering Tin from Tinned Metal.
M. N. d'Andria, Salford. Eng. Pat. 767, January 18, 1888. 4d.

The scrap tin plate is dipped in a bath of chloride of zinc heated to any convenient temperature above its fusing point. The tin is dissolved, and when present in sufficient quantity in the chloride of zinc, may be recovered therefrom by dissolving the mixture in water and treating with metallic zinc in the presence of a little hydrochloric acid. The tin is precipitated, and the solution of chloride of zinc concentrated, and used over again. As the activity of the chloride of zinc bath decreases by use, it may be revived at intervals by the addition of hydrochloric acid (introduced beneath its surface), or of "acid chloride of zinc." After washing, the recovered iron may be heated in a non-oxidising flame, and welded into thicker pieces for any suitable purpose.—B. B.

Improvements in the Production of Manganese Alloys.
O. M. Thowless, Newark, U.S.A. Eng. Pat. 13,830, September 25, 1888. 4d.

HITHERTO manganese alloys have been made by first reducing manganese from the black oxide, and then alloying it with the required metal, *e.g.*, copper, or by fusing ferro-manganese with a large quantity of wrought-iron scrap, and then adding the requisite amount of copper; if the ferro-manganese and copper were melted together directly, the product would be largely contaminated with iron.

The patentee claims that by his process alloys can be produced cheaply, and free from iron. Three parts of white sand, as free as possible from iron, are mixed with 10 of 65 per cent. ferro-manganese, 1 of cryolite and 10 of copper or other metal desired to be used, such as nickel or tin; the proportion may be varied according to the richness of the alloy that is to be made; the cryolite may be replaced by any other suitable flux. The mixture is fused in a crucible, or, on the large scale, in a blast furnace, when the alloy is produced and may be run off from the heavier slag. The action that takes place seems to be the removal of most of the iron by the sand and cryolite, leaving the manganese free to alloy with the other metal.—B. B.

An Improved Process for Amalgamating Gold by Volatilised Mercury. J. R. R. Yeats, Adelaide, S. Australia. Eng. Pat. 14,435, October 8, 1888. 6d.

THE finely-divided gold ore is fed through a hopper into a chamber, where it meets a hot blast of air from a Roots or other blower, which carries it in the form of dust over the surface of a pan of mercury kept heated by a furnace. Mixed with mercury vapour it passes on over a series of amalgamating tables, where it meets a cold blast of air or a stream of water, and on which the gold amalgam collects, and is removed from time to time.

It is claimed that by this means gold can be extracted that is usually lost by other processes.—B. B.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Light Electric Battery for the Balloon "La France."
Dingl. Polyt. J. 270, 187—188.

RENARD has recently described some electric batteries used for balloon purposes. A bromine battery is the lightest that could be devised, but owing to its obvious disadvantages it was replaced by one in which the liquid is a solution of chromic acid in dilute HCl (11° B \acute{e}). This acts like a solution of chlorine. The best proportions of the two acids are their respective molecular weights. Such a battery will give about 5—6 times more electrical energy in the unit of time than that supplied by liquids employed in the bichromate batteries. The battery contains only this single liquid, and consists of a number of elements or "tube-shaped groups," provided with a cylindrical positive electrode, in the axis of which is a zinc pencil. In this manner the strength of the current is raised to 25—40 ampères on 100 sq. cm. Silver plates covered on each side with platinum are used as electrodes. It is better not to cover the zinc with amalgam. Foreign salts rapidly diminish the efficiency of the battery. The liquid is contained in ebonite or glass tubes, whose height is about ten times the diameter. With a normal tension of 1.2 volts the strength of the current is about 25 ampères on 100 sq. cm. at a temperature of 15° taken on the surface of the zinc.

The crystallised chromic acid may be replaced by the liquid obtained by mixing sodium bichromate with sulphuric acid. With a group of this balloon battery (two elements of six tubes) having a current of 100 ampères and 1.2 volts, Renard was able to melt iron wire of 2½ mm. diameter. The group weighed 10 kilos.—A. R.

PATENTS.

Improvements in Electrolysing Chlorides, Bromides, and Iodides, and in the Utilisation of the Products thereof.
W. Spilker, Berlin, Germany. Eng. Pat. 14,494, October 25, 1887. 8d.

A BATH is employed containing an inner porous compartment, the walls of the outer cell serving as the cathode. The inventor introduces some such body as lime into the liquid of the anode compartment, such body being a bad conductor of electricity, and being able at the same time to form a compound with the chlorine liberated, in the form of a hypochlorite, or, at higher temperatures, of chlorates and chlorides. In practice the inventor causes the solution—of potassium chloride for instance—saturated with the lime, to flow from a tank into the anode compartment, to flow thence by siphons into tanks, each at a lower level, containing lime to further saturate it, and thence to be pumped back again to the first tank; this goes on till the conversion is sufficiently complete.

The liquid in the cathode compartment consists at first of a 2 per cent. solution of potassium chloride, but a potash lye forms which flows over almost free from chloride into a special tank.

By using carbonates or bicarbonates "under chloric acid" is formed. The hypochlorites and the solution containing them may be used for bleaching purposes, and also for extracting metals, especially gold and silver, from their ores; the ores saturated with hydrochloric acid being treated with the solution, and the metals then extracted in the usual way. By adding alcohol to the anode compartment and closing in the latter, chloroform will be formed and may be distilled off; anthracene may also be treated for the production of "anthrachinone bisulphonate of lime," from which alizarin may be obtained chemically. The inventor also claims the method of depolarising the cathode by blowing air over its surface.—E. T.

Improvements in Primary and Secondary Galvanic Batteries. A. F. St. George, Red Hill, and C. R. Bonne, London. Eng. Pat. 16,296, November 26, 1887. 8d.

A positive electrode of tin surrounds a negative one of carbon, the space between being packed with meta-stannic hydrate, formed by the action of nitric acid on tin foil. The result of the battery action is the formation of tin or tin oxides; by keeping the cell constantly moist with nitric acid, the meta-stannic hydrate is reformed. The carbon is preferably made as a perforated hollow cylinder, nitric acid being introduced by a glass tube connecting the interior of the carbon with an outer vessel containing acid, or by dripping tubes and valves, or by capillary threads in connexion with a reservoir. Absorbent earth is sometimes mixed with the paste. For accumulators, both electrodes may be of tin, pasted with meta-stannic hydrate, and placed in dilute nitric acid. The fumes from the battery may be employed to act on tin fragments, and thus produce meta-stannic hydrate.—E. T.

Improvements in Secondary or Storage Batteries. H. Thame, London. Eng. Pat. 16,455, November 30, 1887. 6d.

THE inventor claims the use of plates made of uncured rubber or other vulcanisable material in which lead strips or dust are incorporated, the whole being then vulcanised. Projections can be left of rubber, &c., to act as separators, and also as feet, to raise the plates above the bottom of the cell. The plates are considered very suitable where cells are subjected to great vibration, as in tramears, &c.

—E. T.

An Improvement in Voltaic Batteries. E. Tyer, London. Eng. Pat. 39, January 27, 1888. 8d.

IN each cell are placed several groups of negative electrodes, each group being brought into action, in turn, by an automatic commutator. The electrodes have thus intervals given them for rest and to recover from polarisation.

—E. T.

Improvements in Electrical Accumulators. B. J. B. Mills, London. From J. Barbier, Villeurbanne, France. Eng. Pat. 13,984, September 28, 1888. 8d.

THE patentee subjects red lead, or other suitable salt, to electrolytic action, whereby either peroxide of lead or spongy lead is produced, with all the properties necessary for their use in accumulators. For a flat plate or slab, a framework is built up of lead—or it may be of some metal that will dissolve and ultimately disappear in the electrolyte—with horizontal strips running from side to side. The red lead to be converted is placed between the latter, and the whole made up into a thick plate. This is then treated electrolytically as an ordinary accumulator plate. By suitable frameworks, electrodes of any shape may be produced if desired. It is stated that such electrodes are electrically better, and do not crumble or lose their shape.

Further, by grinding up material thus formed, it may be moulded into solid plates of any desired form, metallic conductors being inserted during the process.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

On Fish Oils. Heyerdahl. Chem. Zeit. 12, 1475—1476.

THE following substances were prepared from 400 kilos. of cod liver oil, extracted by steam: stearic acid having a constant melting point of 69° C., palmitic acid containing traces of other fatty acids, m.p. 62° C., oleic acid, glycerol, gaduin (formed by a secondary reaction from some substance still unknown), iodine to the extent of 0.0002 per cent., and traces of bromine. A portion, heated in a

current of CO₂, which was then led into hydrochloric acid, yielded trimethylamine, identified by means of its platinichloride. On a second experiment being made, none was obtained, so that it does not appear to be a constant characteristic product. Volatile acids were detected, but in extremely small quantity.

The influence of the length of time during which the livers were heated, on the proportion of free fatty acid in the resulting oil, was then made the subject of experiment. It was found that, contrary to expectation, the percentage of free fatty acid decreased slightly but perceptibly as the time of heating was increased (from 20 to 80 min.) and the temperature raised (from 62° to 85° C.). This effect might be due to the first portions of the extracted oil being richer in fatty acids, or to the presence of volatile fatty acids which were gradually driven off. To settle this point, measured volumes of air were driven through samples of oil heated on the water-bath, when it was found that the percentage of free fatty acid decreased up to a certain point, and then slowly rose to or beyond its original value. This accords with the second hypothesis. (In all these experiments the total amount of free fatty acid was small, never exceeding 0.7 per cent.)

To decide whether the rancidity of an oil depends on the quantity of free fatty acid it contains, a portion was saponified, the fatty acids separated and added in known proportion—from 2 per cent. downwards—to a sample free from rancidity. No rancid smell was perceptible in any case, and though the oil, to which 2 per cent. had been added, had a sharp taste, it was not of a rancid character. This was borne out by the samples already examined above, some of which were rancid and others not, and in which no connexion could be traced between rancidity and the proportion of free fatty acid. Rancidity appears to be produced by the action of air and on warming. Oil kept in well-closed vessels remains unaltered for years.

As a contrast to the oil obtained by steaming the livers, which contains less than 1 per cent. of free fatty acid, calculated as oleic acid, the following table shows the proportion present in oils obtained by the putrefactive process.

Kind of Oil.		Oleic Acid.
		Per Cent.
Crude medicinal oils:—		
Bright.....		3.79
Somewhat darker.....		3.87
Darkest.....		3.96
Commercial oils:—		
"Bright oil".....		10.9
"Brown oil".....		28.0
Other oils gave:—		
Source of Oil.		Oleic Acid.
		Per Cent.
Liver of <i>Gadus virens</i>		0.17
" <i>Brosmus Brosme</i>		0.08
" <i>Molea vulgaris</i>		4.36
" <i>Raja radiata</i>		4.80
" <i>Lamna cornubica</i>		2.62

They were all free from rancid smell or taste.

The method of determining free fatty acid used by the author is that devised by F. Hofmann. For this process 0.5—7.0 grms. of the oil are taken (according to the proportion of free fatty acid present), dissolved in 20—40 cc. of perfectly neutral ether, and titrated with caustic potash, using an alcoholic solution of rosolic acid (1 : 1,000) as an indicator.—B. B.

The Employment of Clay for Decolourising Paraffin Wax.
Veltrigs. Dingl. Polyt. J. 270, 182—186.

COMPARED with residues of yellow prussiate of potash which were hitherto used for the above purposes, clay, if finely powdered, is much more efficacious. The clay should be as white as possible, and since it acts the better the dryer it is, the fine powder must be heated to 300°—400° immediately before introducing it into the pan containing the molten paraffin, previously freed from water. Thus, a very finely powdered clay had 3—6 times the decolourising action of the agents hitherto employed; but this will not apply in practice, as it would not pay to reduce the clay to so fine a powder. Another advantage of using clay is that much less paraffin is retained in it than in other decolourising agents, and what is retained may be recovered more readily. Moreover, the paraffin filters better, probably owing to the heavy clay settling better in the molten paraffin. For ceresin this method is equally applicable, but it is not so satisfactory in the case of stearin.—A. R.

Presence of Glycollic and Propylenedicarbonic Acids in Suint. A. and F. Bušine. Compt. Rend. 107, 789—792. (Compare this Journal, 1888, 219.)

GLYCOLLIC acid ($\text{CH}_2(\text{OH})\text{CO}_2\text{OH}$) and propylenedicarbonic (pyrotartaric) acid ($\text{C}_3\text{H}_4(\text{CO}_2\text{OH})_2$), occur in the portion of the acids from suint, which is soluble in water, alcohol, and ether, and are left in solution when the malic acid, also present, is precipitated in the form of its barium salt. From this solution the acids are obtained free by treatment with sulphuric acid in excess and extraction with ether; they are then converted into lead salts, and the glycollic acid separated as basic lead glycolate, very sparingly soluble. The lead is removed by sulphuric acid, and the glycollic acid purified by conversion into its barium salt (when a little more malate deposits from the concentrated solution), and by the addition of a little sulphuric acid (much less than would decompose all the barium glycolate) which separates a small quantity of an oily acid which is still under investigation. The barium glycolate thus obtained gave 47.61 per cent. of barium instead of the theoretical 47.77 per cent. The free acid had all the properties of glycollic acid.

The lead salts soluble in water are then converted into the barium salts, and the removal of the small quantity of the unknown oily acid accompanying them, effected as described above, the treatment being repeated if necessary. The barium pyrotartrate is then crystallised from a concentrated solution (50 grms. in 70 cc. of hot water) and takes the form of silky radiating needles; the mother-liquor contains barium lactate. After recrystallisation the salt is found to have a composition corresponding with the formula $\text{C}_3\text{H}_2\text{O}_4\text{Ba} + 5 \text{H}_2\text{O}$. The free acid has all the properties of pyrotartaric acid.

These two acids exist in suint waters as the potassium salts; glycollic acid is one of the actual products of secretion, but it appears doubtful whether pyrotartaric acid is formed thus, or by oxidation of the fatty matter on the fleece. The proportions in which they occur in suint, average 1 per cent. of glycollic acid and 0.2 per cent. of pyrotartaric acid, on the dry residue.

Up to the present the following substances have been found among the products of sudorific secretion in suint: acids of the fatty series, from acetic to capric acid; two hydroxy-acids derived from the fatty series, viz., glycollic and lactic acids; two amido-acids from the same series, glycocine and leucine; three dibasic acids, oxalic, succinic, and normal pyrotartaric acids; one hydroxy-acid derived from the second of these, viz., malic acid; sundry others, e.g., hippuric, benzoic, and uric acids.—B. B.

PATENT.

Treating Vegetable Fibrine in a Manner to render it more applicable for sundry useful Purposes. V. Walter, Stuttgart, Germany. Eng. Pat. 13,969, September 28, 1888. 4d.

See under XIX., page 58.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

The Absorbing Capacity of Grey Vulcanised Caoutchouc for different Gases. G. Hütner. Ann. d. Phys. u. Chem. [N. F.] 34, 1.

(1.) BETWEEN the temperatures 5°—25° no constant coefficient of absorption of atmospheric air by grey vulcanised caoutchouc can be given. Any apparent absorption is due to the taking up of oxygen, which most probably serves to oxidise the caoutchouc.

(2.) Between the temperatures 15°—25°, no measurable quantities of nitrogen are absorbed by grey vulcanised caoutchouc.

(3.) Grey vulcanised caoutchouc absorbs about its own volume of dry carbonic anhydride at a temperature about 2° below zero. The coefficient of absorption diminishes with increase of temperature.

(4.) Between the temperatures - 2° and 13° no hydrogen is taken up by grey vulcanised caoutchouc; no absorption could be detected, even after three months' exposure to the gas.—H. T. P.

XV.—AGRICULTURE, MANURES, Etc.

Chemical Action of Superphosphate on Nitrate. A. Devarda. Bied. Centr. 17, 683—685.

THE author has investigated the question of the loss of nitrogen in mixtures of superphosphate and nitrate; he classifies the factors of destruction under three heads:—1. Those which set free nitric acid, such as free acids, and, perhaps, acid phosphates. 2. Those which convert nitric acid into nitric oxide, such as ferrous salts, easily decomposable organic matter, and ammonia. 3. Conditions favouring these decompositions, such as the temperature and moistness of the superphosphate.

Experiments were made at ordinary summer temperatures and at 50°, with mixtures of nitrate, in proportions corresponding to 2 and 4 per cent. of nitrogen, and bone-ash or animal charcoal superphosphate, containing, with added mineral phosphate, 18.48 per cent. of total, and 15.80 per cent. of soluble phosphoric acid, also with the same proportions of nitrate mixed with bone-meal superphosphate containing 18.13 per cent. of total, and 17.00 per cent. of soluble P_2O_5 , and in one case with ferrous sulphate corresponding to 1 per cent. of iron oxide. These mixtures were exposed, at ordinary temperatures, in sacks; at 50° in glass cylinders covered with linen. The nitrogen, the phosphoric acid, total and soluble, were determined both before and after the exposure and in some cases during the experiments. The quantity of soluble phosphoric acid remained unaltered, and the losses of nitrogen in the experiments at the ordinary temperatures were so small as to come within experimental error, showing that free acids, easily decomposable organic matter, &c. exert no deleterious influence at ordinary temperatures. At 50°, however, the case is different, and great losses of nitrogen (amounting even to $\frac{1}{2}$ per cent.) are observed, the losses being greater in the case of the bone-meal superphosphate than with the bone-ash or animal charcoal superphosphate; this is attributed to the readily decomposable organic matter, to greater proportions of free phosphoric acid, and probably also to the moist condition of the bone-meal superphosphate. The ferrous sulphate proved inactive in both series of experiments. Both the linen sacks and the covers of the glass cylinders were strongly attacked during the exposure by the free acids present; nitrous odours were observed in the cylinders. The bone-ash or animal charcoal superphosphate was dry and coarse-grained in character and evolved hydrofluoric acid on treatment with concentrated sulphuric acid.

From these results the author concludes:—1. That admixture of saltpetre with superphosphate should only be made in matured superphosphates. 2. That as far as loss of nitrogen is concerned such mixtures may be stored in sacks, even during the hot summer months.—D. A. L.

Experiments on the Estimation of Nitrogen in Soils.

Berthelot and G. André. *Compt. Rend.* **107**, 852—854.

These experiments were undertaken with the view of ascertaining what differences exist in the estimations of nitrogen in a soil, when they are made at different intervals of time, the soil being submitted to varying influences; also with the view of testing the stability of the nitrogen.

Three soils were kept at the ordinary temperature in an atmosphere free from nitrogen, to prevent possible absorption of that element, and from oxygen, the authors being of opinion that fermentations causing loss of nitrogen cannot proceed in the absence of oxygen.

Each soil was allowed to dry spontaneously, finely ground, and thoroughly mixed; 500 grms. were then put into a flask of 1 or 5 litres capacity, previously filled with carbon dioxide. The soil was agitated in this for some time, a continuous stream of the gas being passed to ensure complete expulsion of air. The flask was then closed with a slightly vaselined stopper and left to itself.

Soil No. 1 was the poorest in nitrogen and also that which was best fitted for the absorption of nitrogen under the favourable circumstances of other experiments; No. 3, on the other hand, showed a tendency to lose rather than gain nitrogen in other experiments. The following table shows the results:—

Soil No.	Nitrogen; Grms. per Kilo.	
	Analysed on May 22nd.	Analysed on October 3rd.
1	0.9740	0.9860
2	1.6551	1.6552
3	1.7440	1.7760

—A. G. B.

XVI.—SUGAR, STARCH, GUM, Etc.

New Methods and Apparatus for the Manufacture of Sugar.

Dingl. Polyt. J. **270**, 173—179.

J. SACHOMEL considers it advisable, after the thick juice has passed through the animal charcoal, used for purifying the former, to follow up with the thin juice and then with water only. By this means a much larger quantity of the substances taken from the thick juice by the charcoal is removed again, than by mere treatment with water. At the same time the charcoal retains considerable quantities of the lime contained in the thin juice. The stronger the syrup passed through the bone charcoal, the more efficient is the latter in keeping back organic impurities, with the exception of colouring-matter; while inorganic substances appear to be more effectually removed when the syrup is weak.

The article concludes with a detailed account of the occurrence and use of strontianite.—A. R.

Raffinose in Beet Sugar.

Deut. Zuckerind. 1888, **13**, 1484.

LIPPMANN'S evidence of the presence of raffinose in the beetroot has been questioned because he extracted it by the strontium process, which is said to produce raffinose by the action of the strontium hydroxide upon other substances in the juice.

From the low diffusion value of raffinose it is probable that it would accumulate in the syrup of the osmosis process; this the author finds to be the case, having extracted the raffinose with methyl alcohol by Scheibler's process; he concludes that raffinose must exist in the beetroot.

The mucic acid and inversion processes for the estimation of raffinose do not give concordant results, the former giving higher values than the latter; thus, in three sugars, obtained by the osmosis process, inversion gave 5.0, 6.3, and 8.4 per cent. of raffinose respectively, while the mucic acid process gave 6.2, 8.0, and 10.3 as the values. This is doubtless due to an accumulation of galactose, or some such substance, convertible into mucic acid.—A. G. B.

XVII.—BREWING, WINES, SPIRITS, Etc.

Progress in Beer Brewing.

C. J. Lintner. *Dingl. Polyt. J.* **270**, 323—331.

This is a resumé of work done in the above-mentioned direction by various authors. P. Lintner considers that experiments by fermentation on a small scale are suitable for distinguishing different kinds of yeast. He found that by fermenting three varieties of yeast under the same conditions, he obtained entirely different results with respect to fermentation, formation of "head," clarification, sediment, and taste. One sample of fermented wort was intensely bitter and astringent, a second, very pure and agreeable, a third, strong but not pleasant to the taste.

The action of "*Denatium pullulans*" in producing ropiness in wort is also discussed. No certainty as to its noxious action can yet be entertained.

Then follows a short description of the sarcina organisms in regard to fermentation. All varieties of these organisms are killed by short exposure to a temperature of 60°.

In an article on "*Saccharomyces apicalatus*," C. Amthor describes its action on maltose. When the maltose is previously boiled with dilute sulphuric acid, this ferment produces in one-third the time about treble the quantity of alcohol that is produced if the treatment with acid be omitted. This appears to prove that maltose is converted into dextrose before being fermented.

The taste of beer after exposure to sun or daylight is the subject of a note by W. Schultze, in which it is stated that Munich and Vienna beer, contained in colourless glass, is very appreciably affected by the direct rays of the sun, as evinced by an unpleasant smell and taste after a few minutes' exposure. The same applies when this class of beer is exposed to diffused sunlight, the only difference being that the change is not so rapid. Pilsener beer is also spoiled by sunlight, but more slowly than the above varieties.

S. Rohm and H. Wichmann, speaking of the Filtration of Beer through the Stockheim filter, which consists of yellow wood-pulp and white cellulose from wood, remark that yeast and other substances causing turbidity are mostly retained, but not bacteria. After having been used, the filtering medium seems to favour the growth of bacteria. Sometimes treble the number of organisms are found in the filtered beer than were originally present.—A. R.

Analyses of Pure Sherry Wines.

E. Borgmann and W. Fresenius. *Zeits. Anal. Chem.* **28**, 71—77.

These analyses were made, primarily, to determine the amount of sulphuric acid contained in pure sherries, which is always high owing to the practice of plastering the grapes during the preparation of the must. Eighteen samples in all were analysed. Nos. 1—12 were of the finest quality, while Nos. 13—18 represent medium and common sorts. The following results were obtained:—

whole of the aldehydes and acetones is distilled off, leaving in the vessel a portion free from these impurities, and which may be subjected to the ordinary processes of distillation or rectification. The distillate containing the impurities is next treated with an excess of a concentrated lye of alkaline bisulphite (30° B \acute{e}), whereby the aldehydes and acetones are converted into aldehyde and acetone sulphites, and the liquid distilled, by which means the alcohol is separated from the impurities. The distillate is redistilled with a base, such as soda, potash, or lime, to free it from any free sulphurous acid that may be present, the resulting distillate being chemically pure alcohol.—J. H.

PATENTS.

Improved Means of Oxidising and Decomposing by Electrical Action, Organic Matter and Inorganic Salts in Sewage, Water, and other Liquids. W. Webster, jun., London. Eng. Pat. 1333, January 27, 1887. Amended October 9, 1888. 8d.

In dealing with the treatment of "Sewage and other impure liquids," the use of iron alone, and not of any other materials, is mentioned for the positive electrodes. (See this Journal, 1888, 441.)—E. T.

Improvements in Apparatus for Liquid Purification. W. Oliphant, Jersey City, U.S.A. Eng. Pat. 8627, June 12, 1887. 8d.

The improved form of apparatus is devised with a view to the rapid cleansing of the fouled material used for filtering, and also its rapid removal and renewal. It consists of a closed vessel or tank in which suitable material is disposed and retained in such a manner that the impure water, either with or without a defecating reagent, is successfully passed through beds of material of a finer grade than the one preceding. The impure water on its entrance passes through a coarse bed downwards, rising afterwards through finer media. Each bed is provided with a separate cleansing pipe, and cleansed by hydraulic force, and also a man-hole and cover for the removal of old and the introduction of fresh material.—C. C. H.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A)—CHEMISTRY OF FOOD.

On the Nature of Milk. A. Béchamp. Compt. Rend. 107, 772-775. (Preliminary Extract.)

THREE questions present themselves for solution:—

- (1.) Is milk a mere emulsion of naked fat globules, or is each globule provided with a definite covering?
- (2.) Are other albuminoids besides casein present, and are they different in different kinds of milk?
- (3.) Does milk curdle or ferment without the introduction into it of foreign organisms?

The last two questions are answered by the author in the affirmative, but he reserves the detailed proof for the full memoir.

The first is, however, dealt with as follows:—

Fresh milk or cream is mixed with diluted alcohol, and then filtered. The albuminoids—which are combined with the alkalis—pass into the filtrate, while the fat globules are retained. They are washed with a weak solution of ammonium carbonate in dilute alcohol, which does not attack their enveloping membranes, as is seen when they are examined microscopically. These operations should preferably be conducted at a temperature approaching 0° C. Thus prepared, the fat globules can be preserved almost indefinitely in weak aqueous ammonium carbonate or alcohol. After trituration the fat can be dissolved out by ether (the membranes being left easily distinguishable under the microscope), but brisk churning is necessary to cause the separation of butter if only water be used. When heated, a portion, amounting to at least 1·3 per cent. of the dry globules, remains unfused, retaining the butter fat, however, on account of its spongy structure; from this it can be freed by ether. It appears to be epidermal in character. On ignition the globules leave some ash.—B. B.

(B)—SANITARY CHEMISTRY.

Water for Technical and Drinking Purposes. Gärtner. V. 56f. Ges. 1888, 208.

THE following are some of the conclusions arrived at:—

The water should be free from poisonous substances and pathogenic organisms. There must either be no possibility of the presence of the above, or measures must be taken to remove them. The possibility of infection is much increased by the presence of human dejecta. When such impurity is detected the local conditions should be duly considered in judging the water. To encourage the use of a water its physical properties and the nature and quantities of the dissolved substances should be as similar as possible to those of a water locally esteemed. To form a judgment on one water analogous investigations of several other waters of the same kind, and from the same district, are requisite.

Pouehet lays emphasis on the necessity of using both chemical and bacteriological data in order to form a just opinion of a water.—B. B.

XIX.—PAPER, PASTEBOARD, Etc.

PATENTS.

The Manufacture of an Improved Paper for Use in Copying Letters and the like. A. F. Stoddart, Bristol. Eng. Pat. 4341, March 21, 1888.

THIS invention relates to "the manufacture of an improved material or paper whereby letters can be simultaneously blotted and copied." It consists in treating an absorbent paper with animal, vegetable or mineral oil. The paper is then washed with dilute alkali or water, or is treated mechanically to remove the excess of oil.

In order to obtain a copy of a letter it is simply necessary to press a sheet of the prepared paper on the still wet original, when the latter will be blotted and copied at the same time.—E. J. B.

Treating Vegetable Fibrine in a Manner to Render it more applicable for sundry Useful Purposes. V. Walter, Stuttgart, Germany. Eng. Pat. 13,969, September 28, 1888. 4d.

THE inventor claims the manufacture of a new material made by impregnating cellulose with oils or grease. The material so produced may be used as a substitute for oil-cloth, for socks of boots, and other purposes.—E. J. B.

ERRATUM.

This Journal, December 1888, page 863 and 864, for "Wood Shavings" throughout the abstract, read "Ground Wood Cellulose."

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Use of Mercuric Chloride as a Therapeutic and Prophylactic Agent for Asiatic Cholera. A. Yvert. Compt. Rend. 107, 695.

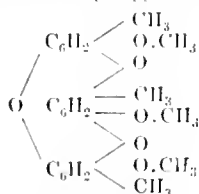
FORTY-FIVE cases of Asiatic cholera in Tonquin, treated by the author with mercuric chloride, in doses varying from

0.02 — 0.04 grm. per 24 hours, showed a death rate of 20 per cent., whilst the average death rate from the disease in that region was 66 per cent. The author has also tried its use as a prophylactic agent, and in no case did any signs of cholera develop.—C. A. K.

Homo-pteroearpin and Pteroearpin from Red Sandal Wood. P. Cazeneuve and L. Hugoumeq. *Compt. Rend.* 107, 737—740.

THE physical properties of these two substances extracted from red sandal-wood have been previously described by the authors. (This Journal, 1887, 737.)

Homo-pteroearpin, when heated until it decomposes, yields cresol and a little catechol (pyrocatechin). Distilled over zinc dust, a small quantity of a volatile oil, with a comarin-like smell, is formed, together with benzene, toluene, acetylene, ethylene, and carbonic oxide. Hydrochloric acid attacks homo-pteroearpin in the cold, more readily on heating, with the liberation of methyl chloride and the formation of a black resin which dissolves in alkalis to form a fluorescent solution; a small quantity of an amorphous body is held in solution by the hydrochloric acid, which also dissolves in alkalis to form a red fluorescent solution, and is regarded by the authors as probably belonging to the fluorescein group of colours. Hydriodic acid acts similarly to hydrochloric acid. Heated with dilute sulphuric acid (1:10) in a sealed tube, homo-pteroearpin appears to undergo an isomeric change, forming an opaque yellow resin; the sulphuric acid undergoes no change. Fused with caustic potash at 250°—300°, a volatile oil having the smell of comarin results; no fatty or aromatic acid could be isolated. Treated with nitric acid in the cold, a green, amorphous, unstable nitro-derivative is obtained, which is decomposed by boiling water with the formation of resinous bodies. Fuming nitric acid attacks homo-pteroearpin very readily, and a nitro-compound results, which is regarded as trinitro-orcinol, $C_7H_3(NO_2)_3(OH)_2$. It melts at 162°, and yields a characteristic barium salt. Two crystalline bromine derivatives result by treating homo-pteroearpin with bromine, having the formulæ $C_{21}H_{23}BrO_6$ and $C_{21}H_{18}Br_2O_6$; the latter melts at 270°. The composition of these products has led the authors to double the original formula assigned by them to homo-pteroearpin (*v. ante*) viz.:— $C_{12}H_{12}O_3$ to $C_{24}H_{24}O_6$. Neither phenyl hydrazine nor acetic anhydride have any action on the substance; this excludes the presence of an alcohol, aldehyde or ketone group, and the body is regarded as an anhydride of a poly-orcinol, the following constitutional formula being suggested as a probable one:—



Homo-pteroearpin.

Pteroearpin.—The action of the above-mentioned reagents on pteroearpin is similar to their action on homo-pteroearpin, and there is no doubt that the former is a lower homologue of the latter, having the formula $C_{20}H_{16}O_6$. It yields a monobromo-derivative $C_{20}H_{15}BrO_6$.—C. A. K.

On Saccharine. Bruylants. *J. Pharm. Chim.* 1888, 292.

IT is usually supposed that saccharine is completely eliminated with the urine. The author took doses of 0.5, 1, 1.50, and 2 grms. respectively of saccharine, and on examining the urine of 24 hours could only account for 80 per cent., 82 per cent., 84 per cent., and 88 per cent. of the saccharine taken. A ewe received on different days, doses of 1, 2, and 5 grms. of saccharine without suffering in health. The milk at first contained none, the second time traces, and the last time large amounts of saccharine. Saccharine is often

considered an energetic antiseptic, and recommended as an addition to beer. The author finds that 1 per cent. of it does not prevent the alcoholic fermentation, although the process is protracted, whereas an addition of 0.013 per cent. is without any action whatever; 2.5 parts of saccharine per mille cannot prevent the acetification of beer. The pepsin digestion is not disturbed by saccharine, whereas the fermentation of pancreatic fluids, which contain 1 per cent. of it, proceeds very slowly. The author also confirms the fact that taken as a medicine it is harmless. For some considerable time he took daily doses of 3 grms. without the least injurious effect; it did not even interfere with the digestion. (Compare this Journal 1888, 688.)—S. H.

The Relations between Atropine and Hyoseyamine. A. Landenburg. *Ber.* 21, 3065—3070.

WILL (this Journal, 1888, 584) found that hyoseyamine is converted into atropine when treated with dilute alkalis or when heated above its melting point. Will and Bredig, who investigated this subject more fully, came to the conclusion that atropine is an optically active base ($\alpha_D = -1.89$).

The author prepared atropine aurochloride from a sample of the purest commercial atropine (which was further purified by several recrystallisations), and recrystallised it 14 times; the resulting salt melted at about 140°, and an 18 per cent. solution of the atropine obtained from this salt was optically inactive.

When an 8 per cent. alcoholic solution of commercial atropine is mixed with a few drops of very dilute soda, and kept for two hours, the solution is still optically active, but if the base obtained from the solution be recrystallised several times, its rotatory power decreases. When a 6 per cent. alcoholic solution of atropine is mixed with a small quantity of soda, and kept for 5 hours, the solution is optically active; after standing for 19 hours longer the solution is still optically active, but if the base be then twice recrystallised from dilute alcohol, the pure compound obtained has no rotatory power.

From these results the author concludes that atropine is an optically inactive base, standing in the same relation to hyoseyamine as racemic acid to levotartaric acid, and that the conversion of hyoseyamine into atropine, although possible, has not yet been accomplished. He also found that when atropine aurochloride, prepared from ordinary atropine, is recrystallised many times, small quantities of the hyoseyamine salt are obtained, and he is also of the opinion that the supposed coconversion of hyoseyamine into atropine results from the employment of impure materials.

—F. S. K.

Narcotine. W. Roser. *Ann.* 249, 156—172.

A CONTINUATION of researches on the derivatives of narcotine. (This Journal, 1888, 518.) The present paper deals with those derivatives which have cotarnine for their starting point, and the author prefers Anderson's method, for the preparation of this substance from narcotine, by the action of nitric acid in preference to manganese dioxide and sulphuric acid. The melting point of cotarnine is given as 132°—133°, at which it also begins to decompose. By the action of methyl iodide on cotarnine a product is obtained containing the two following substances:—

Cotarnine hydriodide, $C_{12}H_{13}NO_3HI$, forms glittering yellow needles sparingly soluble in water and cold alcohol.

Cotarninemethylhydriodide, $C_{14}H_{20}NO_3I$, is easily soluble in hot water, and crystallises by slow cooling in long glittering needles of light yellow colour. On digesting this with silver chloride the corresponding chloride, $C_{14}H_{20}NO_3Cl \cdot 3H_2O$, is obtained, and is distinguished by its readiness to form large clear crystals. Cotarninemethylhydriodide is remarkable in being derived from cotarnine, not merely by the addition of methyl iodide but by the inclusion of a second methyl-group. On treating the aqueous solution with caustic soda, a separation of oily drops ensues accompanied by the smell of a volatile base. The decomposition of the base of the salt is expressed by the equation—



The oily body forms on cooling a white crystalline compound, $\text{C}_{11}\text{H}_{19}\text{O}_4$, which, having the characters of a ketone, is termed *cotarnone*. The volatile base is trimethylamine. From the nature of this change the constitutional formula of cotarnmethinmethyliodide must be $(\text{C}_{11}\text{H}_{11}\text{O}_4)\text{N}(\text{CH}_3)_3\text{I}$, and from a consideration of the transformation undergone by cotarnine in these reactions, the author draws the following conclusions:—

"The formula of cotarnine is not $\text{C}_{12}\text{H}_{13}\text{NO}_3 \cdot \text{H}_2\text{O}$, but $\text{C}_{12}\text{H}_{13}\text{NO}_3$, the so-called water of crystallisation belonging to the constitution. Cotarnine is a secondary base.

"A pyridine group is not contained in free cotarnine, but is contained in its salts."

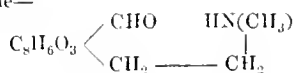
Cotarnone, $\text{C}_{11}\text{H}_{19}\text{O}_4$, is easily soluble in alcohol, ether or acetic acid, and crystallises from alcohol in rhombic plates, melting at 78° . It is an indifferent body, stable against alkalis, but transformed on warming with acids into dark-coloured products.

Cotarnonoxime, $\text{C}_{10}\text{H}_{11}\text{O}_3(\text{NOH})$, is formed on warming cotarnone with hydroxylamine hydrochloride in alcoholic solution. It crystallises from dilute alcohol in fine needles, melting and decomposing at 130° – 132° .

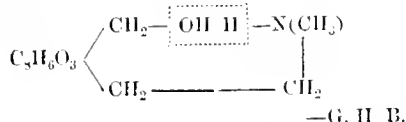
Cotarnic acid, $\text{C}_8\text{H}_6\text{O}_3(\text{COOH})_2$, is obtained from cotarnone by the action of potassium permanganate. It crystallises readily from water, and melts at 178° with decomposition. It forms an acid potassium salt, which, on double decomposition with silver nitrate, yields a neutral silver salt and free acid. The author observes that hydrastinine comport itself on treatment with methyliodide in a manner strictly analogous to cotarnine, yielding a volatile base, and an indifferent substance as final products.

The formula for cotarnine, and its relation to hydrocotarnine, as deduced from the results of these researches, may be thus expressed.

Cotarnine—



Hydrocotarnine—



XXII.—EXPLOSIVES, MATCHES, Etc.

Improvements in the Explosives Industry. O. Guttman.
Dingl. Polyt. J. **270**, 215–223.

H. GÜTLER (German Pat. 44,078, December 19, 1887) has patented further improvements in his charcoal furnace. The wood is introduced into the furnace in the form of pulp. The improved apparatus cannot be described in the absence of drawings; but it appears to be an important addition to this special branch of powder manufacturing.

Le Boulenger's well known chronograph has been adapted to meet the requirements of the present high velocity of projectiles. The chief alteration consists in placing the wire frames that are shot through 100 metres apart, instead of, as formerly, 50; and in the same proportion the time recorded is increased. A special arrangement allows of the apparatus being used in places where the range is less than 100 metres.

The *French Explosives Commission* has examined the conditions which give rise to the ignition of fire-damp by certain explosives.

According to a report of Mallard and Le Chatelier (*Revue Industrielle*, 1888, 298), the heat generated by an explosion must exceed $2,200^\circ$ before it will ignite fire-damp. Equal parts of dynamite and soda crystals, or sulphate of soda containing 10 aq., or ammonia alum, or ammonium

chloride, when detonated in an atmosphere of fire-damp, failed to ignite it even in the presence of coal dust.

Mixtures of nitro-glycerol and gun-cotton with nitrate of ammonium have a special advantage because the nitrate acts as an explosive, but depresses the temperature; the temperature of the explosion being, in the case of nitrate of ammonia $1,130^\circ$, that of dynamite, nitro-glycerol, and gun-cotton, being $2,940^\circ$, $3,170^\circ$, $2,636^\circ$, respectively. The Commission found that 20 parts of dynamite or nitro-glycerol with 80 parts or more of nitrate of ammonium failed to ignite the most inflammable fire-damp.

A. Zettler has introduced a new electro-magnetic exploder. According to experiments by Prof. Carl, it is capable of exploding 80 detonators at one time and weighs only 14 lbs.

A new method for determining the percentage of glycerol in the crude material is suggested by R. Benedikt and M. Cantor. It is based on the observation that glycerol is converted into triacetin on boiling with anhydrous acetic acid. The triacetin is determined by dissolving in water, neutralising with soda solution and titrating back the excess.

The increased demand for quality and purity of explosives has brought about a change in the methods of manufacture of the same, and on sounder and more scientific principles. Greater attention has of late been directed to electrical phenomena so often observed during the process of manufacturing gunpowder, but concerning which no safe conclusions have been arrived at owing to the absence of the evidence of reliable observers.

The most important and also the most common occurrence is the accumulation or attraction of atmospheric electricity during storms. The buildings of explosive works, as a rule, are detached, and often in elevated positions. In England it is prescribed that the lightning conductor should be fixed *on to the building itself*. In other countries it is considered sufficient to attach the lightning conductor to a high staff near to the building, and we are of opinion that the buildings in question are afforded more protection. In many cases the lightning conductor has been known to favour the discharge of electricity, and it is suggested that an explosion of a powder magazine at Salonica occurred in this way.

As regards the machinery in the buildings, precautions should be observed against the accumulation of atmospheric electricity as well as from other sources, more especially in the manufacture of explosives, of which sulphur is a constituent. In the powder works of W. Güttler the sulphur mills are connected with the earth so as to carry off the electricity, and since this arrangement has been introduced the sulphur has never fired, it being, previously, a matter of constant occurrence.

In another large powder works in Germany, not long since, an explosion occurred in the press-house after a storm. The powder was between chlorite plates, and under pressure before the commencement of the storm. When the storm had ceased, a workman released the pressure and proceeded to separate the cakes from each other. According to a statement made by him before his death, a spark 19 centimetres in length was discharged into his finger as he was in the act of lifting one of the cakes.

W. T. Reid has observed that warm air passing over nitro-cellulose generates electricity in considerable quantities.

The generation of electricity has been observed in other industries during manufacturing processes, and several instances are quoted; but, according to the author, no instance has come to his knowledge which is of importance or which has caused immediate danger.

The author considers that the extensive application of rubber, ebonite, &c. to machinery used for the manufacture of explosives is somewhat hazardous. In England, for instance, the shoots of the separators and the bed-plates of the granulating mills are lined with rubber composition. This stuff has the advantage that it wears well, and possesses certain elasticity combined with great strength, &c., but under favourable conditions such a bed-plate might act as an electrophorus.

The author considers the question of the accumulation and attraction of electricity one which should receive greater

attention, and observes that it should be made compulsory to connect all machinery and apparatus with the earth by conductors properly constructed.—C. N. II.

PATENTS.

Improvements in Explosive Compounds. H. E. Newton, London. From A. Nobel, Paris, France. Eng. Pat. 4179, December 2, 1875. (Third Edition.) 6d.

THE object of this invention is to convert at the ordinary temperature, liquid explosive substances, such as nitroglycerol, the nitrates of methyl, ethyl and amyl, and nitrobenzene into a viscid or pasty state by incorporating these with another substance capable of gelatinising or thickening them, such substances being chosen which detract little or nothing from their explosive force, such as, for instance, gum-cotton.

"Nitroglycerin may be gelatinised by dissolving in it nitrated cellulose, known as collodion cotton."

About 7 per cent. of gum-cotton is found to be sufficient to form a solid jelly, "which is very safe and highly suitable for every purpose to which very powerful explosives can be applied."

The addition of nitrobenzene, dinitrobenzene, charcoal, or ordinary gunpowder to gelatinised nitroglycerol is proposed, with a view of modifying the rapidity of combustion, and also of lowering the freezing point of the nitroglycerol.—C. N. II.

Improvements in the Manufacture of Charcoal. O. Bowen, A. S. Tomkins, and J. Cobeldick, London. Eng. Pat. 11,537, August 24, 1887. 4d.

THE object of this invention is to produce a charcoal rich in hydrogen, and suitable for the manufacture of gunpowder. For this purpose wood or suitable carbonaceous matter is subjected to a heated current of air mixed with hydrogen. The furnace employed has been described in Eng. Pat. 509 of 1881 and 1457 of 1886.—C. N. II.

Improvements in Machines for the Compression of Gunpowder, and for similar Purposes. A. Greenwood, Leeds. Eng. Pat. 1153, January 25, 1888. 11d.

THE object of this invention is to provide for the manufacture of small cylindrical or conical pellets, for use in rifle cartridges, or of prismatic or cubical powder.

The machine works automatically and is designed to perform the following operations:—

To measure the quantity of powder required for each pellet; to place this powder in a mould; to insert one or more needles into the mould and apply vertical and lateral pressure, finally withdrawing the needles, and after removal of the pressure ejecting the finished pellet. For details the specification and drawings must be consulted.—C. N. II.

Improvements in Explosive Compounds. C. D. Abel, London. From H. Schöneweg, Dudweiler, Germany. Eng. Pat. 1591, February 2, 1888. 4d.

AN explosive mixture consisting of 20 parts of dinitrobenzene, 80 parts of potassium nitrate, and a proportion of ammonium oxalate, varying between 5 per cent. and 12 per cent. of the other two ingredients combined.

The oxalate of ammonia is added with a view of producing a flameless explosive.—C. N. II.

Improvements in the Manufacture of Explosives. E. Turpin, Colombes, France. Eng. Pat. 4310, March 20, 1888. 6d.

THIS invention relates to an improved smokeless powder for firearms, which is prepared by dissolving gun-cotton more or less nitrated in any solvent most suited to the kind of gun-cotton employed, e.g., "nitrobenzene and other nitro-bodies of the aromatic series, aniline, aldehydes, amido-compounds of various kinds, acetone, sulphuric, nitric, acetic, and other ethers." Also "ammonia in solution in sulphuric or other ether, acetone in solution in sulphuric or other ethers or mixtures of ethers are suitable for dissolving gun-cotton more or less nitrated."

The resulting paste is spread upon plates or trays with raised edges and allowed to dry. When sufficiently dry the sheets are rolled out to the desired thickness, and subsequently cut crosswise by suitable machinery in order to form small cubes. The rapidity of combustion of the powder is retarded by the addition of camphor, nitrobenzene, nitrotoluene, paraffin, &c. By varying the proportions of the ingredients above-named, "powders may be obtained adapted to suit all requirements."—C. N. II.

Improvements in the Method of Preparing High Explosives for Use and in the Charges of Cartridges made of such Explosives. J. W. Graydon, Washington, U.S.A. Eng. Pat. 6498A, May 1, 1888. 8d.

THE object of this invention is to prevent exudation or other physical change in high explosives, "as, for instance, dynamite, melinite, and roborite." The invention is carried out by separating the mass of explosive into a number of small portions, and entirely enclosing each portion in a separate envelope so as to form explosive pellets which can be packed together in a suitable wrapper or case to make a cartridge, or to be used or handled loosely without any casing.

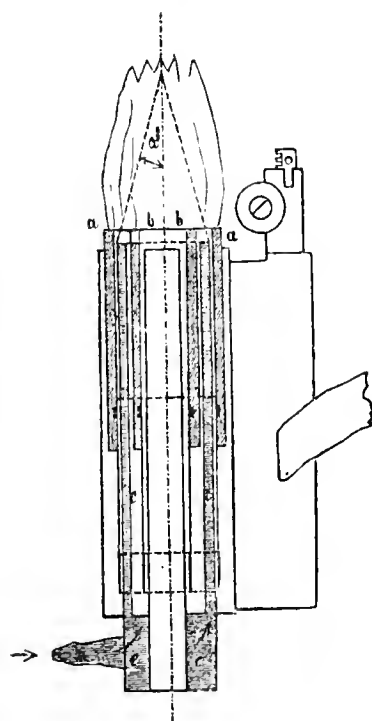
The purpose of the invention can also be attained by loading the explosives into cartridges containing partitions which separate it into small portions. Drawings of cartridges are attached to the specification.—C. N. II.

XXIII.—ANALYTICAL CHEMISTRY.

A New Spirit Lamp for obtaining High Temperatures, a Substitute for the ordinary Gas Blow Pipe. R. Rosenlecher. Chem. Zeit. 12, 1622—1623.

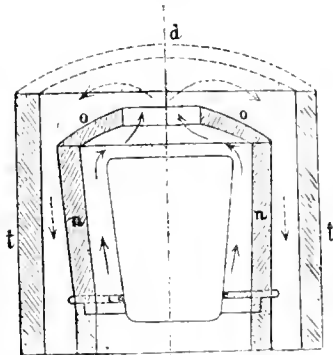
THE shape of the lamp is that of the common Bunsen lamp, but, instead of a single wick, there are two concentric circular wicks *a* and *b* (Fig. 1). The space between the two

Fig. 1.



wicks is formed by platinum foil into a channel *c*, for the admission of air under pressure, which channel is provided at the top with 10 small holes, bored aslant at an angle *a*¹, so as to concentrate the heat on one point. The amount of air required is very small, and can be easily supplied by a hand or foot blower of medium size. If the crucible to be heated be introduced into a fire-clay furnace (Fig. 2), a

Fig. 2.



white heat is readily attained, and if the fire-gases which escape be not likely to reduce the contents of the crucible, the furnace may be covered with a lid *d*, whereby the gases escape in the direction indicated by the arrows. It will be found best to have the height of wick from 2 to 3 mm., and the height of the flame from 4 to 5 cm. The burner may also be used in connexion with the common Berzelius lamp by being screwed down into the alcohol receiver of the lamp.—S. H.

An Apparatus for the Electrolytic Estimation of Metals. C. Levoir. Zeits. Anal. Chem. **28**, 63.

THE solution to be electrolysed is contained in a platinum dish supported on three metallic knobs, which serve to conduct the current from the positive pole of the battery. A smaller platinum dish is suspended inside the first dish by means of three platinum wires, the distance between the two basins being three centimetres. The three wires are attached to a stouter platinum wire, which dips into a mercury cup connected with the negative pole of the battery. The liquid to be electrolysed is thus situated between the parallel surfaces of the two dishes. During the passage of the current, the oxygen, liberated on the bottom of the upper dish, bubbles through the solution, and keeps it in constant circulation. Every portion of the solution is, therefore, brought into contact with the negative electrode, resulting in the rapid and complete deposition of the dissolved metal.—H. T. P.

Estimation of Zinc in Presence of Manganese. G. Neumann. Zeits. Anal. Chem. **28**, 57—58.

THE author finds that Bragard's method for the separation of zinc from formic acid solution as sulphide in presence of iron and nickel, is also applicable to the estimation of zinc in presence of manganese. The ratio of zinc to manganese, in the mixtures analysed, varied between wide limits. The results obtained were very satisfactory.

—H. T. P.

Arsenic in Precipitated Calcium Phosphate and its Estimation. H. Fresenius. Zeits. Anal. Chem. **28**, 64—67.

IT is well-known that precipitated calcium phosphate has been used for some time with considerable success as an addition to cattle food. The arsenic generally contained in the hydrochloric acid employed in the manufacture of the phosphate, finds its way into the latter in the shape of

calcium arsenite and arsenate, and if present in quantity might exert an injurious influence on the health of the cattle fed with the phosphate. For the estimation of the arsenic the author recommends the method and apparatus devised by R. Fresenius and E. Hintz. Ten grms. of substance are placed in a retort and covered with 100 cc. of HCl of 1.19 specific gravity. When the precipitate has mostly dissolved, 5 cc. of a cold saturated solution of ferrous chloride are added, and the whole nearly distilled to dryness. The arsenic is then estimated in the distillate as trisulphide in the usual manner. Twenty-five samples examined by this method were found to contain percentages of arsenic (metal) varying from 0.028 to 0.17.

The question as to the maximum quantity of arsenic permissible in phosphates used for feeding purposes, in the opinion of the author, can only be solved by a series of practical feeding trials made with phosphates containing gradually increasing percentages of arsenic.—H. T. P.

The Estimation of Copper Electrolytically. F. Rüdorff. Ber. **21**, 3050.

IN estimating copper electrolytically, it is advantageous to acidify the solution with nitric acid; but when chlorides are present, considerable time is taken up in evaporating the solution with sulphuric acid.

The author found that when an ammoniacal copper solution is electrolysed, the metal separates in a spongy condition, but that if 2 to 3 grms. of ammonia or potassium nitrate be added, and then about 10 cc. of ammonia for every 100 cc. of the solution containing 0.1—0.3 gm. of metal, the latter separates in excellent condition, even when the strength of current employed varies between considerable limits. The operation is at an end when the solution has become colourless.—F. S. K.

Determination and Separation of Zinc. J. Riban. Bull. Soc. Chim. **50**, 518—520.

See this Journal, 1888, 771.—C. A. K.

Separation of Cobalt and Nickel by the Nitrite Method. M. Baubigny. Compt. Rend. **107**, 685—686.

THE author points out that lead forms a triple nitrite with potassium and nickel, similar to those obtained with the alkaline earths. It is a yellow-orange coloured precipitate, which is only slightly soluble in water, even when acidulated by acetic acid. The exact composition of the compound has not yet been determined, but it is clear that the presence of lead, like that of the alkaline earths, must interfere with the separation of cobalt and nickel by the nitrite method.—C. A. K.

Tin. L. Vignon. Compt. Rend. **107**, 734—737.

IF metallic zinc be employed to precipitate tin from a solution of stannous or stannic chloride, the precipitated metal possesses the ordinary properties of tin, provided the solution contains an excess of acid; but if there be no free acid in the solution, i.e., if it be pure stannous or stannic chloride, the deposited tin always contains some stannous oxide. The quantity of the oxide formed increases with the length of time during which the deposition has taken place. The presence of this stannous oxide (SnO), which in the samples of deposited tin examined varied from 22 per cent. to 33 per cent., renders the metal quite infusible, and causes it to burn away, when heated in the air, without melting. When heated to a red heat in a current of carbon dioxide the tin sublimes in the form of minute globules, whilst a greyish powder is also deposited consisting mainly of stannous oxide. The specific gravity of this partially oxidised metal was found to be 6.910 to 7.198 at 15°; examined under the microscope it appeared of a fine dendritic structure, differing in this from pure tin, which, when precipitated on zinc, consists of compact needle-shaped crystals.—C. A. K.

On the Analysis of Commercial Scheelite. K. Rusag
Chem. Zeit. 12, 1316.

AUSTRALIAN scheelite, commercially known as the crude material from which tungsten and tungstates are manufactured, contains as impurities, quartz, calcium carbonate, silicates, sulphur ore, and arsenical ores. If metallic iron occurs, showing its presence by magnetic attraction, it may be supposed to owe its origin to instruments used in mining operations.

It is a moot point whether, in testing the commercial product, it is preferable to commence with the decomposition of the tungstate of lime by means of acids, or with breaking it up by fusion with carbonate of soda. If the latter process be adopted, the presence of silica in the fused product necessitates recourse to a variety of difficult operations, and the possible formation of silicate of tungsten may necessitate further roundabout processes. It is not possible to decompose the tungstate of calcium by means of solutions of alkaline carbonates and oxalates, nor did the author succeed by means of boiling nitric acid in rendering the whole of the tungstate accessible to the subsequent action of ammonia. A better result is obtained with concentrated sulphuric and hydrochloric acids, which both decompose it completely when heated for a sufficiently long time, the residue, exhausted by water and ammonia, generally proving free from tungstates when fused with soda. Hydrochloric acid is the more easily applied of the two. It does, it is true, dissolve a portion of the tungstate, but precipitates it again when diluted.

But as it is necessary, even when employing hydrochloric acid, to submit the silicates which have been separated to further tests, the most practical method appears to be to first remove the silica as fluoride of silica, which may be done without loss of tungstate by a mixture of hydrochloric acid and hydrofluoric acid; while, on the other hand, by heating with fluoride of ammonia, the formation of volatile combinations of fluorine and tungsten (also observed by Marignac) could not be avoided.

According to this method, from 2 to 3 grms. of finely-powdered scheelite are heated with hydrochloric and hydrofluoric acids until the silicic acid and the excess of hydrofluoric acid have entirely evaporated. The dry residue is again moistened with fuming hydrochloric acid, diluted after some time with an abundance of hot water, heated to boiling point, and left to settle.

The tungstic acid which has separated is washed without bringing it on the filter by decanting with hot dilute hydrochloric acid, dissolved in ammonia, and filtered after rendering it capable of filtration by heating and the addition of sal-ammoniac. The filtrate is evaporated to dryness in a large flat porcelain dish. The residue of tungstate of ammonia, if pure, would firmly adhere to the dish, but this is prevented if, during filtration or afterwards, sufficient sal-ammoniac has been added, and particularly if it has been heated until the point when decomposition sets in. The salt is now transferred to a large tared porcelain crucible, any residue which adheres to the dish being dissolved in ammonia, sublimed sal-ammoniac (free from ash) added, and evaporated as before. This is added to that in the crucible, and the operation repeated, if necessary, once or twice. The sal-ammoniac is driven off, and the tungstate of ammonia decomposed at a temperature far below the visible red heat, which is only brought to bright red at the end of the operation.

The remaining tungstic acid is of a pure yellow colour, provided the use of platinum vessels for ignition be avoided. Although only very sparingly soluble in ammonia, fused with soda it dissolves in water without leaving a residue, and, when boiled with sal-ammoniac, does not precipitate flocks of silicic acid or alumina.—T.

The Detection of Acetanilide. Zeits. Anal. Chem. 28,
103—104.

VARIOUS reactions are given for the detection of this substance, which is used medicinally to a considerable extent under the name of "antifebrin." G. Vulpius recommends the following test. A few centigrammes of the substance are boiled with 1 cc. of potash solution for a short time. A glass rod dipped in a bleaching-powder solution is then

suspended over the liquid; the bleaching-powder solution quickly assumes an amber-yellow colour, especially when viewed by transmitted light. By reflected light it has a violet tinge, and after long boiling, a distinct violet colour is produced. Aniline treated in a similar manner gives an immediate violet colouration, but no intermediate yellow tinge is produced. To detect acetanilide in urine, Vulpius gives the following:—The concentrated urine is boiled for a few minutes with HCl, cooled, extracted with ether, the ether evaporated, and the residue dissolved in water and mixed with a few cubic centimetres of an aqueous solution of phenol, and half its volume of a 1 per cent. solution of bleaching-powder. A brownish-red colouration is produced, which is changed to a beautiful blue by ammonia.

Vyon heats acetanilide gently with mercurous nitrate, whereby a body is produced which dissolves with a green colour in alcohol.

D. Cella and Arzeno heat a few centigrammes of the substance very gently with 2—3 drops of a solution of mercurous nitrate, and after solution has been effected, add 2—3 drops of strong sulphuric acid, when a blood-red colouration is produced. The last reaction is given by resorcinol, phenol, salicylic acid, tannic acid, gallic acid, and thymol, but not by benzoic acid.

F. A. Plückiger rubs up two parts of acetanilide with one part of caustic potash, moistened with chloroform, transfers the mixture at once to a test-tube, and heats very gently. The mixture turns brown, and gives off the very characteristic smell of phenyl carbaniline.—H. T. P.

Detection of Cotton-Seed Oil in Lard. Bishop and L. Engé.
J. Pharm. Chim. 1888, 348.

AMERICAN lard frequently contains as much as 50—60 per cent. of foreign fats, such as olein, "oleomargarin," cotton-seed oil, and cotton-seed stearin, while hard tallow is added to give the product the requisite consistency.

The best means of detecting cotton-seed oil is by the use of Bechi's test, of Labiche's reaction with lead acetate and ammonia, and of the rise of temperature with sulphuric acid. These are executed by the authors as follows:—

(1.) Bechi's test:—5 grms. of the clear melted fat are heated with 20 cc. of absolute alcohol and 3 cc. of an alcoholic solution of silver nitrate, containing 2 grms. in 250 cc., for 10 minutes on the water-bath, with continuous shaking. In the presence of cotton-seed oil a colouration appears, which may also be observed in the fat itself on solidifying, and—if the alcohol be decanted off and the cake of fat dissolved in ether or petroleum spirit—in its cold solution.

(2.) Labiche's test:—25 cc. of a solution of lead acetate containing 500 grms. per litre (heated to about 35° C.) are mixed with 25 grms. of the clear melted fat, and 5 cc. of ammonia (22° B. or sp. gr. '924) added with vigorous stirring for some minutes. The colour (orange-red) is observed after 24 hours.

(3.) Rise of temperature with sulphuric acid:—20 grms. of the clear fat are allowed to cool to about 30° C., the temperature exactly taken, and 20 grms. of sulphuric acid of a specific gravity not less than 1.836 run in, while the mixture is stirred vigorously with a thermometer; when the temperature ceases to rise, it is read off, and the total rise in temperature thus ascertained. Treated thus, genuine lard gave a rise of temperature of 35° C., with an acid of specific gravity of 1.837; and of 42° C. with one of specific gravity 1.842, while with the former acid a very old sample of cotton-seed oil gave 70° C., and a new one 66° C.

In all three tests the age of the sample does not much affect their value, though with Bechi's test a greater reduction of silver nitrate takes place with a new than with an old oil, and with Labiche's reaction the colouration is more marked in the case of an old oil.

The authors conclude that the detection of cotton-seed oil in lard is easy, but that no reliable method exists for its estimation.

(For recent papers on the same subject, see the "Analyst," 13, 161, 165, 168, 170, 172, 189, 203.)—B. B.

Detection of Adulterations in Vegetable Fatty Oils.

W. Peters. Arch. Pharm. 1888, 322.

The following points are to be observed :—

1. The melting point of the mixture of insoluble fatty acids obtained by saponification with hydrochloric acid or dilute sulphuric acid. In pure olive oil this should be between 24° and 29°; if above 29°, cotton-seed oil is present; if below 24°, linseed, poppy, or castor oil is present.

2. The colour imparted to a solution of the oil in nitric acid and sulphuric acids by the addition of sugar dissolved in hydrochloric or nitric acid. This will detect sesamé oil in olive and almond oils. Cotton-seed oil is coloured by the addition of nitric acid or a strong solution of antimony chloride. Rape oil will reduce alcoholic silver nitrate; earth-nut oil gives no colour reaction with acids.

3. The colours developed by the elaidin reaction. Cotton seed, sesamé, and peach-kernel oils are thus detected in olive oil.

4. The different solubilities of the fatty acids in 90 per cent. alcohol. Such a solution of the fatty acids from cotton-seed or earth-nut oil solidifies at 15°; so that if these oils be present in olive or almond oil, the alcoholic solution of the fatty acids will become turbid at 15°.

5. Hübl's iodine absorption value for pure olive oil is 80·2–85; a higher number indicates adulteration.

—A. G. B.

A Source of Error in the Determination of Benzene in Gas Mixtures. E. P. Treadwell and H. N. Stokes. Ber. 21, 3131–3133.

BERTHELOT published in 1876 (Compt. Rend. 83, 1255), a method for the analysis of illuminating gas, which consisted in absorbing carbonic acid by potassium hydrate, the "heavy hydrocarbons" by bromine water, benzene by fuming nitric acid, oxygen by an alkaline solution of pyrogallol acid or by phosphorus, and carbonic oxide by cuprous chloride. C. Winkler recommended this method in his "Handbook of Technical Gas Analysis." The authors found very variable figures in using red nitric acid, according as the gas was shaken with the acid a short or a long time. An illuminating gas contained 12 per cent. of carbonic oxide as tested by ammoniacal cuprous chloride; and when 100 cc. of the same gas, freed

from carbonic acid and heavy hydrocarbons, were shaken with red nitric acid, the figures obtained were as follows :—

Volume of the Gas free from CO ₂ and C ₂ H ₂ .	The Time of shaking with Red Nitric Acid.	Volume of the Gas after the Absorption.	
cc. 97·3	Minutes. 5	cc. 87·7	Per Cent. 3·6
..	10	86·0	5·3
..	15	83·6	7·7
..	20	82·2	9·1
..	25	81·2	10·1

In order to discover what constituent of the gas was absorbed by the nitric acid, the behaviour of this acid to carbonic oxide was investigated, when it was found that nitric acid absorbed carbonic oxide quantitatively. From this it was to be expected that nitric acid should absorb carbonic acid, and direct experiments proved this to be the case. It is, therefore, obvious that red nitric acid must not be used for the determination of benzene in gas mixtures containing oxides of carbon. As to the use of bromine-water for the absorption of gases of the ethylene series, very great care should be observed. It was found that bromine-water absorbed not only these gases, but also benzene. Bromine-water is therefore altogether unsuitable for the separation of the "heavy hydrocarbons" from benzene. There exists no process at present that allows of a separate determination of benzene and the gases of the ethylene series, and analysts must be satisfied to simply state the total sum of heavy hydrocarbons in their gas analyses.—S. II.

Estimation of Ash in Coke. F. Stolba. Listy Chem. 12, 63.

ONE grm. of the finely-powdered sample is mixed with 1 grm. of precipitated silver and ignited in a platinum dish at a red heat; incineration proceeds much more quickly than in the absence of the silver.—B. B.

The Examination of Spirit. H. Bornträger. Zeits. Anal. Chem. 28, 60–62.

THE principal impurities found in commercial spirit are aldehyde, acetal, and amyl alcohol. In the pure state, or when present to a considerable extent in spirit, these bodies give the following reactions :—

	Aldehyde.	Acetal.	Amyl Alcohol.
1. Boiling point of the chemically pure bodies	21° C.	104° C.	130° C.
2. Specific gravity	0·807	0·821	0·825
3. Behaviour with water	Easily soluble.	Insoluble.	Insoluble.
4. Behaviour with chloroform	Is taken up, the chloroform increases in volume and sinks to the bottom. A silver mirror is formed.	Same as for aldehyde.	Same as for aldehyde.
5. Behaviour on warming with an ammoniacal silver solution and water.		No mirror, but traces of reduction.	No action.
6. Behaviour with a colourless solution of magenta and sodium hydrogen sulphite in water.	Strong violet colouration, which is turned blue by strong HCl (1 in 500,000 may be thus detected).	No colouration.	No colouration.
7. Behaviour with an equal bulk of strong sulphuric acid.	Strong brown colouration.	Same as for aldehyde.	Same as for aldehyde.
8. Behaviour with an equal bulk of caustic potash solution (1–3).	Yellow colouration.	Same as for aldehyde.	Same as for aldehyde.
9. Behaviour with an equal bulk of strong sulphuric acid, strong potash solution being subsequently added.	Considerable separation of carbon, with slight smell of acrolein (acrylic aldehyde).	Strong smell of acrolein.	Colourless fluid of agreeable odour.
10. Behaviour with three drops of strong HCl and 10 drops of colourless aniline oil.	Yellowish-red colouration (in presence of much aldehyde).	No colouration.	Beautiful raspberry colouration (in presence of 0·05 per cent.).
11. Behaviour on dilution with two parts of water, extraction with chloroform, separation, and addition of three drops concentrated HCl and 10 drops of colourless aniline oil to the extract.	The chloroform is coloured yellowish-red (no reaction with traces).	No colouration.	The chloroform is coloured deep red in presence of large quantities; small amounts give a pink colouration.
12. Behaviour with a strong solution of potassium iodide.	Strong browning.	No colouration.	No colouration.

The colour tests are best performed in small porcelain dishes.

A commercial spirit is tested for the above constituents most conveniently as follows:—

I. (1.) A sample is largely diluted with water. If oily drops collect on the surface, they must be tested for acetal, by treating with strong sulphuric acid and potash (test, No. 9), and for amyl alcohol according to test No. 10.

(2.) Another portion is examined for aldehyde by means of tests 6 and 12.

II. If no separation of oily drops take place, the spirit is examined as follows:—

(1.) For aldehyde as in I. (2).

(2.) Another portion is diluted with two parts of water, and shaken out with chloroform. The chloroform extract is evaporated at a low temperature, and the residue tested for acetal and amyl alcohol as in I. (1).—H. T. P.

The Estimation of Phosphoric Acid in Sweet Wines, and its Bearing on the Purity of the Wine. W. Fresenius. *Zeits. Anal. Chem.* 28, 67—71.

The author finds that in the determination of phosphoric acid in sweet wines, the results are liable to be low, owing to the volatilisation of phosphorus during ignition of the extract to ash, caused by the action of carbon on phosphates. The following numbers were obtained, on the analysis of Tokay and Malaga wine, by different methods:—

P₂O₅ per Cent.

Tokay. Malaga.

1. Direct estimation in ash.....	0.0336	0.0256
Repetition.....	0.0368	..
2. After removal of the spirit the residue was suitably diluted, fermented with 3 cc. of yeast, dried, ignited (yeast and all), and the P ₂ O ₅ determined, allowance being made for P ₂ O ₅ in yeast.....	0.0339	0.0256
Repetition.....	0.0412	..
3. Same as above (2), only a very few yeast cells being added.....	0.0431	0.0257
4. The wine was evaporated with the addition of 6 grams of sodium carbonate and a little potassium nitrate, and the dried residue gradually added to fused potassium nitrate. The P ₂ O ₅ was determined in the solution of the melt.....	0.0427	0.0263

According to the standards imposed by List, a sweet wine (whether prepared from dried grapes or concentrated must) containing 20 per cent. of sugar ought to contain at least 4 per cent. of non-sugar extract and 0.04 per cent. of phosphoric acid. Wines which do not answer to these conditions are considered to have been adulterated, most probably in the first place with cane sugar. The author points out that non-concentrated sweet wines can be prepared in another way, namely, by adding to the must, when only very partially fermented, enough alcohol to stop the fermentation. To decide whether a wine has been prepared in the manner described, or whether cane sugar has been added, a determination of glycerol must be made. The following examples are given:—

	Tokay.	Cape Wine.	Muscatel.
Specific gravity.....	1.0729	1.0543	1.0653
Polarisation:—			
Direct.....	11	- 6.5	- 7
After inversion.....	11	- 6.5	- 7
After fermentation.....	± 0	± 0	± 0

Tokay. Cape Wine. Muscatel.

100 cc. of the wine contain:—

	Grams.	Grams.	Grams.
Alcohol.....	10.16	13.65	12.31
Extract.....	22.40	19.84	22.55
Ash.....	0.26	0.20	0.26
Free acid.....	0.50	0.35	0.34
Glycerol.....	0.89	0.13	0.15
Phosphoric acid.....	0.0292	0.0204	0.0190
Sugar, calculated as glucose.....	19.66	17.51	20.80

As the glycerol in a pure wine amounts to less than $\frac{1}{10}$ th or even $\frac{1}{100}$ th of the alcohol present, it will be seen from the above numbers that the Tokay wine has been sophisticated with cane or other sugar. The other two examples may be looked upon as musts in which the fermentation has been stopped by the addition of alcohol.

—H. T. P.

ERRATUM.

On page 870, and second line above table in middle of second column, for "As₂S₃" read "As₂S₅."

Trade Report.

(From the Board of Trade Journal and other sources.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

RUSSIA.

Classification of Articles in Customs Tariff.

Note.—Pound = 36 lbs. avoirdupois. Gold Rouble = 2s. 2d. Russian pound = 0.292 lbs. avoirdupois.

Metallic magnesium in narrow strips for indoor illumination.—Section 228. Duty, 45 copecks gold per Russian pound.
Light petroleum or "benzol."—Section 106, point 1. Duty, 1 rouble gold per pound.
Naphthalene, unpurified.—Section 16. Duty, 6 copecks gold per pound gross.
Zinc, in powder.—Section 102, point 1. Duty, 45 copecks per pound.
Bone black.—Section 143. Duty, 25 copecks per pound.
Asbestos in powder.—Section 145. Duty, 30 copecks per pound.
Chloric aluminium, under Section 140.—Duty, 2 roubles 40 copecks gold per pound.

FRANCE.

Circular 1944 forbids the use of benzoic acid and saccharin in drinks and provisions, as being dangerous to health on the same grounds as salicylic acid.

SPAIN.

Classification of Articles in Customs Tariff.

Nitrobenzine.—Category 32. Duty, 10 cents. per kilogram.

TRINIDAD.

Modification of Customs Duties.

Oleomargarine, butterine, or any preparation of fat, other than lard or ghee.—Duty, 1d. per lb.

Cressote oil.—Duty, 4 per cent. *ad valorem*. The drawback formerly allowed on olive oil only is extended to all oils except petroleum, coconut, or cressote oils. On the first-mentioned the old drawback of 11d. per gallon is allowed, the latter two are excepted from the operation of drawbacks. The old rate of 6d. per lb. (drawback) on gunpowder is retained.

MODIFICATIONS IN THE TARIFF OF AUSTRIA-HUNGARY
EFFECTED BY THE TREATY OF COMMERCE WITH
SWITZERLAND (APPLICABLE TO THE PRODUCE OF THE
UNITED KINGDOM).

Tariff No.	Classification of Articles.	Old Duties.	New Duties.
330	Alizarine 100 kilos.	Fls. kr. 10'00	Fls. kr. 1'50
342	Oil for dyeing Tur- key-red	1'00	2'50

NEW CUSTOMS TARIFF OF TASMANIA.

Classification of Articles.	Rates of Duty now levied.
Acid, tartaric.....	Lb. £ s. d. 0 0 4
Cements, mineral.....	Cwt. 0 0 0
Glucose.....	" 0 6 0
Glue	Lb. 0 0 1
Gunpowder, blasting	" 0 0 1
" sporting	" 0 0 6
" FFF, loose.....	" 0 0 1
Matches, buifer	Cubic foot 0 1 0
" wax vesels	" 0 3 0
Naphtha	Gallon 0 1 0
Oil, kerosene.....	" 0 1 0
Oils, all kinds, not otherwise enumerated. ..	" 0 1 3
" medicinal and perfumed	12½ ad val.
Opium, including extract of	Lb. 1 0 0
Paints of every description	" 0 0 0½
Soap, except fancy and perfumed.....	" 0 0 1
" fancy and perfumed.....	" 0 0 3
Soda, carbonate of	" 0 0 1
Soda crystals	" 0 0 0½
Spirits, methylated, taken as proof containing not less than 10 per cent. of methyl alcohol	Gallon 0 3 0
Spirits, perfumed	" 1 4 0
Spirituous compounds	15s. per gallon proof (no allowance for under proof).
Spirits of tar.....	Gallon 0 0 6
Starch	Lb. 0 0 1
Turpentine	Gallon 0 1 0
Varnish and polish, not otherwise enumerated	" 0 1 6

The following articles are free of duty:—Acids, carbonic, citric, muriatic, sulphuric; alum; antimony, in ingots; arsenic, crude; bluestone; carbolic powder; chloralium; coppers; dye-woods and dye-stuffs for manufacturing purposes only; ink, printing; creosote, crude; lime, carbolate of; lime, chloride of; logwood; manures; Muntz metal; myrobolans; paraffin and mineral wax; phosphorus; pitch; potash and pearlash; pottery materials, viz., litharge, china clay, Cornish stone, felspar, manganese, and oxide of cobalt; resin; salt, rock; shellac; soda ash; caustic soda; silicate of soda; solder and soldering fluid; stearine; sulphate of magnesia; sulphate of copper; sumac; tannin; and tannin extracts; tar; terra japonica; valonia; and vegetable black.

MISCELLANEOUS TRADE NOTICES.

THE PROPERTIES OF SACCHARIN.

With reference to the notification published on page 419 of the October (1888) number of the *Board of Trade Journal*, respecting the properties of saccharin, a communication has been received from Dr. C. Fahlberg, of Saltsjö Westerhausen, traversing the statement that this article is injurious to the public health, and enclosing a pamphlet entitled "A Vindication of Saccharin," in which the opinions are quoted of various medical authorities as to the harmlessness of the article in question.

SACCHARIN IN BELGIUM.

A commission appointed by the Belgian Academy of Medicine have come to the conclusion that saccharin cannot be considered a substitute for sugar in aliments; but that, although differently borne by different subjects, it is not poisonous. They are of opinion also that it is not wholly voided out through the urine, and is liable to find its way into the milk and saliva. Consequently the Commission have reported that in their judgment all persons selling wholesale or retail articles sweetened with saccharin should be compelled to indicate the fact in a conspicuous manner.—*Chemist and Druggist*.

THE MANURE ACT.

Last February the French Parliament passed a law respecting the sale of fertilisers which in many ways resembles the British legislation governing the same subject. The new law on January 11 received its first application in the case of Samson and Cie., manufacturers of artificial guano. The firm, through their agent, one Millaud, sold to one Lanosa 100-kilo, bag of manure labelled and billed "Guano compost; 2 per cent. nitrogen, 10 to 15 per cent. phosphates." Lanosa complained that the article was wrongly described. Specimens were analysed by expert chemist Lhoté, who reported the fertiliser to contain 2'42 per cent. of nitrogen and 17'85 of phosphates, but to be an artificial compound in no way equal to natural guano. The defence set up was that the article had not been described as guano, but as "guano compost," that is, a compound of like value. The Seine Correctional Tribunal held that the word "guano" had evidently deceived Lanosa into buying the article, and that the provisions of the law had been violated. In consequence, Millaud was sentenced in two fines, 50 francs and 11 francs respectively, and costs. Civil damages will also probably follow as a matter of course.—*Chemist and Druggist*.

AVERAGE PRICES OF SULPHATE OF AMMONIA AND
NITRATE OF SODA FOR THE TEN YEARS 1879-1888.

Year.	Sulphate of Ammonia (Good Grey 24 per Cent. f.o.b. Hull) per Ton.	Nitrate of Soda. In Liverpool 95 per Cent. per Cwt.
	£ s. d.	s. d.
1879	18 8 9	15 0½
1880	19 0 0	14 9
1881	20 4 6	15 8
1882	20 8 6	14 8
1883	16 11 0	13 1
1884	14 9 3	11 2
1885	11 9 1½	9 9
1886	11 3 7½	10 2
1887	11 17 8	9 9
1888	11 18 0½	9 9½

—Bradbury and Hirsch, Liverpool.

CONSUMPTION OF NITRATE OF SODA.

	1886.	1887.	1888.
	Tons.	Tons.	Tons.
Continent of Europe	320,000	385,000	527,000
United Kingdom.....	106,000	98,000	102,500
United States	60,000	65,000	65,000
	486,000	548,000	694,500
Whilst the shipments for the same periods have been....	438,000	680,000	764,000

SULPHATE OF AMMONIA.

The production of sulphate of ammonia during 1888 has been 117,500 tons. Of this quantity England supplied 82,000, Scotland, 33,500; Ireland, 2,000 tons. The total may be divided among the different industries as follows:—

	Tons.
Gas works.....	87,000
Shale oil works.....	22,000
Iron works.....	5,500
Coke ovens and carbonising works.....	3,000
	<u>117,500</u>

PRODUCTION, DELIVERIES, AND EXPORTS OF SULPHATE OF AMMONIA DURING FIVE YEARS, 1884-88.

	1888.	1887.	1886.	1885.	1884.
	Tons.	Tons.	Tons.	Tons.	Tons.
PRODUCTION:					
England, Scotland, and Ireland, from all sources ..	117,500	107,000	103,000	97,000	87,000
DELIVERIES AND EXPORTS:					
Germany, Denmark, Sweden, &c.	32,000	33,000	31,000	30,000	35,000
France, Spain, and Italy	19,000	21,000	16,000	12,000	13,000
Belgium and Holland.....	18,000	16,000	19,000	14,000	10,000
America and Colonies.....	11,000	11,500	10,000	5,000	7,000
Home consumption for agricultural and chemical purposes (including the liquor used in various processes of manufacture)	26,000	23,200	22,000	21,000	13,000
Stocks	8,500	1,800	2,000	6,000	3,000
	<u>117,500</u>	<u>107,000</u>	<u>103,000</u>	<u>97,000</u>	<u>87,000</u>

—Bradbury and Hirsch, Liverpool.

NITRATE OF SODA.

SHIPMENTS, CONSUMPTION, STOCKS, AND PRICES, FROM 1881 TO 1888.

	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Shipments from South American ports to all parts for the six months ending 31st December.....	207,000	261,000	327,000	289,000	243,000	274,000	417,000	486,000
Do. do. for the 12 months ending 31st December.....	319,000	476,000	567,000	535,000	420,000	438,000	680,000	764,000
Afloat for Europe on 31st December.....	118,000	132,000	230,000	190,000	154,000	181,000	325,000	334,000
Stocks in United Kingdom ports:—								
Liverpool.....	2,000	11,000	11,000	13,500	18,000	10,700	2,000	3,500
London	1,200	450	1,500	2,000	6,200	5,300	3,250	1,800
Out ports.....	5,500	17,550	19,500	14,600	13,800	17,000	10,750	9,200
	<u>8,700</u>	<u>29,000</u>	<u>32,000</u>	<u>31,000</u>	<u>40,000</u>	<u>33,000</u>	<u>16,000</u>	<u>14,500</u>
Stocks in Continental ports on 31st December	27,000	35,000	73,000	130,000	116,000	66,000	50,000	63,500
Consumption in United Kingdom for the six months ending 31st December.....	24,500	26,000	31,000	27,000	22,000	21,000	30,000	27,000
Do. in Continent do. do. ..	72,500	99,000	124,000	118,000	70,000	112,000	145,000	187,000
Do. in United Kingdom for the 12 months ending 31st December.....	65,500	76,500	99,000	106,000	95,000	106,000	98,000	102,000
Do. in Continent do. do. ..	165,500	237,000	314,000	358,000	200,000	320,000	385,000	527,000
Do. in United States do. do. ..	55,000	60,000	55,000	58,000	15,000	60,000	65,000	65,000
Visible supply on 31st December (including the quantity afloat for Europe and stocks in United Kingdom and Continent)	157,700	256,000	335,000	351,000	310,000	280,000	321,000	412,000
London spot price on 31st December.....	Per Cwt. 14s. 7½d.	Per Cwt. 12s. 3d.	Per Cwt. 10s.	Per Cwt. 9s.	Per Cwt. 11s. 3d.	Per Cwt. 9s.	Per Cwt. 9s.	Per Cwt. 11s.

—W. Montgomery & Co.

MINERAL PRODUCTS OF THE UNITED STATES, 1882 TO 1887.

		1882.		1883.		1884.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
METALLIC.							
Pig-iron, spot value (a).....	Long Tons (b)	4,623,323	Dollars. 106,336,429	4,595,510	Dollars. 91,910,200	4,097,868	Dollars. 73,761,624
Silver (c), coinage value.....	Troy Ozs.	36,197,695	96,809,000	35,733,622	46,200,000	37,744,095	48,809,000
Gold, coinage value (d).....	"	1,572,186	32,500,000	1,451,249	30,000,000	1,480,949	30,800,000
Copper (e), value at New York City.....	Lbs.	91,646,232	16,938,991	117,151,795	18,061,807	147,806,197	18,106,162
Lead, value at New York City.....	Short Tons	132,800	12,624,550	143,957	12,322,719	139,897	10,537,942
Zinc, value at New York City.....	"	33,765	3,646,620	36,872	3,311,106	38,544	3,422,707
Quicksilver, value at San Francisco.....	Flasks (f)	52,732	1,487,042	66,725	1,253,632	31,913	836,327
Nickel (g), value at Philadelphia.....	Lbs.	281,616	309,777	58,800	52,920	64,550	48,412
Aluminum, value at Philadelphia.....	Troy Ozs.	.. (h)	..	1,000	875	1,800	1,350
Antimony, value at San Francisco.....	Short Tons	60	12,000	60	12,000	60	12,000
Platinum, value (crude), at New York City.....	Troy Ozs.	200	600	200	600	150	450
Total value of metallic products.....	..	..	219,755,109	..	203,128,850	..	186,426,074
NON-METALLIC (SPOT VALUES).							
Bituminous coal (i).....	Long Tons	60,861,190	76,076,487	68,531,500	82,237,800	73,730,539	77,417,066
Pennsylvania anthracite.....	"	31,358,264	70,556,094	31,336,400	77,257,055	33,173,756	66,351,512
Building stone.....	..	..	21,000,000	..	20,000,000	..	19,000,000
Lime.....	Barrels (m)	31,000,000	21,700,000	32,000,000	19,200,000	37,000,000	18,500,000
Petroleum.....	" (l)	30,053,500	23,704,698	23,400,229	25,740,252	24,089,758	20,476,294
Natural gas.....	..	..	215,000	..	475,000	..	1,400,000
Cement.....	Barrels (n)	3,250,000	3,072,750	4,190,000	4,293,500	4,000,000	3,720,000
Salt.....	" (n)	6,412,373	4,340,140	6,192,231	4,211,942	6,514,937	4,197,734
Limestone for iron flux.....	Long Tons	3,850,000	2,310,000	3,814,273	3,401,136	3,401,136	1,700,965
South Carolina phosphate rock.....	"	332,077	1,992,462	378,380	2,270,280	431,779	2,374,784
Zinc-white.....	Short Tons	10,000	700,000	12,000	840,000	13,000	910,000
Mineral waters.....	Gallons sold	..	..	7,529,423	1,110,603	10,215,328	1,459,143
Borax.....	Lbs.	4,296,291	338,903	6,500,000	585,900	7,000,000	490,000
Gypsum.....	Short Tons	..	..	..	..	..	..
Manganese ore.....	Long Tons	3,500	52,500	8,000	120,000	10,000	120,000
Mineral paints.....	..	7,000	105,000	7,000	84,000	7,000	84,000
New Jersey marls.....	Short Tons	1,080,000	540,000	972,000	486,000	875,000	437,500
Pyrites.....	Long Tons	12,000	72,000	25,000	137,500	35,000	175,000
Flint.....	..	25,000	100,000	25,000	100,000	30,000	120,000
Mica.....	Lbs.	100,000	250,000	114,000	285,000	147,410	368,525
Corundum.....	Short Tons	500	80,000	550	100,000	600	108,000
Sulphur.....	"	600	21,000	1,000	27,000	500	12,000
Precious stones.....	..	..	75,000	..	74,050	..	82,975
Gold quartz, souvenirs, jewellery, &c.....	..	..	75,000	..	115,000	..	140,000
Crude barytes.....	Long Tons	20,000	80,000	27,000	108,000	25,000	100,000
Bromine.....	Lbs.	250,000	75,000	301,100	72,264	281,100	67,464
Feldspar.....	Long Tons	14,000	70,000	14,100	71,112	10,900	55,112
Chrome iron ore.....	"	2,500	50,000	3,000	60,000	2,900	58,000
Graphite.....	Lbs.	425,000	34,000	575,000	46,000	..	..
Fluorspar.....	Short Tons	4,000	20,000	4,000	20,000	4,000	20,000
Slate ground as a pigment.....	Long Tons	2,000	24,000	2,000	24,000	2,000	20,000
Cobalt oxide.....	Lbs.	11,553	32,046	1,906	2,795	2,000	5,109
Noxalite.....	"	..	..	..	..	..	..
Asphaltum.....	Short Tons	3,000	10,500	3,000	10,500	3,000	10,500
Asbestos.....	"	1,200	36,000	1,000	30,000	1,000	30,000
Rutile.....	Lbs.	500	1,800	550	2,000	600	2,000
Total value non-metallic mineral products.....	..	..	228,410,380	..	242,111,880	..	220,050,074
Total value mineral products.....	..	..	219,755,109	..	203,128,850	..	186,426,074
Estimated value of mineral products unspecified (q).....	..	..	8,000,000	..	8,000,000	..	7,000,000
Grand Total.....	..	..	456,165,489	..	453,240,748	..	413,476,748

(a.) By "spot" value is meant value at the point of production.
 (b.) "Long tons" are tons of 2,240 avoirdupois pounds. "short" tons are 2,000 avoirdupois pounds.

(c.) 1.2929 dols. per troy ounce.

(d.) 20.6718 dols. per troy ounce.

(e.) Including copper made from imported pyrites.

(f.) Of 76½ avoirdupois pounds net.

(g.) Including nickel in copper-nickel alloy, and in exported ore and matte.

(h.) Not reported.

(i.) Including brown coal and lignite, and small lots of anthracite mined elsewhere than in Pennsylvania.

(j.) The commercial product of bituminous coal, that is, the amount marketed, was only:—

Years.	Quantity.	Value.
1882	57,963,038	Dollars. 72,453,797
1883	65,030,171	78,096,205
1884	66,809,556	70,147,824
1885	63,560,284	80,640,564
1886	63,380,119	75,554,620
1887	75,454,404	94,230,752

MINERAL PRODUCTS OF THE UNITED STATES, 1882 TO 1887—*continued*.

		1885.		1886.		1887.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
METALLIC.			Dollars.		Dollars.		Dollars.
Pig-iron, spot value (a).....	Long Tons (b)	4,944,525	64,712,400	5,683,329	95,195,760	6,417,148	121,925,800
Silver (c), coining value.....	Troy Ozs.	39,910,279	51,600,000	39,415,312	51,000,000	41,269,219	53,141,300
Gold, coining value (d).....	"	1,528,376	31,801,000	1,881,250	35,000,000	1,506,500	33,100,000
Copper (e), value at New York City.....	Lbs.	170,962,607	18,292,999	161,235,381	16,527,451	184,670,524	21,052,149
Lead, value at New York City.....	Short Tons	129,412	10,469,431	135,629	12,667,719	160,700	14,463,000
Zinc, value at New York City.....	"	40,688	3,539,856	42,641	3,752,408	50,340	4,782,300
Quicksilver, value at San Francisco.....	Flasks (f)	32,073	979,189	29,381	1,000,000	33,825	1,429,000
Nickel (g), value at Philadelphia.....	Lbs.	277,304	191,753	211,992	127,457	205,556	133,200
Aluminium, value at Philadelphia.....	Troy Ozs.	3,400	2,550	"	27,000	"	74,905
Antimony, value at San Francisco.....	Short Tons	50	10,000	35	7,000	75	15,500
Platinum, value (crude), at New York City.....	Troy Ozs.	250	187	50	100	448	1,848
Total value of metallic products.....	..	..	181,599,365	..	215,364,825	..	250,419,283
NON-METALLIC (SPOT VALUES).							
Bituminous coal (i).....	Long Tons	64,840,668	82,347,648	65,810,676	78,481,056	(j)78,470,857	98,004,656
Pennsylvania anthracite.....	"	34,228,548	76,671,948	34,853,677	76,119,120	(k)37,578,747	81,552,181
Building stone.....	"	..	19,000,000	..	19,000,000	..	25,000,000
Lime.....	Barrels (m)	40,000,000	20,000,000	42,500,000	21,250,000	46,750,000	23,375,000
Petroleum.....	" (l)	21,842,041	19,193,694	28,110,115	20,028,157	28,249,597	18,856,606
Natural gas.....	..	..	4,854,200	..	9,847,150	..	15,898,500
Cement.....	Barrels (o)	4,150,000	3,492,500	4,501,000	3,990,000	6,692,714	5,156,877
Salt.....	" (n)	7,038,653	4,825,345	7,707,081	4,736,585	7,831,962	4,093,816
Limestone for iron flux.....	Long Tons	3,356,956	1,678,478	4,717,163	2,830,297	5,377,000	3,226,200
South Carolina phosphate rock.....	"	437,856	2,846,064	430,549	1,872,936	480,558	1,836,818
Zinc-white.....	Short Tons	15,000	1,050,000	18,000	1,440,000	18,000	1,440,000
Mineral waters.....	Gallons sold	9,148,491	1,312,845	8,950,317	1,284,070	8,259,599	1,261,473
Borax.....	Lbs.	8,060,000	180,000	9,778,290	488,915	11,000,000	550,000
Gypsum.....	Short Tons	90,405	405,000	95,250	428,625	95,000	425,000
Manganese ore.....	Long Tons	23,258	190,281	30,193	277,636	34,524	333,844
Mineral paints.....	"	3,950	43,575	15,800	285,000	20,000	310,000
New Jersey marls.....	Short Tons	875,000	437,500	800,000	400,000	600,000	300,000
Pyrites.....	Long Tons	49,000	220,500	55,000	247,500	52,500	210,000
Flint.....	"	30,000	120,000	30,000	120,000	32,000	185,000
Mica.....	Lbs.	92,000	161,000	40,000	70,000	70,500	142,250
Corundum.....	Short Tons	600	108,000	645	116,190	600	108,000
Sulphur.....	"	715	17,875	2,500	75,000	3,000	100,000
Precious stones.....	..	..	69,900	..	70,056	..	88,600
Gold quartz, souvenirs, jewellery, &c.....	..	..	110,000	..	40,000	..	75,000
Crude barytes.....	Long Tons	15,000	75,000	10,000	50,000	15,000	75,000
Bromine.....	Lbs.	310,000	89,500	428,334	111,350	199,087	61,717
Feldspar.....	Long Tons	13,600	68,000	14,000	71,500	10,200	56,100
Chrome iron ore.....	"	2,700	40,000	2,000	30,000	3,000	40,000
Graphite.....	Lbs.	327,883	26,231	415,525	33,242	416,000	31,000
Fluorspar.....	Short Tons	5,000	22,500	5,000	22,500	5,000	20,000
Slate ground as a pigment.....	Long Tons	1,975	24,687	3,000	30,000	2,000	20,000
Cobalt oxide.....	Lbs.	68,723	65,373	..	(p) 36,878	(p) 18,340	18,774
Novaculite.....	"	1,000,000	15,000	1,160,000	15,000	1,200,000	16,000
Asphaltum.....	Short Tons	3,000	10,500	3,500	14,000	4,000	16,000
Asbestos.....	"	200	9,000	200	6,000	150	4,500
Rutile.....	Lbs.	600	2,000	600	2,000	1,000	3,000
Total value non-metallic mineral products.....	..	..	240,114,544	..	243,963,063	..	285,864,942
Total value mineral products.....	..	..	181,599,365	..	215,364,825	..	250,419,283
Estimated value of mineral products unspecified (q).....	..	..	7,000,000	..	6,000,000	..	6,000,000
Grand Total.....	..	..	428,713,909	..	465,327,888	..	542,284,225

(k.) The commercial product of anthracite, that is, the amount marketed, was only:—

Years.	Quantity.	Value.
1882	29,120,096	65,520,216
1883	31,793,027	71,534,311
1884	30,718,294	61,436,586
1885	32,265,421	72,271,544
1886	32,764,710	71,558,126
1887	35,279,442	79,965,244

(l.) Of 42 gallons.

(m.) Of 200 lbs. (n.) Of 280 pounds net. [Portland.
(o.) Of 500 pounds for natural cement, and 400 pounds for artificial
(p.) Including cobalt oxide in ore and matte.
(q.) Including, except where an amount is specified in the table, fire-clay, kaolin, potters' clay, common brick clay, terra cotta, building sand, glass sand, limestone used as flux in lead smelting, limestone in glass making, iron ore used as flux in lead smelting, marls (other than New Jersey), gypsum, tin ore, iridosmine, mill limestone and stone for making grindstones, novaculite, lithographic stone, talc and soapstone, quartz, nitrate of soda, carbonate of soda, sulphate of soda, native alum, ozocerite, mineral soap, strontia, infusorial earth and tripoli, pumice-stone, sienna, amber, zinc-white, and mineral waters.

DAVID T. DAY,
Chief of Division of Mining Statistics,
U.S. Geological Survey, Washington.

THE KAINITE SYNDICATE.

Chem. Zeit. 12, 1723.

The owners of the potash mines in the Stassfurt district have formed a new syndicate for a term of ten years. The production of raw salts is distributed among the different mines, thus:—

	Carnallite.		Kainite.	
	To be Worked up into KCl and K_2SO_4 .	For Agricultural and other Purposes.	To be Worked up into KCl and K_2SO_4 .	For Agricultural and other Purposes.
	Per Cent.	Per Cent.	Centners.	Per Cent.
Royal Prussian Mines, Stassfurt	18½	20	1,300	18½
Ducal Anhalt Mines, Leopoldshall	18½	20	1,300	18½
Consolidated Alkali Works, Westeregeln	14½	10	800	15
Neustassfurt Company, Löderburg	14½	30	1,800	18½
Potash Works, Aschersleben	14½	5	2,000	18½
Ludwig II. Co., Stassfurt	10½	10	..	..
Potash Works, Nenenburg	7½	5	..	12½

The normal output amounts to 7,200 centners, about 360 tons per day.—S. H.

PERUVIAN GUANO.

The imports into Europe during the past six months amount to about 14,000 tons. The shipments from Peru seem to be on a very limited scale and point to the probability that the deposits are about exhausted.—*W. Montgomery & Co.*

DISCOVERY OF KAOLIN IN SWEDEN.

The Swedish *Post-och-Tidnings*, for 11th December last, announced the discovery of a bed of kaolin of unprecedented wealth in the island of If. In ploughing the land, a layer of excellent chalk was brought to light, and while a geological survey was being made of this chalk, a lower layer of remarkably fine kaolin or porcelain clay was unearthed. Specimens of this clay, having been analysed at Lund, at Berlin, and in the chemical station at Christianstad, prove to be of singular purity. The large extent of this deposit, moreover, is of interest, as porcelain clay has hitherto been found in Sweden only in small quantities. It is expected that the factory which has already been prepared for the manufacture of articles from the If kaolin will prove a source of wealth to the province.

THE WORKING OF THE MERCHANDISE MARKS ACT.

See Board of Trade Journal for January, p. 86.

METHYLATED SPIRITS.

The latest returns issued by the Board of Trade disclose the fact that the number of gallons delivered from the bonded warehouses in the United Kingdom for methylating purposes has advanced from 430,617 gallons in 1886 to 505,231 gallons in 1887, and 508,717 gallons in 1888.—*Chemist and Druggist*.

THE DRAWBACK ON SPIRITS EXPORTED AS MEDICINES.

We understand that the following instructions have been issued to officers of Inland Revenue, so that those druggists who contemplate exporting alcoholic medicinal preparations will find no difficulty in availing themselves of the general order issued in November 1888. We also hear that the authorities are considering further extension of facilities which are the logical outcome of those recently granted:—"Collectors are now authorised to grant compounders' licences to makers of medicinal spirits, notwithstanding that they use methylated spirits or keep stills for chemical purposes, on condition that the licence be used solely in relation to the preparation and export of medicinal spirits, under the general order of the 26th November last. Subject to this condition, the ordinary regulations applicable to rectifiers and compounders using stills need not be insisted on in regard to such persons. Collectors will take care to make any trader to whom a licence is issued aware of these conditions."—*Chemist and Druggist*.

QUICKSILVER.

	Imports.	Exports.	Price.	
			Highest.	Lowest.
	Bottles.	Bottles.	£ s. d.	£ s. d.
1888	73,770	47,132	11 0 0	6 15 0
1887	61,212	62,476	11 5 0	6 10 0
1886	58,966	66,080	7 10 0	5 13 0
1885	55,153	48,823	6 15 0	5 10 0
1884	50,970	52,492	6 15 0	5 2 0
1883	51,520	18,907	5 17 6	5 2 0
1882	45,921	40,424	6 5 0	5 14 0
1881	56,261	21,842	7 0 0	6 2 6
1880	49,541	16,970	7 15 0	6 7 6
1879	53,062	28,711	8 15 0	5 17 6

Estimated consumption United Kingdom, 12,000 bottles per annum.

January, 1889.

—A. S. Pickering, Mining Lane, E.C.

The production of this metal seems to have been stationary during 1888 as compared with 1887, although several of the component items have varied a little. The increase of importations into United Kingdom to 69,167 bottles for the season ending 30th November, as against 59,811 bottles in the previous season, may therefore be attributed to California and China denuding themselves of stock, an operation that cannot be repeated this year. In fact, we expect this year's imports will be smaller than for many years past, because a serious accident at the Spanish Almaden mine will diminish the supplies from that quarter to a very considerable extent.

The exports have fallen off by about 18,000 bottles, which cannot be accounted for by any actual diminution in real consumption, so we fully expect a very material improvement in the statistical position will be developed during this current year. The market rates, owing to the exceptionally small exports and large imports previously referred to, have had a downward tendency, and would have fallen to a very low point had it not been for the exceptional firmness of the importers of Spanish, who for the past three months have rigidly maintained the price of 9l. 10s., against sales in the open market at very irregular quotations, at one time touching 7l. 17s. 6d., and to-day being about 8l. 5s. But of course, this action is putting them into a position to control the rates later on, when timid speculative holders are cleared out.—*W. T. Sargent & Sons' Annual Circular*.

QUICKSILVER—continued.

	1888.	1887.	1886.	1885.	1884.	1883.	1882.	1881.	1880.	1879.
Production of Spanish*	Bottles, 53,243	Bottles, 51,011	Bottles, 48,537	Bottles, 45,813	Bottles, 48,098	Bottles, 49,177	Bottles, 46,716	Bottles, 44,989	Bottles, 45,322	Bottles, 42,072
Italian*.....	10,160	7,400	8,090	7,888	8,010	5,340	5,382	3,741	2,459	3,212
Austrum.....	14,000	14,000	14,000	14,370	14,689	13,700	12,000	11,700	10,870	12,600
Californian	28,000	33,760	29,981	32,073	31,943	46,725	52,732	60,851	59,926	73,684
Borneo†	1,559	1,559	1,559	1,559	1,559	1,559	1,559	1,559	1,559	1,559
Total	107,262	107,720	102,167	101,703	104,299	116,501	118,389	122,840	120,136	133,727
Exports from United Kingdom* ..	15,806	64,049	66,974	59,912	50,631	50,022	40,423	24,802	46,972	28,710
Highest price of Spanish.....	£ s. d. 10 10 0	£ s. d. 11 5 0	£ s. d. 7 10 0	£ s. d. 6 17 6	£ s. d. 6 15 0	£ s. d. 5 17 6	£ s. d. 6 5 0	£ s. d. 7 0 0	£ s. d. 7 15 0	£ s. d. 8 15 0
Lowest price of Spanish.....	6 15 0	6 10 0	5 13 0	5 10 0	5 1 6	5 2 0	5 14 0	6 2 6	6 7 6	5 17 6

* Calculated November to November.

† Average Production.

—*Ibid.*

LEAD.

There is again a material increase in the imports, and a small increase in the out-turn of British mines. A considerable surplus has been created which is chiefly stored in London warehouses. There has been considerable speculative activity, both here and in New York. Frequent and continuous efforts have been made to secure control of the markets, but in face of increasing supplies there seems no sound reason for such a course, and so far as we have been able to gather considerable losses have been incurred by

the attempt, and at one moment, the failure of an important speculator in America, brought about something like a feeling of panic. But this has gradually disappeared, and the market has a steady appearance at the close, and a full consumption is confidently looked for during this year. A rise based on this will be satisfactory to all parties.

The present quotation is 13*l.* 2*s.* 6*d.*, and the average for 1888 was 13*l.* 12*s.* 6*d.*

	1888.	1887.	1886.	1885.	1884.	1883.	1882.	1881.	1880.	1879.
Production of British mines	Tons, 45,000*	Tons, 41,000	Tons, 39,500	Tons, 37,687	Tons, 39,000	Tons, 39,189	Tons, 53,000	Tons, 48,587	Tons, 56,949	Tons, 51,635
Importation of foreign into United Kingdom	132,911	114,382	107,878	108,063	109,014	101,589	87,741	93,400	95,202	102,440
Exports from United Kingdom ..	18,653	44,367	42,388	38,378	33,530	39,267	37,378	43,109	33,551	37,007
Highest price of soft pig	£ s. d. 15 15 0	£ s. d. 15 15 0	£ s. d. 13 12 6	£ s. d. 12 10 0	£ s. d. 11 10 0	£ s. d. 13 10 0	£ s. d. 14 5 0	£ s. d. 15 5 0	£ s. d. 19 0 0	£ s. d. 19 10 0
Lowest	12 5 0	11 17 6	12 0 0	10 5 0	10 2 6	11 10 0	13 5 0	14 5 0	14 5 0	13 5 0

* Estimated.

—W. T. Sargant & Sons' Annual Circular.

TABLE SHOWING THE QUANTITY OF PHOSPHATES IMPORTED INTO THE UNITED KINGDOM FROM 1885 TO 1887.

	1885.	1886.	1887.
United States.....	Tons, 138,844	Tons, 144,620	Tons, 165,275
Canada	21,484	18,069	19,194
Dutch West Indies (Curacao, Aruba)	11,588	12,581	9,505
British West Indies (Sombroero, &c.).....	7,727	3,351	6,451
Spain and Portugal.....	19,282	5,825	15,612
Belgium	35,405	31,551	45,322
Holland	865	2,194	1,778
France	2,276	1,503	11,140
Australia .....	..	200	350
Germany	704	..	..
Haiti—San Domingo .....	..	2,175	3,044
Brazils .....	..	..	1,290
Other countries.....	397	1,029	1,544
Total	238,572	223,111	283,415

—“Our Supply of Phosphates,” HERMANN Voss.

THE ANNUAL TARIFF OF PRICES AND DISPENSING CHARGES FOR PRUSSIA.

The annual tariff of prices and dispensing charges for Prussia just issued includes the names of some new remedies. It will probably be of interest to note the figures at which the pharmacist is to charge for these articles, while at the same time the list indicates the opinions of the compilers as to which of the recent introductions are likely to continue in demand:

	s.	d.
Camphoric acid.....	1 decrm.	0 6½
“ ..	1 grm.	0 2½
Pictonitric acid	10 grms.	0 2
Creolin (liquor antisepticus Jeyes)...	10 ..	0 1½
“ ..	100 ..	0 8
Camol.....	10 ..	0 2
Guaicol.....	1 grm.	0 2
Phenacetin	1 ..	0 3
Sozoidol (sodium and potassium)...	1 ..	0 4
Sulphonal	1 ..	0 3
“ ..	10 grms.	2 11
Thalin tartrate	1 decrm.	0 6½

With regard to manipulations the only novelty is the inclusion of a price for compressing medicines. For one tablet, including all the necessary operations, a charge of 1*d.* is allowed. The other changes are of slight importance.—*Chemist and Druggist.*

THIOL.

Ichthylol has a rival in the field under the name of "Thiol." This is a patent preparation made from the paraffin oils obtained in the distillation of peat. According to the specification oil is heated to about 215° C., and a certain quantity of sulphur is added. Sulphuretted hydrocarbons are formed with disengagement of sulphuretted hydrogen. From the former the sulpho-acids are formed by the action of concentrated sulphuric acid, and from the acids the various salts are prepared. Trials have been made with the sodium and ammonium salts in the Clinic, Berlin, by Dr. Reeps; and it is said that in several cases thiol has been found equal to ichthylol therapeutically, and only slightly different from it in chemical and physical properties.—*Chemist and Druggist*.

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

IMPORTS INTO THE UNITED KINGDOM FROM SPAIN.

PRINCIPAL ARTICLES.	Three Months ending	
	Dec. 1887.	Dec. 1888.
Chemical products unenumerated, Value £	17,532	12,811
Copper ore and regulus	£ Tons 17,866	25,528
	£ Value £ 375,447	573,974
Manganese ore	£ Tons 2,180	1,810
	£ Value £ 3,190	5,520
Pyrites of iron or copper	£ Tons 118,101	136,588
	£ Value £ 225,889	282,582
Quicksilver	£ Lbs. 12,603	193,782
	£ Value £ 1,290	50,000
Rags, esparto	£ Tons 14,798	12,723
	£ Value £ 88,265	78,346
Total Value	£ 3,213,144	3,186,335

EXPORTS OF BRITISH AND IRISH PRODUCE FROM THE UNITED KINGDOM INTO SPAIN.

PRINCIPAL ARTICLES.	Three Months ending	
	Dec. 1887.	Dec. 1888.
Alkali	£ Cwts. 71,561	76,910
	£ Value £ 22,865	23,828
Caoutchouc, manufactures of	£ Value £ 6,361	5,578
Cement	£ Tons 1,464	2,715
	£ Value £ 2,519	4,711
Chemical products and preparations (including dyestuffs)	£ Value £ 11,827	14,678
Coal, products of (including naphtha and paraffin)	£ Value £ 1,657	5,871
Glass manufactures	£ Value £ 2,663	3,066
Manure	£ Value £ 12,822	26,257
Painters' colours and materials	£ Value £ 7,600	10,577
Paper of all sorts	£ Cwts. 1,475	718
	£ Value £ 3,091	1,903
Soap	£ Cwts. 696	679
	£ Value £ 609	684
Total Value	£ 766,805	785,767

STATISTICS.

BOARD OF TRADE RETURNS.

Exports.

	Compared with December 1887.		
	Total.	Increase.	Decrease.
	£	£	£
Articles of food and drink	720,791	..	111,902
Raw materials	1,209,735	223,841	..
Cotton manufactures	4,708,594	..	843,141
Linen manufactures	480,026	9,517	..
Woollen and worsted manufactures	1,622,217	..	384,420
Metals and ironwork	2,910,069	..	255,345
Machinery and millwork	1,101,988	65,778	..
Articles of personal use	875,860	..	58,570
All other articles	5,094,529	..	223,013
	18,811,209	216,136	1,887,391
Net decrease			1,571,255

Imports.

	Compared with December 1887.		
	Total.	Increase.	Decrease.
	£	£	£
Animals living	365,083	43,528	..
Articles of food and drink (duty free)	12,457,038	720,135	..
Articles of food and drink (dutiable)	2,711,394	270,526	..
Metals	2,022,363	..	1,040
Chemicals	501,463	..	194,710
Raw materials for textile manufactures	10,200,838	2,280,035	..
Raw materials for other industries	2,844,492	376,434	..
Manufactured articles	4,538,882	361,018	..
Miscellaneous articles	2,297,972	..	..
	37,940,625	4,051,676	285,024
Net increase		3,766,652	

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

1888.

18,749. W. Matthews and J. Yates, Manchester. Apparatus for producing spray. December 22.

18,750. M. Smith, Manchester. Apparatus for supplying fuel to boiler and other furnaces. December 22.

18,783. H. J. Hodges and W. T. Ramsden. See Class XVII.

18,808. W. A. Richards, Liverpool. Improvements in or apparatus relating to centrifugal filters. December 21.

18,860. H. J. Allison.—From the Casamajor Filter Co., United States. Apparatus for cleansing filtering media. Complete Specification. December 27.

18,917. E. K. Muspratt and J. H. Lewis, London. Improvements in apparatus or vessels for use in the absorption of gases by liquids. December 27.

18,918. V. Popp, London. Improved methods and apparatus for utilising compressed air for the production of cold. December 28.

18,951. G. C. Dymond.—From the Aerated Fuel Co., United States. Improvements in or relating to furnaces for utilising hydrocarbon as fuel, and in burners and operating devices applicable therefor. December 28.

18,957. R. Poole Roe, Liverpool. Improvements in apparatus for filtering water and other liquids. December 28.

19,057. E. Dobson, London. Improvements in apparatus or appliances for consuming or preventing smoke in furnaces. December 31.

1889.

34. T. Skitter, London. Improvements in apparatus for evaporating liquids. January 1.

81. W. Lawrence, London. Improvements in apparatus for distillatory and other purposes. January 2.

490. F. H. Danchell, London. Improvements in means or apparatus for separating solid matters from liquids. January 10.

676. P. de Mol and A. Gerken, London. Improvements in filters. January 14.

681. The Native Guano Co., Limited, and C. E. Robinson, London. Improvements in apparatus for measuring liquids. January 14.

785. H. H. Lake.—From J. M. Duncan, United States. Improvements in apparatus for evaporating brine, and for similar purposes. Complete Specification. January 16.

824. H. B. Higginson.—From H. P. Higginson, New Zealand. Improvements in or connected with apparatus for compressing air. January 16.

900. Fleming's Oil and Chemical Co., Limited, and G. H. Fenner. See Class II.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

1888.

18,678. F. R. Jones, Huddersfield. A new or improved method of and means for preventing the emission of smoke from mill or other chimneys. December 21.

18,682. W. J. Righton, London. Improvements in instantaneous water-heaters. December 21.

18,692. H. Darby, London. Improvements in apparatus for generating and burning gases from hydrocarbon oil and water. December 21.

18,950. J. R. Wicham, London. Improvements in illuminants for lighthouses, beacons, and like places. December 27.

18,918. J. Nimmo and J. Scotland, Glasgow. Improvements in the manufacture of coke, and in the ovens and apparatus employed therefor. December 27.

18,951. G. C. Dymond.—From the Aerated Fuel Co. See Class I.

1889.

50. C. F. Claus, London. Improvements in the production of mixtures of hydrogen and carbonic oxide, and in obtaining hydrogen, carbonic oxide or carbonic acid, each severally; also obtaining certain by-products. January 1.

90. S. G. Rhodes, London. Improvements relating to "fire-balls" for use as artificial fuel in gas stoves and grates. January 2.

111. W. F. Richards, Glyncollen. Improvements in the treatment of anthracite small coal or culm. January 3.

248. R. Clark and J. W. T. Stephens, Cardiff. Improvements in the manufacture of artificial fuel. January 5.

329. T. Wrench, Liverpool. Improvements in firelighters. January 8.

411. J. S. Chapman, London. Improvements in appliances and compositions to be used therewith, for lighting fires, and other lighting purposes. January 9.

531. E. Pierce and F. Mirks, Manchester. Improvements in appliances for and method of increasing the illuminating power of gas, oil, and similar lights. January 11.

599. J. T. Key, London. The manufacture of gas from water for manufacturing, illuminating, and other purposes. January 12.

703. H. S. Maxim, London. Improvements in and relating to apparatus for carburetting gas. January 14.

768. J. O. Spong, London. An improved construction of gas-carburetting apparatus. January 15.

900. Fleming's Oil and Chemical Co., Ltd., and G. H. Fenner, London. An improved construction of moulds for casting rectangular slabs of naphthalene or like material. Complete Specification. January 17.

905. W. B. Westlake, Swansea. Improvements in machinery or apparatus for the manufacture of perforated fuel. January 19.

1011. W. B. Westlake. Improvements in machinery or apparatus for the manufacture of perforated fuel. January 19.

COMPLETE SPECIFICATIONS ACCEPTED.*

1887.

17,799. H. Hutchinson, London. Apparatus for generating gas. January 2.

1888.

14,925. W. T. Walker. Apparatus for the purification of coal gas. January 2.

15,995. R. H. Michell. Method and means for consuming smoke and economising fuel. January 2.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

COMPLETE SPECIFICATION ACCEPTED.

1888.

6341. J. Imray.—From J. Bartsch, Germany. Treatment of coal to obtain separate products therefrom, and apparatus therefor. January 2.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

1888.

18,709. E. Edwards.—From Standert Brothers, Belgium. A new or improved blue dye. December 21.

18,859. J. H. H. Richez, London. Improvements in the manufacture of aniline blue. December 21.

1889.

16. A. Deninger, London. Improvements in the preparation of nitro and amido phenols from the corresponding amides. Complete specification. January 1.

388. W. G. Thompson and A. Rée, Middleton, Manchester. A new process for the manufacture of soluble colouring matters. January 9.

1046. B. Willeox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in and connected with the manufacture and production of unsymmetrical acid green. January 19.

COMPLETE SPECIFICATION ACCEPTED.

1888.

9280. C. Dreyfus. Production of new colouring matters for dyeing and printing. January 2.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATION.

1889.

66. H. W. Langbeck, Longton. A process for separating and utilising all valuable matter obtained by washing wool in various ways. January 2.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

1888.

18,717. E. O. Fankbanser, London. A new mordant for dyeing purposes. Complete Specification. December 21.

18,773. R. P. Frist, London. Improvements in linings for bleaching keirs, vats, dye tanks, and other analogous receptacles. Complete Specification. December 22.

18,780. H. Recker, London. An improved process of and apparatus for dyeing cotton yarn. December 22.

18,877. T. Fox Naylor and A. Naylor, Kidderminster. Dyeing banks of yarn. December 27.

18,904. J. Cowan, Glasgow. Improvements in and connected with indigo dyeing. December 27.

18,987. J. Pollard, Manchester. Improvements in apparatus for washing, scouring, bleaching, dyeing, and otherwise similarly treating textile fabrics. December 29.

1889.

197. J. Inray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, France. A process for dyeing with yellow, orange, and red azoic colouring matters. January 1.

216. W. Bracewell, Brinscail, Lanc. Improvements in apparatus for keirs used in bleaching and dyeing. January 5.

350. W. Mather.—From V. G. Bloede, United States. A process for tinting fabrics with fast colours. January 8.

351. W. Mather.—From V. G. Bloede. Improvements in processes for colouring and finishing cotton and other cheap fabrics. January 8.

552. W. Mather.—From V. G. Bloede. Improvements in processes for colouring or tinting fabrics. January 8.

553. W. Mather.—From V. G. Bloede. Improvements in processes for tinting fabrics and fibres. January 8.

376. W. L. Wise.—From M. von Gallois, Germany. Processes for the manufacture of new chrome mordanting substances, and for the application thereof for dyeing and printing purposes. January 8.

415. A. G. Salamon, London. Improvements in the bleaching of fibre. January 9.

508. H. Smith, Halifax. Improvements connected with dyeing essels employed for dyeing cloth or other fabrics. January 11.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

1888.

18,921. R. H. Steedman and A. J. Kirkpatrick, Glasgow. Improvements in reconvertng and utilising by-products such as are formed in processes for obtaining chlorine. December 28.

19,023. E. W. Parnell and J. Simpson, Liverpool. Improvements in the method of treating alkaline sulphides in solution, or an aqueous mixture of the same with carbonic acid gas for the production of sulphuretted hydrogen, and in apparatus therefor. December 31.

1889.

94. J. Hargreaves, T. Robinson, and J. Hargreaves. See Class IX.

214. R. Hodgson, Birmingham. A new or improved method of and apparatus for the manufacture of salt from brine by hot air and steam. January 5.

382. M. Williams, Liverpool. Improvements in the manufacture of barytes. January 9.

778. F. Maxwell-Lyte, London. Improvements in the production of chlorine and of hydrochloric acid. January 15.

881. R. H. Steedman and A. J. Kirkpatrick, Glasgow. Improvements in obtaining chlorine, and in reconvertng and utilising by-products of the processes. January 17.

1007. O. E. Pohl, Liverpool. Improvements in the manufacture of salt, and in apparatus and appliances employed therein. January 19.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

2920. F. Maxwell-Lyte. Production of basic lead salts for use as pigments and for other purposes. January 2.

3218. F. H. Gossage and T. T. Mathieson. Manufacture of the sulphides of sodium and potassium from their respective sulphates. January 2.

15,980. H. Albert, C. Fellner, and C. Ziegler. Apparatus in combination with furnaces for roasting pyrites, &c., containing sulphur, for obtaining the sulphurous gases given off therefrom. January 2.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

1888.

18,810. H. Faulkner, Walton-on-Thames. The imitation of polished marbles, granites, and other stones, and for the imitation of glazed tiles. December 24.

1889.

153. J. B. Adams, Barnsley. A method of and apparatus for making glass ball stoppers and solid or hollow articles from molten glass or suitable plastic or molten material. January 1.

161. T. Willett, London. Improvements in and machinery or apparatus for manufacturing plates and other articles in earthenware, china, and other plastic materials. January 1.

308. J. Hill and T. Hill, Fenton. A substitute for plaster of Paris in use for potters' moulds. January 8.

593. W. H. Grindley, Tunstall. Improved thimble for the placing of china and earthenware in enamelling kilns and glost oven saggars. January 12.

644. W. B. Fitch, London. Improvements in the manufacture of glass bottles and similar articles. January 12.

959. H. J. Haddan.—From the Josephine Glass Works, Germany. A process for the manufacture of glass resembling crystal, containing petrified moss or the like. January 18.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

1751. J. B. Gormeil-Bonmand. Production of designs on china, earthenware, and glass. January 2.

2184. E. Story and R. Panshon, London. Manufacture of glass. January 2.

16,153. J. Syer. Silvering glass. January 2.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

1888.

18,708, E. Edwards.—From F. Meyer, Germany. Improvements in waterproof roofing material. Complete Specification. December 21.

18,712, J. B. Spence, London. Improvements in the preservation of wood and other fibrous materials. December 22.

18,771, W. Millar, G. M. R. Layton, and T. Grover, London. Improvements in or relating to fire-proof building construction. December 22.

18,806, F. Hunsinger, London. An improved roofing tile. Complete Specification. December 27.

19,010, G. H. Sharpe and F. W. Turner, London. Improved manufacture of cement suitable as plaster, and for moulding purposes. Complete Specification. December 29.

1889.

91, J. Hargreaves, T. Robinson, and J. Hargreaves, Liverpool. Improvements in the treatment of lime refuse from alkali works to render it suitable for the manufacture of cement, and in apparatus employed therein. January 3.

116, R. Stone, London. Improvements in the manufacture and utilisation of cement and plaster, and in the machinery and appliances therefor. January 3.

961, C. J. Widmark, London. Improvements in the manufacture of cement. Complete Specification. January 18.

COMPLETE SPECIFICATION ACCEPTED.

1888.

1978, W. Joy. Manufacture of cement, and apparatus therefor. January 2.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

1888.

18,792, J. Clark, Birmingham. Improvements in obtaining aluminium and its alloys. December 22.

18,823, J. A. B. Bennett, Birmingham. Improvements in the manufacture of aluminium from aluminium sulphate or alums. December 24.

18,842, L. L. Burdon, London. Ingots for making seamless plated wire. Complete Specification. December 24.

18,919, B. Willeox.—From La Société Anonyme le Ferro-Nickel, France. Improvements in the manufacture of iron and steel alloyed with other metals. December 27.

18,928, W. Clifford, Sheffield. Improvements in the construction of safety-lamps for mines. December 28.

1889.

7, A. G. D. Cranshaw, London. Improvements in the manufacture of steel chain. January 1.

28, A. B. Cunningham.—From H. Havemann, France. Improvements relating to the extraction of gold, silver, and lead from substances containing the same, and to apparatus therefor. January 1.

77, E. A. Billault, London. The manufacture of jewellery, gold, and silversmiths' ware, buttons, and other ornamental objects for dress, furniture, &c., from sulphide of silver. January 2.

157, M. Breslauer, London. An improved alloy to serve as a substitute for silver. January 4.

149, J. W. Summers, Staleybridge. Improvements in the process of working scrap metal. January 4.

160, P. Evans, Liverpool. An improved coating for iron or steel and other metal plate, pipes, and other articles, and modes or means of and apparatus employed in the coating of such materials or articles. January 4.

187, P. M. Parsons, London. Manufacture or production of metallic alloys. January 4.

256, L. P. H. J. Mauchaire, London. Improved means and apparatus for treating gold, silver, and other ores. January 7.

281, A. B. Cunningham, London. Improvements in the manufacture of sodium and potassium. January 7.

311, S. Pope and J. Duce, London. Improvements in armour plates for ships and other structures. January 8.

322, W. Key, Glasgow. Improvements in and relating to gas furnaces, applicable for smelting and other purposes. January 8.

336, E. Britton, Birmingham. Improvements in boxes known as "box piles," to be employed in the converting of iron or steel scrap into bar or plate. January 8.

339, R. A. Hadfield, London. Improvements in the manufacture of steel. January 8.

345, C. N. B. Wetzelar.—From W. L. Carl, United States. A portable prospecting machine for use in mining and working on the dry process. January 8.

359, C. Netto, London. Improvements relating to the extraction of aluminium from cryolite and other substances. January 8.

477, A. G. Greenway, Liverpool. Improvements in the manufacture of zinc from hard spelter, zinc-iron, or galvanisers' dross. January 10.

590, G. Gatheral, London. Improvements in the treatment of copper precipitates. January 11.

597, S. O. Cowper-Coles and W. A. Thomas, London. Coating metals or their alloys with platinum. January 12.

659, C. A. Burghardt, Manchester. Improvements in the reduction of zinc and tin from their ores. January 14.

668, J. Wallis, Sheffield. Improvements in the manufacture of iron and steel, iron and steel forgings and castings. January 14.

739, R. S. Casson, London. Improvements in and connected with the casting of metals. January 15.

812, R. A. Hadfield and A. G. M. Jack, London. Improvements in the manufacture of common and other cast steel shells. January 16.

841, J. B. Haunay, London. Improved means of extracting precious metals from ores. January 16.

843, J. H. Selwyn, London. Improvements in hydro-metallurgical processes. January 16.

868, J. Hart, Middlesbrough. A new method of heating plates of steel, iron or any other metal. January 17.

890, R. Stanfield and T. Clarkson, London. An improved method and means for separating metals and heavy minerals from ores. January 17.

971, J. Y. Johnson.—From A. Imbert, France. Improvements in or connected with the reduction of metallic oxides, and the means or apparatus employed therein. January 18.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

3071, J. Pearson. Miners' safety-lamp. January 2.

11,340, H. Ostermann and C. Lacroix. A new metallic alloy. January 2.

11,941, H. Ostermann and C. Lacroix. A new non-magnetic metallic alloy. January 2.

14,511, W. H. Jenkins. Mining drills. January 2.

16,063, F. Tribbensee. Process for coating copper, iron, and other metallic vessels with lead. January 2.

16,872, A. Ritter von Klinkosch and I. Ritter von Klinkosch. Process and apparatus for making spoons and forks of silver and other metals and alloys. January 2.

17,270, M. Graff. Manufacture of steel. January 2.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

1888.

18,751, G. C. Dymond.—From C. Gassner, Germany. Improvements in or relating to galvanic batteries. December 22.

18,858, F. J. Brougham.—From La Société Perreux-Lloyd et fils, France. Improvements in electro-chemical generators. December 24.

18,881, L. Reuleaux, London. Improvements in the preparation of materials which have to be submitted either to voltaic heat or to electric heating, combined with electrolysis. December 27.

18,968, E. L. Zalinski and H. J. Smith. See Class XXII

18,978. T. W. Bush, Broseley. An oblique meshed grid plate for storage batteries. December 29.

18,981. M. Doubleday, Nottingham. An inner expanded chamber grid plate for storage batteries. December 29.

18,991. M. Doubleday, Nottingham, and T. W. Bush, Broseley. A bent plate storage battery. December 29.

18,991. G. C. Dymond.—From J. M. A. G. Lésenyer, France. Improvements in and appertaining to the manufacture of metals or metallic alloys by means of electricity. December 29.

19,034. W. J. S. Barber-Starkey, Manchester. Improvements in secondary voltaic batteries. December 31.

19,047. R. W. Hewett. See Class XVI.

19,058. J. Y. Johnson.—From F. Gendron, France. Improvements in electric batteries. December 31.

19,061. A. Cornwell, London. An improvement in materials to be used in galvanic batteries. December 31.

1889.

85. A. Poleschko, London. Improvements in dynamo-electric machines. January 2.

126. G. B. Luckhoff, London. An improvement in or relating to dynamos. January 3.

319. W. P. Kookogey, London. Improved apparatus and connections for charging and discharging storage batteries. Complete Specification. January 8.

320. W. P. Kookogey. Improved methods of preparing solution compounds for galvanic batteries. Complete Specification. January 8.

361. H. H. Lake.—From E. Thomson, United States. Improved methods of and apparatus for welding, shaping, and otherwise working metals by the aid of electricity. Complete Specification. January 8.

362. H. H. Lake.—From E. Thomson. Improved methods of and apparatus for welding, shaping, and otherwise working metals by the aid of electricity. Complete Specification. January 8.

377. H. H. Lake.—From E. Thomson. Improvements relating to the riveting of metal plates and other objects by the aid of electricity. Complete Specification. January 8.

435. J. H. Holmes, Newcastle-on-Tyne. Improvements in dynamo-electric machines. January 9.

485. H. E. Newton.—From D. Piedrahita, France. Improvements in electric generators. January 10.

588. B. M. Drake and J. M. Gorham, London. Improvements in secondary batteries. January 12.

746. O. Lugo, London. Improvements in and relating to electric secondary batteries or accumulators. Complete Specification. January 15.

813. W. Diehl, London. Separation of aluminium and its alloys from its fluorides by electric or by chemical metallurgic process. January 16.

907. T. Cuttriss, Leeds. Improvements in secondary or storage batteries. January 19.

1031. J. W. King, London. Improvements in dynamo-electric machines. January 19.

COMPLETE SPECIFICATION ACCEPTED.

1888.

8700. L. M. J. C. C. Renard. Electric batteries. January 2.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

1888.

18,782. R. Stone, London. Improvements in the manufacture of soap. December 22.

18,852. H. H. Lake.—From La Société Anonyme des Parfums Naturels de Cannes, France. Improvements relating to the purification of fatty substances, and to apparatus therefor. December 21.

18,857. H. H. Lake.—From La Société Anonyme des Parfums Naturels de Cannes. Improvements relating to the purification of fatty substances, and to apparatus therefor. December 21.

18,934. R. Hunt, Liverpool. Improvements in the purification of cotton-seed, rape-seed, and linseed oils, and foots and discoloured greases. December 28.

19,015. G. T. Bishop, London. Improvements in apparatus to be employed in the manufacture of soap. December 29.

1889.

854. F. W. Longhurst, London. Improvements in the manufacture of soap. January 16.

903. O. Hehner, London. A process for removing odour and taste from oils and fats. January 17.

COMPLETE SPECIFICATION ACCEPTED.

1888.

2971. W. T. Lawson. An improved compound for washing purposes. January 2.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

1888.

18,705. H. B. Condy, London. Improvements in or relating to the manufacture of white lead. December 21.

18,716. C. Morfit, London. An improvement in the manufacture of resin liquor for paper makers and others. December 21.

1889.

722. J. Y. Johnson.—From G. Fell, New York. Improvements in the manufacture or production of lead pigments. Complete Specification. January 15.

847. E. Edwards.—From A. E. Mornard, France. An improved composition for facilitating the application and preservation of paint or varnish upon cement or other materials. January 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

2920. F. Maxwell-Lyte. See Class VII. January 2.

5399. R. Stone. Manufacture of paint. January 2.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

1888.

19,002. E. Edwards.—From J. E. Pechinot, France. Improvements in the utilisation of leather, and in its treatment for the purpose of such utilisation. December 29.

1889.

645. H. E. Frendenberg, London. Improvements relating to the treatment of hides and skins, and to apparatus therefor. January 12.

880. H. Belcher, London. Improvements in the treatment of skins and hides for the preparation of leather. January 17.

XV.—AGRICULTURE, MANURES, Etc.

APPLICATIONS.

1888.

18,905, P. M. Justice.—From W. J. Williams, United States. Improved method of manufacturing nitrogenous fertilisers from phosphates of iron and alumina. Complete Specification. December 27.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

1888.

18,722, W. T. Crooke, Stratford. Improvements in pockets or bags employed in the manufacture of sugar and like substances, together with an improved process for cleansing the same. December 22.

18,872, E. J. Ball, London. Improvements in the manufacture of sugar. December 26.

18,952, C. D. Abel.—From E. Kiderlen, E. Kiderlen, jun., and J. W. Van Leenhoff, Holland. Improved treatment of syrups for the removal of impurities therefrom. December 28.

19,347, R. W. Hewett, Handsworth. A new or improved method of refining sugar by electricity. December 31.

1889.

75, O. Lenz, London. Process for manufacturing crystallised maltose. Complete Specification. January 2.

76, O. Lenz. Process for manufacturing colourless maltose syrup. Complete Specification. January 2.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

1888.

18,783, H. J. Hodges and W. T. Ramsden, London. Improvements in cooling beer and other liquids, and apparatus connected therewith. December 22.

1889.

83, W. Lawrence. See Class I.

86, O. Inray.—From A. Bergh, Denmark. Improved process for aerating and purifying beer worts and beer, and apparatus therefor. January 2.

221, A. Perry, London. Improvements in the treatment or preparation of rice and other grain or cereals for brewing and other purposes, and in means or apparatus employed therein. January 5.

770, H. E. Sorel, London. Improvements in the treatment of commercial alcohols. January 15.

883, H. MacLagan, New York. Distilling volatilisable liquids from a mash or mixture. January 17.

962, A. Malzy, London. Improved alcoholic beverages. January 18.

COMPLETE SPECIFICATION ACCEPTED.

1888.

16,885, H. H. Lake.—From J. W. Free. Apparatus for the manufacture of malt. January 2.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

1888.

19,009, J. L. Johnston, London. Further improvements in the preparation and combination of animal substances for use as food. December 29.

1889.

163, E. Pott, Munich. The preservation of eggs and of all other articles of food. January 1.

163, H. S. Wellcome, London. An improved dry preparation of tea or coffee. January 4.

255, G. Christopher and R. W. Leftwich, London. Improvements in the preparation of the extracts of tea and coffee. January 7.

771, G. D. Wheaton, London. Improved means of effecting the preservation of materials of a perishable nature. January 15.

1033, W. G. Pursell, Glasgow. Improvements in and relating to the treating and preserving of fish. January 19.

B.—SANITARY CHEMISTRY.

1888.

18,719, W. Warner, London. Improvements in the means of and apparatus for treating refuse. December 21.

18,791, J. Chabanel, London. Improved apparatus for separating, filtering, and disinfecting fecal matters. December 22.

1889.

412, U. A. Smith, London. An improved system of sewerage. January 9.

413, U. A. Smith. An improved system of sewerage. January 9.

C.—DISINFECTANTS.

1888.

18,775, W. B. Giles, A. Shearer, and F. G. A. Roberts, London. Improvements in the manufacture or production of bisulphite and meta-bisulphite of sodium or potassium. Complete Specification. December 22.

1889.

204, R. Hannan and W. Paterson, Glasgow. Sanitary ink, being an antiseptic and deodorising compound for application to paper or any other material in printing or otherwise. January 5.

397, R. Hannan and W. Paterson. See Class XIX.

COMPLETE SPECIFICATION ACCEPTED.

A.—CHEMISTRY OF FOODS.

1888.

2426, W. Peacock. Apparatus to be employed in effecting the preservation of fruit, meat, fish, or other perishable articles of food. January 2.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

1888.

18,690, E. N. Hilher and J. C. Hetherington, London. Improvements in the manufacture or treatment of paper for copying letters and other documents. December 21.

18,693, G. Fry, London. An improved apparatus for washing paper pulp and similar substances. December 21.

18,716, C. North. See Class XIX.

18,753. L. Pictet, London. Improved method of sorting the disintegrated wood for the manufacture of cellulose, and apparatus therefor. December 22.

18,765. J. C. Hetherington.—From E. Rammerstein, Austria. Improvements in the manufacture or treatment of paper for copying letters and other documents. December 22.

18,795. W. Searle, London. Improvements in the preparation of paper to be used for copying letters and other writing. December 22.

1889.

108. C. Herbert, Glasgow. Improvements in apparatus for cleaning, staining, and pressing paper pulp or similar pulp. January 3.

295. H. J. Medbury, Glasgow. Apparatus for manufacturing tubes, pipes, and like articles from pulp. Complete Specification. January 8.

363. W. H. Cook, London. A novel application of pulped paper stock. Complete Specification. January 8.

397. R. Hannan and W. Paterson, Glasgow. A sanitary paper being deodorising and disinfectant. January 9.

COMPLETE SPECIFICATION ACCEPTED.

1888.

17,227. H. H. Lake.—From C. H. Atkins. Apparatus for removing metallic particles from paper pulp. January 2.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATION.

1889.

741. A. F. Y. Schwartz and F. H. Mercklin, London. Improvements in the production of films sensitive to light, and of materials for assisting or continuing the effect of light on photographic films. January 15.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

1888.

18,366. A. Melville, London. Improvements in the manufacture of explosive mixtures. December 28.

18,367. A. Melville, London. Improvements in the manufacture of explosive mixtures. December 28.

18,968. E. L. Zalinski and H. J. Smith, London. Improvements in, and relating to electric primers or igniters for blasting or firing mines, torpedoes, projectiles, guns, and the like. December 28.

1889.

39. A. Martin, London. Improvements in percussion fuses for explosive projectiles. January 1.

236. R. S. Lawrence, London. Improved methods or means of treating high explosives, such as dynamite, and for the utilisation, protection, and firing of such explosives in projectiles, torpedoes, cartridges, and the like. January 5.

511. T. Martin, "La Fosse Andre," Guernsey. Improvements in rifle cartridges, time fuses, and the development of explosives in charges. January 11.

635. R. H. Heenan, London. Improvements in apparatus for charging cartridges with pulverulent explosive. Complete Specification. January 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

1439. A. V. Newton.—From A. Nobel. Explosive compounds. January 2.

1470. A. V. Newton.—From A. Nobel. Manufacture of safety fuses. January 2.

2723. J. Pann. Ships' signal lights and similar fireworks. January 2.

THE JOURNAL

OF THE

Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 2.—Vol. VIII.]

FEBRUARY 28, 1889.

[Non-Members 30/- per ann.; Members 21/- per Set of Extra or Back Nos.; Single Copies 2 6.]

The Society of Chemical Industry.

Past Presidents:

Sir H. E. Roscoe, M.P., LL.D., V.P.R.S.	1881—1882.
Sir Frederick Abel, C.B., D.C.L., F.R.S.	1882—1883.
Walter Welton, F.R.S.	1883—1884.
W. H. Perkin, Ph.D., F.R.S.	1884—1885.
E. K. Muspratt	1885—1886.
David Howard	1886—1887.
Prof. James Dewar, F.R.S.	1887—1888.

COUNCIL FOR YEAR ENDING JULY, 1889.

President: Ludwig Mond.

Vice-Presidents:

Sir I. Lowthian Bell, F.R.S.	David Howard.
R. Forbes Carpenter.	Ivan Levinstein.
Prof. F. Clowes, D.Sc.	E. K. Muspratt.
Sir J. Neilson Cuthbertson.	Sir H. E. Roscoe, M.P., F.R.S.
Prof. James Dewar, F.R.S.	Prof. W. A. Tilden, F.R.S.
Dr. John Evans, F.R.S.	John Williams.

Ordinary Members of Council:

Alexander M. Chance.	F. J. Rowan.
James Duncan.	Dr. Edward Schunck, F.R.S.
A. E. Fletcher.	E. C. C. Stanford.
S. H. Johnson.	J. C. Stevenson, M.P.
B. E. R. Newlands.	T. W. Stuart.
B. S. Proctor.	Thos. Tyrer.

With the Chairmen and Secretaries of Sections.

Honorary Treasurer:

E. Rider Cook, East London Soapworks, Bow, E.

Honorary Foreign Secretary:

Dr. Ferdinand Harter.

General Secretary: Charles G. Cresswell.

Offices:

Palace Chambers, 9, Bridge Street, Westminster, S.W.

THE JOURNAL.

Publication Committee:

The President.

Sir F. A. Abel, F.R.S.	Prof. A. K. Huntington.
A. H. Allen.	F. Harter, Ph.D.
Prof. H. E. Armstrong, F.R.S.	F. Jones, F.R.S.E.
G. H. Bailey, D.Sc., Ph.D.	Ivan Levinstein.
Joseph Bernays, M.I.C.E.	Prof. R. Meldola, F.R.S.
H. Brunner.	E. K. Muspratt.
W. Lant Carpenter.	C. O'Sullivan, F.R.S.
Prof. Frank Clowes, D.Sc.	John Pattinson.
W. Y. Dent.	W. H. Perkin, Ph.D., F.R.S.
Prof. Jas. Dewar, F.R.S.	Sir H. E. Roscoe, M.P., F.R.S.
John Heron.	John Spiller.
D. B. Hewitt, M.D.	A. Norman Tate.
David Howard.	Thomas Tyrer.
Prof. J. J. Hummel.	

Editor:

Watson Smith, The Owens College, Manchester.

ASSISTED BY THE FOLLOWING STAFF OF

Abstractors:

T. L. Bailey, Ph.D.	W. E. Kay.
G. H. Beckett.	A. J. King, B.Sc.
D. Bendix.	F. S. Kipping, D.Sc.
E. Bentz.	Chas. A. Kohn, Ph.D.
E. E. Berry.	F. W. T. Krohn.
E. J. Bevan.	T. A. Lawson, Ph.D.
Bertram Blount.	J. Walter Leather, Ph.D.
Arthur G. Bloxam.	A. Liechmann, Ph.D.
C. H. Bothamley.	D. A. Louis.
E. G. Clayton.	W. Macnab.
Julius B. Cohen, Ph.D.	G. Harris Morris, Ph.D.
C. F. Cross.	J. M. H. Munro, D.Sc.
A. R. Davis.	H. T. Penternmann.
W. W. Haldane Gee, B.Sc.	S. G. Rawson, B.Sc.
C. Napier Hake.	A. Rée, Ph.D.
S. Hamburger, Ph.D.	F. W. Renaut.
Oswald Hamblin.	A. Studer, Ph.D.
John Heron.	Bertram Thomas.
Bertram Hunt.	Eustace Thomas.
C. C. Hutchinson.	V. H. Veley, M.A.
D. E. Jones, B.Sc.	R. Lloyd Whiteley.
	A. Wingham.

NOTICES.

Members who require back numbers are requested to make application only to the General Secretary.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

Notice is hereby given, for the information of subscribers for this Journal, that Messrs. EYRE and SPOTTISWOODE, Her Majesty's Printing Office, East Harding Street, London, E.C., have been appointed sole agents for the supply of the Journal to non-members and the trade.

IMPERIAL INSTITUTE.

The following BALANCE SHEET in regard to SUBSCRIPTIONS from FELLOWS of the CHEMICAL SOCIETY, INSTITUTE of CHEMISTRY, and SOCIETY of CHEMICAL INDUSTRY to the IMPERIAL INSTITUTE, has been furnished to the SOCIETY by DR. W. J. RUSSELL, F.R.S., Treasurer to the Fund.

	£ s. d.		£ s. d.
Subscriptions received from March 2nd, 1887, till July 14th, 1888.....	364 4 0	Printing circulars, notices, &c.	28 13 6
		Stationery	0 11 11
		Treasurer's stamps and drafts	0 11 2
		Bank charges on drafts	0 2 6
		Balance paid to Imperial Institute.	334 4 11
	<u>£364 4 0</u>		<u>£364 4 0</u>

Certified as correct,

F. A. ABEL,
Organising Secretary,
Imperial Institute.

W. J. RUSSELL,
Treasurer.
February 6, 1889.

LIST OF MEMBERS ELECTED, 22nd FEBRUARY, 1889.

Adamson, G. P., Easton, Pa., U.S.A., manufacturing chemist.
Baker, Jno. T., Easton, Pa., U.S.A., manufacturing chemist.
Bull, Henry J., 18, Ezerion Terrace, Ardwick, Manchester, chemist.
Burlon, J. Montague Chas., Mostyn Street, Llandudno, North Wales, pharmaceutical chemist.
Chaster, Jno. E., 13, West Scotland Street, Kinning Park, Glasgow, electro-chemical engineer.
Clapperton, Jas., 25, Queen Square, Regent Park, Glasgow, chemical student.
Cockrell, E., Gordon, 17, Grosvenor Chambers, Deansgate, Manchester, oil manufacturer.
Coffey, Eneas H., 111, Grosvenor Road, Pimlico, S.W., distiller.
Cooper, Astley, The Terrace, Beeston Hall, Leeds, analytical chemist.
Fuller, Chas. D., Braddock, Pa., U.S.A., chemist to Edgar Thompson furnaces.
Gee, W. W., Haldane, Owens College, Manchester, lecturer on physics.
Glossop, W. Dale, 93A, Portland Street, Manchester, paper merchant.
Hay, Alex., Kirby Villa, Arboretum Avenue, Lincoln, manufacturing chemist.
Hopkins, Thos. J., Cradle Bridge Works, Trowbridge, Wilts, engineer.
Klipstein, August, 52, Cedar Street (P. O. Box 2833), New York, U.S.A., chemical manufacturer.
Leach, Walter, Stephenson's Buildings, Sunbridge Road, Bradford, Yorks, analyst.
Low, Wilson H., c/o N. K. Fairbank & Co., 18th and Blackwell Streets, Chicago, Ill., U.S.A., chemist.
MacEwan, Peter, 42, Cannon Street, London, E.C., and 1, Gresley Road, Hornsey Lane, N., pharmacist and journalist.
Mawdsley, W. H., 8, Eaton Road, Chester, chemist.
Neil, Jas., c/o North British Chemical Co., Clydebank, Glasgow, assistant chemist.
Oldroyd, Geo. H., Sprinkwell Mills, Dewsbury, manufacturer.
Orchard, John, 100, High Street, Kensington, W., chemical engineer.
Richardson, S. M., 415, Main Street, Bonhill, N.B., analytical chemist.
Tasker, Geo., 2, Marchmont Terrace, Langside, Glasgow, analytical chemist.
Trechmann, A. O., Cliff Terrace, Hartlepool, analytical chemist.
Underhill, Thos. J., H. M. Victualling Yard, Deptford, S.E., clerk.

Walker, Jno. Cameron, 190, West Regent Street, Glasgow, analytical chemist.
Wesson, David, c/o N. K. Fairbank & Co., 225, 18th Street, Chicago, Ill., U.S.A., chemist.
Woolf, Mortimer, 3, Accl Road, West Hampstead, N.W., vinegar brewer.
Yule, Wm., Hendon Paper Works, Sunderland, analytical chemist.

CHANGES OF ADDRESS.

Bechler, Dr. M.; Journals to Manbré Saccharine Co., Ltd., Fulham Palace Road, Hammersmith, W.
Bramham, Wm., 1/o 82; 115, Bow Road, E.
Dibdin, W. J.; Journals to Mayfield, Grange Road, Sutton, Surrey.
Earle, G. Peplow, 1/o Lee; Garnston, New Eltham, Kent.
Edmonds, H. R., 1/o East 27th Street; 334, East 28th Street, New York, U.S.A.
Elliott, A. H., 1/o Broadway; College of Pharmacy, 209—213, East 23rd Street, New York, U.S.A.
Gilechrist, P. C.; Journals to Ruscombe, Willoughby Road, Hampstead, N.W.
Hatton, W. P., 1/o North Kensington; c/o W. R. Hatton & Sons, Wernwood Scrubs, W.
Hilditch, Thos., 1/o Cedar Grove; 12, Brownsville Road, Heaton Chapel, Stockport.
Hodgkins, Jno.; Journals to c/o Messrs. Hopkin and Williams, 16, Cross Street, Hatton Garden, E.C.
Horrocks, S., 1/o Southport; 4, Wellesley Terrace, Prince's Park, Liverpool.
Howarth, R. H.; Ferguslie (not Fergustie) Threadworks, Paisley, N.B.
Jackson, R. Valentine, 1/o Crosshill; c/o A. S. Boyd, 257, West George Street, Glasgow.
Jago, Wm.; Journals to 32, Clarendon Villas, Brighton.
Joyson, F.; Journals to 24, Noel Road, Edgbaston, Birmingham.
MacEwan, Peter; Journals to 4, Gresley Road, Hornsey Lane, N.
Macnab, Wm., 1/o East India Avenue; 14, Great Smith Street, Westminster, S.W.
Mahon, R. W., 1/o Camden; Rose Polytechnic Institute, Terre Haute, Indiana, U.S.A.
Neilson, Jas.; Journals to 107, High John Street, Glasgow.
Paul, F. W., 1/o Hope Street; Hallside Steelworks, Newton-by-Glasgow.
Perkin, Dr. W. H., jun., 1/o Lonsdale Terrace; Heriot Watt College, Edinburgh.
Redmayne, J. M.; 26 (not 27), Grey Street, Newcastle-on-Tyne.
Roseow, J., 1/o Fairview; Durnlea, Littleborough, Lancashire.
Smith, A. J., 1/o Elswick; 50, Hanover Street, Brookhill Park, Plumstead, S.E.
Tomlinson, G. G.; Journals to c/o F. Tomlinson, Parr's Bank, Widnes.
Trechmann, A. O., 1/o Stockton; Cliff Terrace, West Hartlepool.
Wilson, Frank H., 1/o Lane, Alkali Company; 71, Oakland Street, Widnes.
Winham, A.; Journals to Metallurgical Laboratory, Royal School of Mines, South Kensington, S.W.
Wood, W., Copland, 1/o Avenue Cottage; Rosshead, Alexandria, Dumbartonshire.
Woolf, Mortimer, 3, Accl (not Aere) Road, West Hampstead, N.W.

NAMES WRONGLY OMITTED FROM LIST OF MEMBERS.

Galbraith, Wm., c/o Shelton Iron and Steel Company, Stoke-on-Trent.
Hill, A. Bowdler, 101, Southwark Street, London, S.E.
Robinson, A. E., 7, West End Chambers, Broad Street Corner, Birmingham.

Death.

Silva, Prof. R. D., 26, Rue de la Harpe, Paris. February 9th.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	R. Messel.
H. E. Armstrong.	B. E. R. Newlands.
W. Lunt Carpenter.	E. Redwood.
W. Crowder.	T. Royle.
W. J. Dibdin.	John Spiller.
C. Graham.	Wm. Thorp.
S. Hall.	C. R. Alder Wright.
C. C. Hutchinson.	

Hon. Local Sec. and Treasurer:

Thos. Tyrer, Garden Wharf, Battersea, S.W.

SESSION 1888-89.

The Fifth Meeting of the Section will take place on Monday, March 4th, 1889.

Discussion.—"In what direction is State Aid needed to assist Technical Education in Chemistry?"

Messrs. Higgins and Heron's paper on "Cider" is postponed.

Monday, April 1st, 1889.

Dr. Percy F. Frankland. "The Action of Water on Lead."

Meeting held Monday, February 4th, 1889.

MR. DAVID HOWARD IN THE CHAIR.

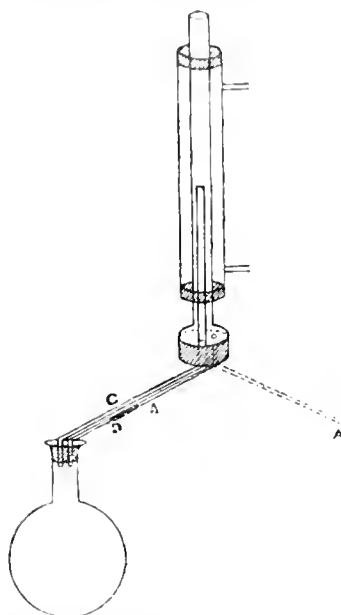
APPARATUS FOR BOILING WITH REFLUX CONDENSER, AND DISTILLING WITHOUT ALTERING THE POSITION OF THE CONDENSER.

BY J. WALTER LEATHER, PH.D.

It is frequently required to first boil a liquid with an inverted condenser, and then to distil off some portion or the whole of the contents of the flask. The moving of the condenser to perform the second operation after the first has been completed, is always somewhat inconvenient, and, in order to avoid this, I have devised the following arrangement:—

The condenser is fixed perpendicularly, as in the above drawing. The lower end of the inner tube has a wide mouth, into which is inserted an india-rubber stopper. The distilling-flask is placed at the side (on the water-bath or tripod stand). Into the stopper of the latter pass two glass tubes. One of these, C, is bent obliquely towards the condenser, and passes through the centre of the india-rubber stopper of the condenser tube, and as far as the centre of the same. The other tube, A, which is bent parallel to C, is divided at the point D. It reaches only just to the upper surface of the condenser-stopper. The junction at the point D is (in the case of boiling with reflux condenser) made by means of a piece of thick-walled india-rubber tube. If, now, the liquid in the flask be made to boil, the vapour passes away up both the glass tubes into the condenser. By the one, C, it passes direct to the centre of the condenser, and the condensed liquid runs down towards the other tube. Vapour from the boiling liquid comes

also into the condenser by means of the other tube, A, but this tube acts in addition as a carrier of the condensed liquid back into the flask again.



When it is required to distil off any portion of the liquid in the flask, it is merely necessary to disconnect the tube A at D by sliding back the india-rubber joint, and to turn tube A round to any position, e.g., A', which may be convenient for connecting with the receiver. At the same time a small cap of india-rubber is fixed over the open end of the short tube at D. The boiling being recommenced, the vapour passes only through C into the condenser, and the condensed liquid passes out through tube A'.

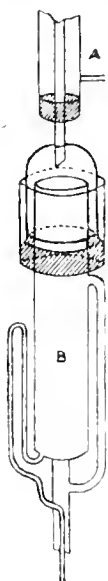
MODIFICATION OF SOXHLET'S EXTRACTOR.

BY J. WALTER LEATHER, PH.D.

The ordinary form of Soxhlet's extractor is attached to the condenser by means of a cork. It is, however, frequently difficult to get good corks, some being so hard as to split the upper part of the extractor, while other descriptions are so porous as to permit the water, which generally collects on the condenser and trickles down to the cork, to enter and thus render the ether extremely wet.

For the idea of substituting a mercury connexion for the cork I am indebted to my friend Dr. Vieth, and I am now able, after several months' trial, to give a description of a mercury connexion which answers the purpose well. In the accompanying sketch, A is the lower part of the condenser, B is the Soxhlet's extractor. On to the lower end of the condenser tube I have had a bell-shaped mouth blown, which is just so wide that it passes readily over the upper end of the extractor, and the end of the condenser tube passes a short way inside the bell-mouth, so that the condensed ether drops directly on to the substance which is being extracted. At the upper part of the extractor is a piece of glass tube,

so wide that it passes readily over the bell-mouth of the condenser, and which is fixed at its lower part (that shaded in the drawing) to the extractor by means

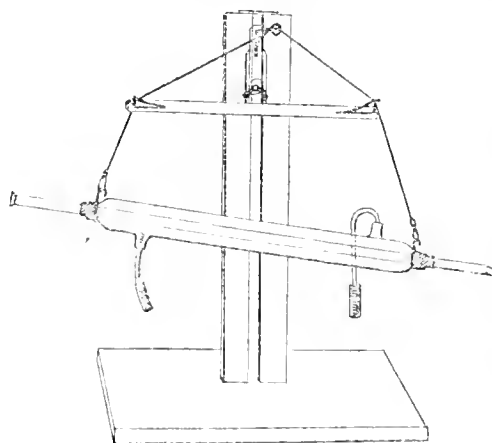


of cement. An india-rubber ring also makes a good joint in place of cement, but it is generally difficult to get one the exact thickness. This wide tube, together with the extractor, forms a ring-cup into which the bell-mouth of the condenser may pass. The ring-cup is filled about half full of mercury and forms, when the extractor is pushed up under the condenser, a perfect joint. The extractor may be held in position by means of a clamp, or it may be readily suspended from the condenser by copper wire.

DISCUSSION.

The CHAIRMAN said that he had been greatly interested by the apparatus shown by Dr. Leather. Suggestions for the improvement of such apparatus were always welcome, especially if, as was always possible, they could be adapted to purposes other than those for which they were specially designed.

Mr. A. H. ALLEN then described the following improved form of condenser stand, devised by Mr. W. Chattaway and himself:—



which allowed the condenser to be reversed at any moment without disconnecting the distilling flask, while it permitted of the contents of the latter being agitated whenever desired. This was done by hanging the condenser from a stout leather thong which passed over three small brackets attached to a piece of wood working vertically in a slot in the stand. The thong could be fixed by means of a screw at the end of the centre bracket. In practice the arrangement had proved very efficient and convenient.

SOME INDUSTRIAL APPLICATIONS OF OXYGEN.

BY L. T. THORNE, PH D.

Now that the work carried out during the last few years, under the auspices of Brin's Oxygen Company, has resulted in the solution of the long-mooted problem of the preparation of oxygen on the large scale at a price which should bring it within the range of industrial applications, it may be of interest to call attention, very briefly, to one or two such applications which have up to the present been investigated.

But before entering on the consideration of these applications it will probably be well to refer, in a few words, to the present position of oxygen production. For though Boussingault's classical researches pointed undoubtedly to the atmosphere as the source for oxygen, and to barium oxide as the medium for its extraction, the practical difficulties of the process—one of the chief amongst which was the gradual diminution of the absorptive power of the oxide for oxygen—have hitherto prevented its being practically carried out.

The last-named difficulty having been overcome by taking special precautions to obtain the baryta employed in a suitable physical condition, and to suitably purify the air from carbonic anhydride and moisture, the further difficulties of economical heating and of converting a small laboratory experiment into a commercially practical process had to be grappled with.

As the present paper does not purport to be on the production of oxygen, but on its applications, it is unnecessary to follow the development of the process in all its details. Suffice it to say the difficulties have been so far overcome that, including all costs, the production of oxygen by this process will certainly not exceed 7s. 6d. per 1,000 cubic feet in London. In the manufacturing districts, where coal and labour is much less than in London, the cost will be reduced to about 5s., and in gasworks and other places, where special facilities as to fuel, power, &c. exist, the cost will be still further reduced.

The furnaces now in use are of several kinds, the retorts being placed in some horizontally, in others vertically. One recent modification, that may in many circumstances prove very advantageous, is the adoption of a constant temperature for the furnace and retorts.

The temperature employed lies between the temperature most suitable for oxydation and that most fitted for deoxydation, the air being pumped in during oxydation under a pressure of from 15 to 20 lbs. on the square inch, and the oxygen drawn off by means of a vacuum. Under these circum-

stances neither the oxydation nor deoxydation of the baryta is so complete as when varying temperatures are employed, and the yield of oxygen per operation is in consequence much smaller. Still the change of pressure is sufficient to determine a certain variation in the state of oxydation of the baryta, and this is aided to some extent by the cooling effect, during oxydation, on the baryta of the cold air pumped in. And though the yield of oxygen per operation is small—about 1 ft. per lb. of baryta used, against about 7 where the temperature is changed—the number of operations per day is so much increased, and the manipulation so much simplified, that this form of furnace will under most circumstances be more advantageous than the older form.

Turning now to the applications of oxygen, I would take the opportunity to apologise for bringing this subject before the Society in its present unfinished state. When at the beginning of the session I undertook to read a paper before you, I fully hoped that the chemical or theoretical side of the questions to be treated of would ere this have been worked out. Owing to press of work, however, the necessary laboratory experiments have not yet been completed. Nevertheless, I thought it best to lay before you the facts already ascertained, and trust at a future time to be allowed to return to the subject when further research has given more definite insight into the rationale of the various processes.

The use of Oxygen in Bleaching.

It is of course well known that in the bleaching of natural colouring matters by chlorous bleaching agents, the true bleaching agent is in almost all cases oxygen. But all attempts to employ free oxygen in the place of chlorine or chlorine compounds have hitherto proved unavailing, except perhaps in the open bleach-field, where the action of the oxygen is aided by sunlight. The opinion has therefore grown up that before oxygen can become an active bleaching agent, it is necessary for it to be in a nascent state, or at least in its active form of ozone. Experiments recently made have shown, however, that this opinion is only justified up to a certain point; for though all attempts to bleach by the action of free oxygen alone—whether at high or low temperature, or under normal or increased pressure—were unsuccessful, it was found that when used in conjunction with chlorine or bleaching powder, oxygen possesses a most decided bleaching power. The experiments were made with paper pulps—wood, straw, esparto, and jute or gunny—and also with raw jute, jute yarn and cloth, and cotton cloth. The results were similar in all cases, but since, as yet, the experiments on yarns and cloths have been confined to the laboratory, the remarks in the present paper will be mainly confined to the bleaching of paper pulps with which experiments have been carried out on a practical scale.

When a stream of oxygen was passed into a mixture of paper pulp and solution of bleaching powder, it was noticed that the de-colouration of the pulp proceeded much more rapidly than was the case when no oxygen was used. At first it was thought that this might be due to the mechanical stirring effect of the current of oxygen. A stream of nitrogen was therefore substituted for the oxygen, but the result was a retardation of the bleaching. A current of air was then tried, the effect being that the rate of bleaching was almost exactly the same as when bleaching powder solution was alone used. When equal volumes and strengths of solution and weights of

pulp were used, the residual liquid from the oxygen experiment always contained, after the bleaching was complete, more available chlorine than either of the others. It thus became clear that oxygen produced a beneficial, nitrogen a detrimental effect, whilst the apparent inaction of the air current was probably due to the effects of the oxygen and nitrogen neutralising one another.

Experiments were now undertaken in a closed churn, and it was found that when using about 28 lbs. dry pulp, mixed with a solution of bleaching powder, from 6 to 8 ft. of oxygen might be slowly passed into the churn without any increase of internal pressure being shown. When nitrogen was passed in, the pressure began to rise immediately, and when the excess of nitrogen was allowed to escape, it was found to be strongly charged with chlorine. When air was used the pressure rose steadily but more slowly than with nitrogen, and the excess of gas was found to contain but little oxygen, but to be strongly charged with chlorine. There could thus be no doubt that the oxygen was actually used up and helped to effect the bleaching, whilst the nitrogen was not only without bleaching effect, but when escaping from the liquid carried away with it part of the chlorine which is constantly being set free in a solution of bleaching powder. And even with oxygen the absorption was limited, and if too much was passed in or it was admitted too rapidly, pressure rose at once and the excess was not only useless but detrimental.

Further experiments showed that not only did a stream of oxygen accelerate the bleaching, but that it very considerably reduced the quantity of bleaching powder necessary. In a large number of experiments the saving of bleach which was effected ranged from 40 to 50 per cent., the saving being greater the finer the state of division of the oxygen on entering the pulp and the more intimately it was brought in contact therewith.

But it is one thing to make a laboratory experiment, another to carry the experiment into practice, and the above detailed results had yet to stand the test of practical working. Arrangements were therefore made to test the process on a large scale at a paper mill. Two large open potchers, each capable of carrying nearly a ton of straw or esparto, were fitted with a finely perforated tube running across the potcher just in front of the beater, and the whole of the pulp bleached in these two potchers during five days was treated, the total amount being over 50 tons of esparto, straw, &c. The conditions of the trial were disadvantageous to the process, since the potchers being open with only about 20 inches head of water, it was difficult to bring the oxygen intimately into contact with the grass and to prevent a large quantity of it escaping. In order to do this as far as possible, the above-mentioned position was chosen for the oxygen pipe, as the revolving beating cylinder then prevented the oxygen rising straight to the surface of the liquid, carried it forward, and did much to bring it into contact with the pulp. But, on the other hand, the strong bleach was run into the potcher on top of the pulp, &c., behind the beater, and it was about a quarter of an hour before it became well incorporated and reached the oxygen pipe, a large part having in the meantime been used up. But even under these conditions the effect of the oxygen was very marked, and the average saving of bleach was about 30 per cent., at a cost of about 200 cubic feet oxygen per ton of raw material treated. In a more permanent installation, where the oxygen and bleaching solution would be introduced side by side and the distribution of the oxygen improved,

the saving would undoubtedly be much larger and would probably reach that obtained in the laboratory experiments already detailed. This process may be applied at very little cost to almost all existing paper-bleaching plant, and besides the saving of bleach, decreases the damage to the fibre and thus produces a paper of increased tensile strength.

With chlorine, oxygen acts in the same way. Whether used for gas-bleaching, or whether the mixed gases are led into water in which paper pulp is suspended, a considerable quantity of oxygen is absorbed, and a saving of about 50 per cent. of chlorine effected. To give a single example, a glass chamber of 4.4 litres capacity was lightly filled with 200 grms. dry jute, slightly moistened, and was then made air tight, and connected with a retort in which chlorine was afterwards generated. Oxygen was passed into the chlorine mixture (manganese dioxide and hydrochloric acid), and the mixed gases then led into the closed chamber. 7.6 litres of oxygen and 3.8 litres of chlorine were thus passed slowly in, but the pressure in the vessel only increased to about 20 mm. water. In the experiments with chlorine and oxygen it was always found that better results were obtained when the oxygen was passed into the chlorine-generating mixture than when the gases were simply mixed before reaching, or in, the bleaching chamber. I am, however, unable at present to say whether this was due simply to more intimate mixture of the two gases, or whether possibly small quantities of some oxide of chlorine were produced.

Sufficient experiments have not yet been made to enable me to say with any certainty what is the chemical explanation of the above phenomena. It is conceivable that the oxygen in some way regenerates the chlorine or bleaching powder at the moment of their conversion into hydrochloric acid or calcium chloride, or, on the other hand, that a part of the oxygen becomes converted, in the presence of the nascent chlorine, into ozone. It is more probable, however, that the bleaching of the natural colouring matters present in fibrous materials does not take place at one bound, but by stages, some of the intermediate products being of an aldehydic or unstable character, and oxydisable by free oxygen. Under ordinary circumstances, no free oxygen being present, the end as well as the initial oxidation must be effected by nascent oxygen supplied through the medium of the chlorine. But if a plentiful supply of oxygen is present, less nascent oxygen, and consequently less chlorous bleaching agent, is required. One fact that tends, I think, to confirm this explanation is, that when a current of oxygen is passed through a solution of bleaching powder undergoing titration with arsenious acid, the amount of arsenious acid is not increased. Were the increased bleaching effects described above due to a formation of ozone or a regeneration of oxy-chlorine compounds, an increased quantity of arsenious acid should be oxydised under the conditions just mentioned.

Use of Oxygen in the Purification of Gas.

As Mr. W. A. Valon recently (June 1888) read a paper on this subject at the annual meetings of the Gas Institute, and this paper, with the discussion thereon, has already appeared in the Transactions of the Institute (1888, pp. 71—98), it will be unnecessary for me to go into the question in detail. It is, however, of such importance, that I may be permitted to give a brief summary of the principal results.

In gasworks where oxide of iron is employed for the removal of the sulphur from the gas, the spent oxide is often revived by being exposed for some time to the air, and this may be repeated ten or a dozen times before the oxide is finally spent. But in order to save the handling of the oxide thus made necessary, a small percentage of air is often added to the gas before it enters the oxide purifiers, and in this way the revivification is made continuous, till the oxide is finally completely spent. But when either of these plans is adopted, the purified gas is generally found to have lost somewhat in illuminating effect, due probably to the nitrogen introduced in the added air. Mr. Valon made a series of experiments to ascertain whether any material advantage would accrue by the substitution of a corresponding amount of pure oxygen for air. He found that not only did the loss of luminosity give place to a slight increase, and the revivification of the oxide proceed more regularly, but that the use of the oxide might be abandoned altogether. For when oxygen was employed in this way, the lime purifiers alone were found to efficiently remove the sulphur compounds, the issuing gas containing only 6 to 8 grains of sulphur per 100 cubic feet of gas. The proportion of oxygen found to give the best results was 0.10 per cent. of the volume of the gas for every 100 grains of sulphur per 100 cubic feet of crude gas. Under these conditions the sulphur remained fixed in the lime (partly as free sulphur), and did not move forward when the lime became saturated with carbonic acid—as is the case where air is employed—and the life of the lime was nearly doubled. The lime lasts much longer than hitherto, owing to the more complete revivification of the lime, and when spent, it has not the noxious smell of "blue Billy," but forms an almost odourless and dry substance. The purifying space and plant is reduced by more than one-half, and the labour in proportion.

The chemical explanation of these results must be left for the present unknown, but of the actual facts there is no doubt. The experiments were made at the Westgate-on-Sea Gas Works, between September 1887 and May 1888, and during that time the whole output of gas was treated by the oxygen method. Permanent oxygen plant has now been put down at the Ramsgate Corporation Gas Works, and the process will shortly be at work, when those interested in gas making will be able to examine it personally.

Maturing of Spirits.

Another application of oxygen, which, though not yet fully worked out, promises to be of considerable importance, is its use in the maturing of spirits. There is little doubt that in the early ageing of spirits in cask, the oxygen of the atmosphere plays an important part. But though this is the case, all attempts to artificially hasten this process seem hitherto to have proved more or less unsatisfactory. But the two applications just referred to show that oxygen when in the pure state may sometimes answer where air utterly fails, and this is also the case in the ageing of spirits. It has been found that if oxygen is forced into spirits at a pressure of one or more atmospheres and left for ten days or so, the spirits become mellowed to the extent of about three to five years ageing. Numerous samples have been thus treated and submitted to experts, with the almost invariable result as stated. Determinations of the fusel oil in some of these samples have been made, of which the following three pairs are examples.

Fusel Oil.

I. Whiskey before treatment.....	72	grms. per litre.
Whiskey after treatment	706	" "
II. Whiskey before treatment	73	" "
Whiskey after treatment	702	" "
III. Whiskey (quite new Scotch) before treatment	1763	" "
Whiskey (quite new Scotch) after treatment	742	" "

From these numbers* it is clear that the effect of the oxygen is really to mature and improve the spirit and convert the harmful fusel oil into innocuous compounds. It may be mentioned that oxygen has for some time past been used in France for this purpose.

Some wines appear also to be matured by this process, but they are also often acidified by it, and it is doubtful whether it will be applicable to wines with advantage.

Use of Oxygen for obtaining High Temperatures.

As the able paper delivered by Mr. Thos. Fletcher on this subject to the Liverpool Section of our Society has already appeared in our Journal, it is unnecessary for me to do more than refer to it. I would, however, take this opportunity of calling the attention of chemists who have not yet used it to the convenience of compressed oxygen as now obtainable in steel cylinders, for laboratory use. There is also little doubt that at the prices mentioned at the commencement of this paper, oxygen will be available even in some metallurgical operations where very high and readily controlled temperatures are required.

Several other industrial applications of oxygen are now under investigation, and I hope ere long to have the honour of bringing these before the notice of the Society.

DISCUSSION.

The CHAIRMAN said that he was sure all the members would agree with him in thanking Dr. Thorne for an especially interesting paper. It was surprising that oxygen had been so completely shut out from all industrial uses until recently. The most familiar of all chemical substances, the first thing to a knowledge of the use of which every beginner in chemistry was introduced, had hitherto been so scarce and valuable that its industrial employment was impossible. Excepting a very limited use in oxyhydrogen furnaces, it might be said that the industrial application of oxygen in chemistry was unknown. Messrs. Brin's process had created the possibility of the industrial use of oxygen, and was in itself a most interesting object of study. The first effects of the introduction of this process were a repetition of what had been so often seen before:—a discovery was made so simple and so admirably fitted for its purpose, that everybody immediately concluded that the whole question was solved. Then the practical difficulty of applying the process came to the fore. Perhaps there was nothing more certain with respect to industrial processes than that nothing, however perfectly simple in the laboratory, ever worked well at first on a practical scale. It

* It should be noted that these numbers are given rather for their relative than their absolute value. In these determinations the numbers to be compared are from the *same* spirit before and after treatment, and therefore are in a great measure free from the objections raised against ordinary fusel oil determinations. The alcohol of the spirit was carefully fractionated off by the help of a Le Bel-Henninger fractionating tube (four bulbs), and the aqueous residue treated by Marquardt's method.

was not merely beautiful laboratory experiments that were wanted in applied chemistry, but the more complex results of great engineering and manufacturing experience allied to that purely theoretical chemistry which we are apt to think all-sufficient. It was most interesting to see how the difficulties besetting the process had been overcome, and results obtained indicating that the various applications of oxygen had a great future. The whole question of bleaching was one of great interest and importance, but he would not venture to dogmatise on it. Undoubtedly oxygen had for centuries past done a large amount of bleaching; in fact, until the present generation or thereabouts, all bleaching had been done by it. At any rate, without going deeply into theories, one might assume that oxygen had *some* bleaching power. How that power was exercised was a difficult and interesting question. He felt strongly, however, that Dr. Thorne was right in his view that chlorine was not the true bleaching agent. It was probable that it acted simply as—it was difficult to choose expressions which did not bring one on to debatable ground, but perhaps he might use a safe, if incomprehensible, expression, and say that it acted in a catalytic manner. At any rate it seemed clear that the joint presence of ordinary oxygen and oxygen combined with chlorine did somehow produce the effects characteristic of ozone. If this process could avert the destructive effects produced by chlorine in paper pulp, it would be a vast consideration to all who had respect for the permanence of documents; and if it could be carried still further and avoid the extreme use of chlorine in our clothes, that would be an improvement which would add materially to the happiness of the community. It must be confessed that modern science had not succeeded in producing the same permanence which the linen of our grandmothers showed; and if the oxygen process could restore that permanence, everybody—except those whose business it was to spin—would be grateful. The other proposed applications of oxygen were striking and interesting. In the case of spirits, if we could be saved what had been called forelight processions down our throats, that alone would be a great improvement. The ageing of spirits was another of those simple processes difficult to analyse and work out. Everyone knew that it took place, but no one seemed to know how. It would certainly be an economic and valuable application of oxygen if the interest of large sums of money which at present lay idle while spirits were ageing could be thereby saved. He would not go through all the possible applications of oxygen, some of which were well recognised at present, while others belonged only to the future, but would call upon those having knowledge of the subject—especially those learned in the purification of coal gas—to give the meeting the benefit of their experience.

Mr. S. H. JOHNSON said that with respect to the bleaching properties of oxygen, he would like to ask Dr. Thorne whether he had compared the cost of the oxygen used with that of the chlorine which it displaced. A thousand cubic feet of oxygen would weigh, roughly, about 14 lbs., and its cost would be 7s., or about 6d. per pound. In comparing the cost of that oxygen with that of the chlorine which it displaced, one must take the chlorine in the form of bleaching powder. He thought that the two values would be found to be about equal, and thus there would be no saving. It was, however, very interesting to find that oxygen could be used directly in such a way, and it was to be hoped that the process would be cheapened in the future. He would like to hear

Dr. Thorne's opinion of the saving to be effected by using oxygen instead of oxide of iron for the purification of gas. He had had a long experience of the use of oxide of iron and of lime for that purpose. One of the principal objections to the use of lime was the enormous expense of handling the lime; but this expense was saved in the case of iron oxide by the same oxide being used over and over again, and he had no doubt whatever that oxide of iron was by far the cheaper agent for purifying gas from sulphide of hydrogen.

MR. B. E. R. NEWLANDS asked how it was possible to correctly estimate such a small quantity of fusel oil in spirit as that mentioned as existing after treatment by oxygen. He had failed to get accurate results by the book methods, and therefore when he inquired into the matter during a recent visit to Paris he was somewhat gratified to find that one of the most eminent chemists in the alcohol industry confessed himself equally at a loss to estimate such minute proportions of fusel oil. In fact, fusel oil was a very complex body. It was essentially a mixture left in the still after the alcohol was distilled off at a certain temperature, and the oil at one manufactory might differ considerably from that at another. Therefore a process that would determine it correctly in one works would perhaps fail to determine it at another.

MR. E. J. BEVAN was glad to find that Dr. Thorne regarded oxygen as the chief agent concerned in bleaching rather than chlorine. At the same time he would like to know how Dr. Thorne explained the action of chlorine on jute in the experiment he had described in which he had passed chlorine gas into a glass cylinder containing jute. It was well known that jute was not bleached at all under such conditions. The chlorine was absorbed by the jute, forming a chlorine compound of definite composition, and thus accounting for the non-increase of pressure mentioned by Dr. Thorne. He would like to know, too, whether the bleaching effected by means of oxygen and bleaching powder had been found to be permanent. That was a matter of great importance to paper-makers. It was possible to produce what might be called a white wash as contrasted with a distinct bleach. In some cases bleaching could be effected very rapidly, and a good white apparently obtained; but after some time the pulp rapidly deteriorated and went back to the original colour. But after all, the most important point for a paper-maker's consideration was the relative cost. He would like to hear Dr. Thorne's opinion on that, and also whether he had estimated the loss in weight which occurred with pulps treated by the two different processes—*i.e.*, by bleaching powder alone and by bleaching powder in conjunction with oxygen. He would also be glad to know whether Dr. Thorne had determined what action, if any, was produced by oxygen alone, without the use of any bleaching powder.

DR. C. R. ALDER WRIGHT asked whether the "blue Billy" shown by Dr. Thorne contained free sulphur or calcium sulphide, or whether the sulphur compounds in it had been oxidised to sulphate; and whether the action of the oxygen had been traced by the analytical examination of the product. There was another application of oxygen which had been brought forward some time ago, which Dr. Thorne had not mentioned; that was its use for purifying water by being dissolved therein. It was a curious fact that a watery solution of oxygen under several atmospheres pressure in a syphon when discharged into a tumbler was just as tasteless as boiled water.

Though "fizzing" vigorously it tasted as flat as ditch-water. He had gathered from Mr. Jackson some time ago that there was a prospect of oxygen being used for the purification of water containing organic matter, but had not yet heard of any experiments to that end. Mr. Jackson had, however, kindly sent him for home consumption sundry samples of plain aerated water and of lemonade aerated with oxygen. He had noticed that the oxygen had by no means completely oxidised the citric or tartaric acid of the lemonade nor the essential oil and sugar contained therein, and it therefore occurred to him that there might be certain constituents of ordinary water which it would equally fail to oxidise.

MR. C. T. KINGZETT asked whether Dr. Thorne had made any estimation of the comparative cost of oxygen by the Brin process and in the form of peroxide of hydrogen in the application of the two substances to such bleaching processes as the oxidation of paper pulp and fusel oil. And further, whether the oxygen employed to purify gas prevented the formation of that magnetic oxide of iron which was the bugbear of the process. If one could really prevent the formation of magnetic oxide there was no reason why the ferric oxide should not be employed *ad infinitum*.

MR. A. WINGHAM said he understood that the sulphur in the "blue Billy," shown by Dr. Thorne, was in the state of free sulphur. If that was so, it seemed very remarkable that one should introduce oxygen into the gas and get a reduction. The probable explanation seemed to him to be that the oxygen being introduced into the gas burnt by preference a certain amount of sulphuretted hydrogen into sulphurous acid, which, reacting on the unburnt sulphuretted hydrogen, gave free sulphur; the lime acting simply as a mechanical filter. If that was so, the objection to the cost of lime would be overcome, as coke could be used. With respect to the application of oxygen to bleaching, he would like to ask Dr. Thorne to what extent he could replace chlorine by oxygen; and, if the oxygen had a catalytic action, whether he had experimented as to the amount of chlorine necessary to enable oxygen to bleach, whether a trace only would be sufficient. In this connexion he would draw attention to the great desire that existed at the present time for a really pure paper for artistic purposes. He had had complaints recently from several artists that the paper supplied to them rapidly destroyed the colours put on them, especially the vegetable colours. There would certainly be a demand for any process which should overcome this fault.

MR. H. SHARP said that he was glad that, though a member of the Society, it did not fall to his lot to answer the various technical questions raised on the subject of Dr. Thorne's paper. One gentleman had inquired as to the cost of bleaching by oxygen as compared with peroxide of hydrogen. Dr. Thorne would probably answer that question; but in the meantime he might say that they had not attempted to compete with peroxide of hydrogen—or rather that hydrogen peroxide had not, he thought, attempted to compete with their oxygen. The former would, he believed, be much more expensive. His object in rising, however, was, as chairman of Brin's Oxygen Company, to emphasise an invitation which had already been sent to the Council. He trusted that the Council would accept that invitation, and that the Society, on its annual meeting this year in London, would pay a visit to the works

and see the industrial production of oxygen going on. It was unfortunately beyond their power to show members all the applications of oxygen; but he would assure them of a most hearty welcome. He would now leave the answering of the questions to Dr. Thorne.

Dr. THORNE, in replying, said: In the first place as to the question asked by Mr. Johnson, and repeated by other gentlemen, concerning the relative cost of oxygen and bleaching powder— if Mr. Johnson reflects for a moment he will recognise that he has made a slip in his calculation. A thousand cubic feet of oxygen weigh about 81 lbs., and not 14 lbs. as he mentioned—the volume of one pound of oxygen at the ordinary temperature of 60° Fah. being about 11·8 ft. This, of course, will reduce the cost of the oxygen from the sixpence suggested by Mr. Johnson down to about a penny per pound. I may say, however, that we have studied the question of the cost of bleaching, and it would be within the mark to say that the ordinary cost of bleaching paper pulp is about 15s. to 18s. per ton of raw material. In some cases it is a little higher, in others a trifle lower. As already mentioned in my paper, in experiments on the large scale a saving was effected of about 30 per cent. of this cost, which is equivalent to between 5s. and 6s. That saving has been effected at the cost of from 180 to 250 cubic feet—or an average of about 200 cubic feet—of oxygen to the ton of raw material. This quantity of oxygen costs in London about 1s. 6d., and we, therefore, have to deduct that sum from the saving of 5s. or 6s. In the midland and northern counties, where coal is cheaper, the cost of the same quantity of oxygen would be about 1s., so that on the lowest estimate of 30 per cent. less bleaching powder used there would be a clear saving of 3s. or 4s. I am confident, however, that in fitting up a complete apparatus a greater economy—say 40 per cent.—could be effected, which would of course proportionately increase the money saving. I may mention that at a large mill where the experiments were made, and where about 150 tons of esparto are treated per week, the proprietors are so satisfied with the results obtained with the 50 tons experimented on that they are on the point of putting up plant. It is now only a matter of settling the details of agreements as to terms. With respect to the question of gas purification, there are a good many points at which a saving may be effected. In the first place we may do away entirely with the oxide of iron. The saving in cost of oxide will be small, but the saving in space, handling, and so on, is by no means small. We shall also be able to reduce even then the amount of lime used, and the space for the lime, which is very considerable, by nearly one-half. Consequently there will be a further saving on the handling of lime. Then there will be another and appreciable saving in obtaining an increase of luminosity instead of a decrease in the purified gas. In the ordinary gas where air is used for the revivification of the oxide of iron, the gas almost always loses a certain amount of luminosity. It may be only half a candle or less, but it does lose. Where oxygen is used there is an undoubted increase of about half a candle-power. This increase is no doubt due to a trace of oxygen left in the gas, which is not sufficient (the total quantity used being very small—only about 6 feet per 1,000 feet of gas) to appreciably increase the rate of consumption of the solid particles of carbon in the flame, but is yet sufficient to increase its heat, and thus increases the luminosity. Referring to Mr. Newlands' remarks, I appreciate the difficulty

of the fusel oil determinations, and shall be as glad as he will be to find a satisfactory method of analysis. But in this instance I do not have to contend with the same difficulty as the ordinary analyst. I should be sorry to say that the '28 which I have written down is an accurate determination of the fusel oil. But I have the great advantage in this case that I am comparing the *same* spirit before and after treatment. I have not to deal with one fusel oil made in one distillery and another made elsewhere. The value of my results is relative rather than absolute, the same spirit having been analysed in the same way before and after treatment by oxygen. The method used was a modification of the Marquardt method. Most of the alcohol and part of the water was carefully distilled off in a Le Bel-Henninger fractionating apparatus. When the temperature has risen to 93° or 95° C the residue (which is almost free from ethyl alcohol) was treated by the ordinary extraction method with chloroform, oxidised with bichromate of potash and sulphuric acid, and the fatty acids produced were estimated in the ordinary way. Referring to Mr. Bevan's remarks as to the action of the chlorine on jute, I may say that to avoid carrying my paper into great detail I omitted one thing which might have been stated with regard to these experiments. The action of the chlorine on the jute was not a complete bleaching action. In all cases, after treatment with chlorine, the jute required to be finished off with a dilute solution of bleaching powder. When the jutes came out of the chlorine chamber they were more or less orange-coloured, but they were so far acted on as to require very little finishing; and in my results, where comparison is made between jutes bleached with oxygen and chlorine, and those where no oxygen was used, I was careful to keep the finishing solutions very dilute, and equal in quantity and strength. I quote that example as showing the absolute absorption of a very large quantity of oxygen during the bleaching process. In answer to the question as to the permanence of the whiteness, I may say that, as far as can be judged, in all cases the oxygen-bleached materials stand better than those bleached with chlorine or bleaching powder. In the case of the jute bleachings this was very marked. We had samples bleached equally by the two methods. They were equal in colour at the end of the experiment; at the end of four days the oxygen-bleached one retained its whiteness much more completely than the other. This was also the case when working on the large scale, and was noticed by the workmen. When they get their wet pulp bleached on a Saturday night and it has to stand till Monday morning, they generally find it "go back" a little. One batch of oxygen-bleached pulp stood in that way, and the men remarked that it had not "gone back" at all. The question of loss of weight has been tested, and in all cases where oxygen has been used in conjunction with bleaching powder or chlorine the loss of weight has been considerably less—sometimes 50 per cent. less—than in the corresponding cases where chlorine or bleaching powder alone was used. Mr. Bevan asked if I had made experiments as to the action of oxygen alone. I have made a great number of such experiments—at high and low pressures, and at high and low temperatures. In some instances there seemed to be a very slight bleaching action, but in the majority of cases no change could be detected. I may say, therefore, that under ordinary conditions of simple mixture with or exposure to oxygen, I have as yet been unable to produce any change, unless a temperature

was used too high for practical purposes and likely to damage the goods. Referring to the spent lime in gas purification, the sulphur is present partly as reduced sulphur, partly as sulphide, partly as sulphate, and partly also as sulphite. The relative proportions appear to vary, but the actual ratios between them have not been much studied as yet. As far as can be judged, about a quarter to one-half the sulphur is always in the free state, the remainder being in combination. Mr. Sharp has referred to the relative cost of oxygen and hydrogen peroxide, and I can only add that the cost of hydrogen peroxide is so high at present that it can only be used for special purposes, such as the bleaching of ivory, where the action of such agents as chlorine would be detrimental, and where the users can stand the high cost. Could we obtain hydrogen peroxide in a more direct way and at a lower price, no doubt there would be a great field for its powers as a bleaching agent. With regard to the action of oxygen on oxide of iron, converting it into magnetic oxide, I cannot give any information, our experiments having been directed in the first instance only to testing whether the increased action due to the oxygen was sufficient to make it worth using. We soon found that we were able to get rid of the oxide of iron, and our work after that turned exclusively to the examination of the purification by lime, and the products of the action of the oxygen have received but little attention as yet. Dr. Wright asked about the action of oxygen on water. As far as the Oxygen Company is concerned, we have never claimed the purification of ordinary potable water by compressed oxygen. I do not believe that oxygen will have by itself any appreciable effect in purifying potable water. It may, either alone or in conjunction with other materials, be used at some future time for the purification of sewage and similar matters where the organic matter present is of a less stable character; but for improving a potable water containing only the ordinary contaminations there appears no likelihood of its having any value. With regard to the replacement of chlorine by oxygen, my experiments have shown that as we increase the proportion of oxygen to chlorine or bleaching powder, we improve the bleaching effect up to a certain point. When that point is passed the effect remains stationary for some time and then begins to decrease. In the case of chlorine and oxygen, an increase of effect has been noticed up to about two volumes of oxygen to one of chlorine. Up to three or four volumes of oxygen there is very little difference; but if we increase the proportion of oxygen beyond that, we get a loss of bleaching effect. I fear I cannot give Mr. Wingham much hope of a purer paper. No doubt where the use of chlorine or bleaching powder is reduced the paper is increased in purity and tensile strength. Whether or not the bad effects he has mentioned are due to chlorine remaining in the paper I cannot say; nor can I say whether they would be removed by the use of oxygen. It is probable, however, that the use of oxygen would produce an improvement in that direction, because the less chlorine there is used, the less action is there on the fibre of the paper.

Mr. S. H. JOHNSON accepted Dr. Thorne's correction of his mental calculation, but said that another point had since occurred on which he thought he would not be wrong. The oxide of iron used by the gas companies hitherto really cost them nothing, because they got more for their spent oxide than they paid for it originally. At any rate the vendors of it were willing until recently to supply it to the gas

companies free, provided they received back the spent oxide.

Dr. THORNE: With reference to that point, I have already stated that we base our hopes of saving largely on the economy in handling. It is very exceptional, I think, that the gas companies actually get more for their spent oxide than they give.

Mr. JOHNSON: They always do.

Dr. THORNE: I understood that usually a small rental was paid by the gas companies. But even if they do receive slightly more, we shall be able, I think, when we get to work, to show an ample margin for saving.

Manchester Section.

Chairman: Edw. Schunck.

Vice-Chairman: G. H. Bailey.

Committee:

J. Angell.	I. Levinstein.
C. A. Burghardt.	Sir H. E. Roscoe, M.P.
R. F. Carpenter.	C. Truby.
H. Grimsdew.	D. Watson.
J. Grossmann.	T. Wardle.
P. Hart.	P. Winsor.

Hon. Local Secretary:

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Tuesday, January 8th, 1889.

MR. E. MELLOR IN THE CHAIR.

ON THE ESTIMATION OF CHLORINE AND HYDROCHLORIC ACID IN A MIXTURE OF THE TWO GASES.

BY WILLIAM YOUNGER.

DIFFICULTY has been experienced in detecting and estimating hydrochloric acid in small quantity in the presence of chlorine in a mixture of these two gases.

It is necessary to deal with this mixture in the gases from the ordinary chlorine still, and more especially in the gases from the Deacon process.

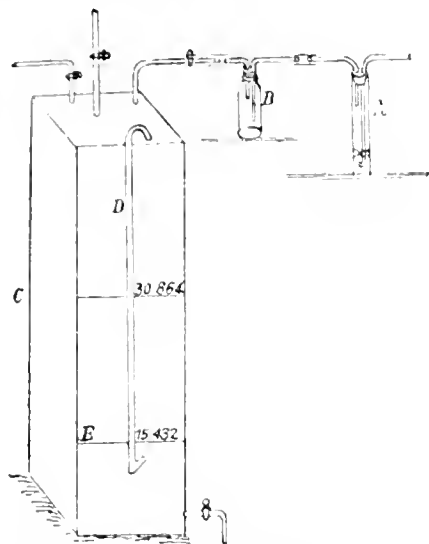
One method employed for this purpose consists in passing the gases through a solution of caustic soda. In this method it is assumed that all the free chlorine is converted into hypochlorite, and that no chloride is formed. This, however, is fallacious, and where there exists very small quantities of hydrochloric acid in the gases it is impossible to obtain any reliable results.

Another method is that in which water is used as an absorbent, the free chlorine being eliminated by means of mercury; but this method I have found unsatisfactory, as the impurities in the mercury vitiate the results, even when the purest mercury which I could purchase was employed.

The method which I find to give very accurate results is by absorbing the gases in a solution of arsenious acid.

The absorption is accomplished in one vessel, which, along with a graduated box as an aspirator,

enables us to get a direct reading of the grains chlorine per cubic foot; while from the same solution, by titration with silver nitrate, we obtain the hydrochloric acid, if any be present in the gases. This is done as follows:—



In the accompanying figure a glass tube A, 20 inches long by seven-eighths of an inch in diameter, is employed for absorbing the gases. This tube is fitted up with other two tubes. Over the bottom end of the long tube is tied a piece of thin cotton cloth, which serves to break up the gas bubbles as they emanate from the lower end of this tube. Two pieces of copper wire are also twisted round the lower end of the long tube, the four ends of which are allowed to project for the purpose, of keeping it in the middle of the absorbing tube, and thus prevent the gas bubbles from travelling up the side. Wire was used for this purpose, so as to cause as little obstruction as possible to the passage of the gases up the tube, and thus prevent the gas bubbles from coalescing.

Into this tube are put 100 cc. of a standard solution of arsenious acid in water, every cc. of which equals 0.15432 of a grain chlorine, so that the 100 cc. equals 15.432 grains, and to which is also added from the end of a glass rod a very small portion of sulphate of indigo paste, which serves to indicate when the aspiration is finished.

The 100 cc. gives a column in the tube of 10½ ins., in which the gases are completely absorbed.

Behind this tube is placed a bottle B, containing solution of iodide of potassium (a gramme or so dissolved in water), which also serves as an indicator, and this bottle in turn is coupled up to a graduated box C, fitted up as an aspirator. A cubic foot in capacity of the box is divided out into as many parts as desired; in our own case I have divided it out into 112 parts.

This aspirator is provided with a gauge-glass D, down the one side of which are the readings for the grains chlorine per cubic foot, while down the other side on the same lines are the number of cc. drawn through, the latter being required in order to obtain the grains hydrochloric acid.

In taking an aspiration the indication appears first in the iodide of potassium bottle by the liberation of iodine, and shortly afterwards the sulphate of indigo in the tube becomes bleached, when the aspiration is stopped and the readings taken from the diagram.

Supposing the line marked E to represent one cubic foot, and supposing the aspiration to be finished when the level of the water in the gauge-glass stood at this line, then the grains chlorine per cubic foot would be exactly 15.432, supposing it to be finished when half a cubic foot had been drawn through, then it would indicate twice that quantity, and so on, doubling itself every time the quantity drawn through is halved. The figures for the intervening readings must, however, be calculated, as starting from the bottom upwards the increase each time is not a fixed number, but a constantly increasing number.

From the same aspiration is also obtained the grains hydrochloric acid per cubic foot, as follows:—After taking an aspiration, 10 cc. of the solution from the tube are titrated with decinormal silver. Supposing no hydrochloric acid to be present in the gases, then 28.2 cc. of silver will be required, being equal to the hydrochloric acid produced by the oxidation of the arsenious acid. Any silver solution required beyond 28.2 cc. is due to hydrochloric acid in the gases, which is calculated into grains per cubic foot by reading off the number of cc. drawn through.

If the experiment be carried out with ordinary care, and the aspiration be stopped just when the colour of the sulphate of indigo is discharged, it will be found that a portion of the solution out of the tube will neither take up any iodine nor discharge the colour of sulphate of indigo, showing that the arsenious acid has all been oxidised, and that no free chlorine is present; or, in other words, that it has neither been overdone nor underdone.

The iodine liberated in the iodide of potassium bottle generally indicates about 0.2 or 0.3 of a grain, and sometimes as low as 0.1 of a grain chlorine.

When two iodide of potassium bottles are put on, it is never found that any liberation of iodine takes place in the second bottle, thus showing that no chlorine escapes beyond the first bottle.

The iodide of potassium is not necessary as an indicator, as a clear indication is always obtained by the sulphate of indigo in the tube. One purpose the iodide of potassium bottle serves is to indicate if the aspiration be running too quickly, for if so, then a little of the chlorine will escape absorption in the tube, but that will not happen if it be kept running at an ordinary speed.

In order to ascertain if any hydrochloric acid escaped absorption in the tube, a bottle containing water was put on behind the tube, in place of the bottle containing iodide of potassium, and the aspiration stopped just immediately before the oxidation of the arsenious acid was complete, so as to avoid the slight trace of chlorine which escapes absorption in the tube at the finish.

On titrating the contents of this bottle with silver solution, no hydrochloric acid was found, thus showing that no hydrochloric acid had escaped absorption in the tube. If a bottle containing silver solution in place of water be employed, a similar result is obtained.

These experiments have been repeated a number of times with similar results.

A method by which a constant aspiration over the 24 hours for the hydrochloric acid in the Deacon gases is obtained as follows:—

In working the Deacon process a constant aspiration over the 24 hours is taken for the grains chlorine, the gases being absorbed in two bottles containing solution of caustic soda, a Bunsen pump and a meter being also employed.

A Winchester quart containing two litres of distilled water is placed in front of the two bottles containing

caustic soda. The hydrochloric acid is absorbed by the water in this bottle, along with part of the chlorine, the remainder of the chlorine being taken up by the caustic soda in the other two bottles.

The water and the caustic soda solution are each titrated separately for the chlorine, and calculated to grains per cubic foot.

Air is then blown through a portion of the water until all the free chlorine is eliminated. Whatever hydrochloric acid may have been present is left in the water, a measured portion of which is then titrated with silver nitrate, and the grains hydrochloric acid per cubic foot calculated. During the blowing evaporation takes place, but no loss of hydrochloric acid is sustained, as it has been proved by experiment that where very small quantities of hydrochloric acid exist, as in this case, that the hydrochloric acid increases just in the same proportion as the bulk of the solution decreases.

As the blowing takes up a considerable time, I have had an arrangement fitted up to the fan blast in the blacksmith's shop, under lock and key, where the blowing can be continued any length of time.

YORKSHIRE GREASE.

BY GEORGE H. HURST, F.C.S.

IN our technical literature but few references are to be found on this subject, and even these of a limited scope.

I propose to deal with the subject under two heads:—

1. Yorkshire grease: its origin, composition, and the products obtained from it.

2. The composition and properties of these products.

Yorkshire Grease: its Origin, &c.

In the woollen industry a large quantity of soap and oil is used in cleansing, milling, and oiling the fibre, yarn, and cloth, during the different processes involved in spinning and weaving wool. Formerly all these products, or rather the waste from them, went into the rivers in the form of soapsuds, and thus helped to pollute them.

Now, almost the whole of the soapsuds of the woollen mills of Yorkshire and other districts is treated with acid and the fat liberated used again for making soap.

The soapsuds are collected into a large tank, calculated to hold a day's supply, say from 6,000 to 8,000 gallons of liquor. Usually two tanks, constructed of brickwork or concrete, are provided, one being used to collect the suds, while the suds collected in the other tank are being treated in the manner following.

Brown oil of vitriol, or, preferably, hydrochloric acid, is added to the suds, and after thoroughly agitating the mixture it is allowed to settle; the fatty matter comes to the top, is skimmed off, and thrown on to large cloth filters to drain. The fatty matter thus collected is known as "magma" or "sake," and the operation of treating the suds with acid is commonly known as "saking," probably a local corruption for "seeking."

This "magma" is then sent to the grease mills, while the residual liquid is run into the rivers.

The "magma" is now put into bags, which are piled up in a tank and weighted, and so left for a

night, when a large quantity of water is pressed out. Then the cakes of magma are placed in a hydraulic filter-press kept hot by means of steam, and subjected to pressure, when a dark greasy product is pressed out, and a more solid matter is left behind in the bags. The latter is known as "sud cake," and is used as manure.

The greasy matter referred to is known as "YORKSHIRE GREASE," of which I have a few samples here.

This body is sometimes used for making soap for wool scouring, but is more frequently distilled, as will be described later on.

Yorkshire grease varies a little in appearance, but usually is of various shades of brown, sometimes almost black. It is very sticky, and easily melts, its melting point being 44° C. On treatment with soda or potash it undergoes saponification; the soap so produced is not readily soluble in water, and is of very short grain. Its specific gravity at 15.5° C. varies from 0.939 to 0.957. So far as my experiments go the lower specific gravity is always associated with a low percentage of unsaponifiable matter.

It contains free fatty acids, unsaponifiable matter, and neutral oils, &c. The free fatty acids vary with different samples according to the character of soap or fat originally used; the unsaponifiable matter contains cholesterol, derived from the natural fat of the wool, and probably also some of the mineral oil which has been used in the wool batching. It also contains water and mineral matter.

The following table shows the composition of four samples of Yorkshire grease:—

	1.	2.	3.	4.
Sp. gr. at 15.5° C.	0.9391	0.9417	..	0.9570
" " 28° C.	0.8900	0.8952	..	0.8720
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Water	0.798	1.53	1.21	0.94
Fatty acid	18.61	24.25	24.15	26.43
Neutral oil	68.62	58.25	50.02	16.86
Unsaponifiable oil	11.68	15.83	44.44	55.77
Ash	0.11	0.14	0.18	Trace.
	100.00	100.00	100.00	100.00

The fat is also used in the manufacture of lubricating greases, and it may be of interest to give its flashing point, &c.:—

	° C.	° F.
Vapourising temperature	182	359
Flashing point	220	428
Fire test	248	478

I have already mentioned that Yorkshire grease is subjected to distillation, which process I will now briefly describe.

The process of distillation is carried on in cast-iron stills (wrought iron cannot be used as it is rapidly corroded by the fatty acids), similar in shape to tar stills, and which are connected with suitable condensing arrangements.

In most works superheated steam is used along with direct heat, its use giving a larger yield of useful products and of better quality than when direct heat is used alone.

The stills are of about 1,000 gallons capacity, and will hold something like four tons of grease. When beginning the distillation, direct heat is used alone until the water in the grease has been driven off,

which will take from 10 to 16 hours, after which superheated steam is run in and kept running into the still during the rest of the time.

Some kinds of grease give off a small quantity of a light "spirit oil;" others do not yield this product. After this comes the principal product, a thin limpid oil of a pale yellow colour, which, on cooling, sets into a pale yellow grease known as "first distilled grease." This grease takes from 20 to 24 hours to come off; it is followed by a greenish oil which is collected separately and is known as "green oil" or "crude grease;" this product is usually put back into the stills with a fresh quantity of grease, or occasionally made into very crude lubricating greases.

After about 36 hours from the beginning of the distillation a thick oil begins to appear. When this occurs, the fires are drawn, and the "pitch" which is left in the still is drawn off.

The products yielded by the first distillation of Yorkshire grease are given in this table:—

	Per Cent.
Water and loss.....	20.76
Spirit oil.....	4.10
First distilled grease.....	45.54
Green oil.....	15.47
Pitch.....	14.13
	100.00

The "first distilled grease" may be treated in two ways: (a) it may be again distilled; or (b) subjected to pressure, thus yielding two products, oleine and stearine.

(a) The "first distilled grease," obtained as described in the first distillation, is now put again into the stills and treated as before, when two products are obtained, "second distilled grease" and "pitch." The latter is softer than that obtained in the previous distillation, and is hence termed "soft pitch." The principal object of this second distillation is to obtain products of a better quality and purer colour.

The "first distilled grease" yields about 96 per cent. of "second distilled grease," and 4 per cent. of pitch.

The "distilled greases" obtained during the first and second distillations are collected in a tank, and allowed to cool slowly, and kept at a temperature of 21° C. for some hours; by this means the stearine it contains separates out in a granular form, which facilitates the after process of pressing. A great deal depends upon the careful cooling of this grease to obtain the maximum yield of oleine with the minimum amount of damage to the press cloths. This operation of "seeding" is sometimes done in shallow metal trays, placed on racks in a slightly inclined position, the racks being in a room kept at from 21° C. to 25° C. The oleine which drains out of the stearine is generally considered to be of better quality than that obtained by pressure, and is designated No. 1 oil. The principal objection to this process is the rapid corrosion of the metal trays, while the metal dissolved in the oleine causes the discolouration of the latter.

The cooled "grease" is now put into canvas cloths, and made into cakes, which are put between the plates of a hydraulic press, where they are subjected to a pressure of about three tons to the square inch for six hours. The liquid oleine No. 2 is thus pressed out, the stearine being left behind in a solid cake.

The grease yields about 66 per cent. of oleine and 34 per cent. of stearine.

The oleine is turbid as it issues from the press, and is clarified by filtering.

The Composition and Properties of Yorkshire Grease Products.

The "spirit oil" as first obtained from the stills is pale yellow, but on keeping at the works generally becomes in time of a reddish-brown colour. The cause of this I will discuss presently.

It has a rather unpleasant empyreumatic odour, and is readily inflammable.

Its specific gravity at 15.5° C. is 0.794. It begins to boil at 150° C., 10 per cent. comes over under 170° C., then it distils regularly up to 240° C., when about 62 per cent. has come over, the distillation then gradually decreases in speed until about 320° C., when about 88 per cent. has come over; the temperature then rises rapidly.

It contains a small amount of free acid, equal to 1.2 per cent. of oleic acid.

Nitric acid acts only slightly on it, sulphuric acid chars it a little, while alkalis simply neutralise the small quantity of free acid it contains.

The distilled greases are of a pale yellow colour, and are granular in structure. Two samples which I have examined had the following composition:—

	First Distilled Grease.	Second Distilled Grease.
Water.....	0.98	1.04
Free acid.....	63.12	66.56
Unsaponifiable matter.....	12.88	13.21
Neutral oil, &c.....	23.02	19.16
	100.00	100.00

It is interesting to note that the second distilled grease contains more free acid and unsaponifiable matter than the first distilled grease. This might be expected, since the distillation of grease must result in partial decomposition of the neutral oils it contains, leading to the formation of acid bodies and hydrocarbons. This is also shown in the analyses of the wool oils given below.

Oleine.—This, which is better known as "wool oil," comes from the press as a pale coloured body, but gradually assumes a pale brown colour. This colouration is undoubtedly brought about by the presence of iron in the oil derived from the press or from the tanks in which it is kept.

These oils are mostly used for oiling wool, hence their name; but they have been used for making lubricating greases and soap.

It varies very much in its composition, even from the same maker, which depends very greatly on the composition of the grease from which it is prepared.

The following table gives some analyses of several samples of wool oil:—

	1.	2.	3.	4.	5.
Sp. gr. at 15.5° C.	0.9031	0.898	0.905	0.900	0.9091
" " 98° C.	0.852	0.8403	0.849	0.8434	..
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Water.....	1.12	2.33	1.38	2.51	..
Free acid.....	55.02	56.26	53.65	59.83	64.12
Unsaponifiable oil.....	34.66	29.46	16.32	38.92	9.95
Neutral.....	9.20	11.95	28.65	..	25.63
	100.00	100.00	100.00	101.26	100.00

These figures can only be taken as approximate.

The acid is calculated as oleic acid, while probably there are other acids present, both of higher and lower molecular weight.

The flashing points of the two classes of oil differ by about 16° F.:—

	Oil No. 1.	Oil No. 2.	Oil No. 3.
	F.	F.	F.
Vapourising temperature	212	263	172.5
Flashing point.....	338	342	322
Fire test.....	386	379.5	356

It would be advisable to reject any oil that has a lower flashing point than 330° F. for oiling wool.

Stearine.—This product is a hard, pale yellow, solid body of a greasy appearance. That obtained from first distilled grease is of a darker colour than that from second distilled grease, but usually has a slightly higher melting point, and contains less fatty acids and more oil.

The following table gives the analyses of three samples of stearine:—

	No. 1 Second Distilled.	No. 2 First Distilled.	No. 3.
Sp. gr. at 15.5° C.	0.9393	0.9044	..
" " 98° C.	0.836	..	..
	Per Cent.	Per Cent.	Per Cent.
Water	0.6	1.48	2.85
Free acid	85.6	76.3	72.13
Unsaponifiable oil.....	0.49	0.4	3.12
Neutral oil	2.11	7.7	..
Solidifying point	45° C., 113° F.	53.5° C., 128° F.	..
Melting point	48° C., 118° F.	57° C., 134° F.	..

The acid was calculated as stearic acid, but I am of opinion that there are acids of higher combining values present. The neutral oil given above was extracted by petroleum ether after neutralising with alkali. There is evidently some other constituent beside those enumerated.

Stearine, when saponified with soda, gives a soap which forms an exceedingly gelatinous mass with water, and from which it is exceedingly difficult to extract with ether any free oil which may be present. It is possible to mix 25 per cent. of paraffin scale with stearine, and yet, on saponification, no separation of mineral oil will be noticed. It is this circumstance which makes wool grease stearine of so much value in making sizing tallow, which are mostly mixtures of paraffin scale and stearine. On the other hand, this gelatinising property of stearine being probably due to the comparative insolubility of the soap it produces in water, makes it a bad article for soap making, and soap made from this stearine is noted as not making much lather.

The pitch is used for various purposes, making waterproof paper, cloth, &c.

DISCUSSION.

Mr. H. GRIMSHAW wished to ask Mr. Hurst about how much of the unsaponifiable oil in the samples of oleine did he attribute to the mineral oil originally present in the oils used for greasing the wool, and about how much did he consider to be unsaponifiable oils produced in the distillation of the grease, as he had always considered in his analysis that the presence of unsaponifiable oils were due to both of these causes. He also suggested that Mr. Hurst had omitted to mention that one of the uses of Yorkshire grease is in the manufacture of lubricants for machinery, the axles of which become overheated, such as those of the tinplate rolling machines, and therefore require a grease which is adhesive and does not melt very easily, and is retained upon the bearings.

Mr. ROWLAND WILLIAMS wished to know what method Mr. Hurst had adopted in the examination of his samples. Some time ago he was engaged at a calico-printing works where they extracted the fatty matter from waste soap, by decomposing it with hydrochloric acid and passing the magma through a hot filter-press. It was afterwards packed in casks and sold to a firm of soap makers on analysis. The method mutually agreed upon was to take a weighed quantity and dry it in the ordinary way, and then to extract the fatty acids with strong boiling alcohol and filtering through a weighed filter. The residue on the filter was weighed, and the fat usually taken by difference. In the case he referred to the recovered grease consisted principally of fatty acids, without any unsaponifiable matter.

Mr. J. CARTER BELL asked what kind of apparatus Mr. Hurst used for determining the specific gravity of grease at 100° C., and also how the "oleine" of commerce was defined, as its composition was a matter of great importance, seeing that some insurance companies would not allow any oil to be used, except oleines, olive oil, and Gallipoli.

Mr. LAKE: Has Mr. Hurst ever heard of damage being done to goods by the Yorkshire grease used in the sizing process? He knew of an instance where a heavy claim was made for some warps, which were supposed to have been seriously damaged, the use of this oil making them very streaky.

Mr. C. RAWSON, of Bradford, said that he could not understand the presence of hydrocarbon oils in normal Yorkshire grease. At all the wool-washing establishments in Bradford and neighbourhood, the raw wool, after sorting, was taken direct to the scouring machines and treated with either a solution of soap alone, or a mixture of soap and an alkaline carbonate. The decomposition of the waste suds was usually effected in a series of large wooden cisterns, which in some cases were heated by steam in order to accelerate the separation of the fatty magma. The grease obtained from the hot presses had still to undergo a further operation, viz., its purification. This was effected by boiling it for some time with dilute sulphuric acid. Yorkshire grease varied very greatly in composition, depending to a great extent upon the quality of the wool from which it had been obtained. In the case of very greasy wool, the recovered grease contained a correspondingly higher percentage of unsaponifiable matter and lower percentage of free fatty acids than the average qualities.

Mr. SINGER asked if Mr. Hurst could say whether the iron in the mineral oils would have any effect on the colour in the process of dyeing the wools. As regards the purification of grease from sand, &c., he thought it would be easy to eliminate any particles that might be mixed up with the grease by dissolving it in bisulphide of carbon or other solvent, and filtering the solution.

Mr. HURST, in reply to Mr. Grimshaw, said the unsaponifiable oil in the samples was not due to the mineral oil in all cases, but was probably due to a small percentage of the fatty acids being decomposed in the process of distillation from the grease, although mineral oils were used for wool oils and necessarily found their way into the grease. It was difficult to distinguish between mineral oil, which had been added in these wool oils, and the unsaponifiable oil naturally present. In reply to Mr. Hart, the term "neutral" oil, as described in the paper, had reference only to saponifiable oils free from acidity. In reply to Mr. Williams, the method of analysis adopted in the examination of the samples was to titrate for the fatty acids, then saponify with caustic soda, and extract the unsaponifiable oil with petroleum spirit. In reply to Mr. Bell, the specific gravity was determined at 98° C. by the Westphal balance. With regard to the term "oleine" as used in commerce, it was very difficult to define. The calico printers' oleine was essentially a distinct product from the candle makers' oleine, or from the Yorkshire grease oleine. The oleine used by calico printers is a liquid oil prepared from castor oil by treatment with sulphuric acid and alkali. The candle makers' oleine is either oleine chemically speaking, or a somewhat impure oleic acid, according to whether it has been prepared by pressure or distillation from fats; and Yorkshire grease oleine is different from either of these. In reply to Mr. Lake, he had not come across any of the complaints mentioned by him with regard to the damage done by the grease in the sizing of cloth, but still he thought it would be quite possible to occur, owing rather to the impure character of the Yorkshire grease stearines. In reply to Mr. Singer, with regard to the effect of iron in the dyeing of wools, he did not think the very minute quantity which was present would have any material effect in the process. With regard to his question as to the use of solvents in the abstraction of grease, he did not think they had been used in this country. In reply to Mr. Rawson, his reply to Mr. Grimshaw would be sufficient to answer his question with regard to the presence of hydrocarbon oil in the grease. In answer to the Chairman, the oil is applied to the wool by means of machines and not necessarily by sprinklers, and he was inclined to think that the blue flame was due to the use of an oil with a low flash point, and that there was a certain quantity of electricity produced by the working of the machine which caused the vapour of the oil to flash. He had known of similar cases in other industries where volatile oils had been used in connexion with machinery. In reply to Mr. Bell, the No. 3 oil in which this flashing was noticed had a flash point of 322° F.

Mr. C. RAWSON: The usual methods of estimating unsaponifiable matters in oils when applied to Yorkshire grease do not give satisfactory results. I have adopted the following plan, which, although somewhat lengthy, is perfectly reliable. A given weight of the sample (4–5 grms.) is saponified in the usual way with an excess of alcoholic potash. The solution is evaporated to dryness, adding when nearly dry a little bicarbonate of soda and some sand or ground

glass. The mixture is then transferred to a Soxhlet's apparatus and extracted with ether. The ethereal solution, which contains all the unsaponifiable matters (cholesterin, &c.) with a little soap, is shaken up with water containing a little potash in a separator. The two liquids now quickly separate, as in the case of a mixture of fatty and mineral oils, and the ether solution is washed with water and treated in the usual way.

Meeting held February 5th, 1889.

DR. G. H. BAILEY IN THE CHAIR.

BISULPHIDE OF CARBON. ITS MANUFACTURE AND PURIFICATION.

BY IGNATIUS SINGER.

BISULPHIDE of carbon is prepared by passing sulphur vapours over red-hot charcoal in a closed vessel; the sulphur combines at this high temperature with the carbon, and CS₂ distils over, which may be condensed. The combination of the two elements being direct, and the reaction of the simplest kind, its preparation would seem to be very easy. Nevertheless many difficulties attend its manufacture—chiefly on account of its great inflammability and the poisonous nature of its vapours—which, however, are purely technical, and will therefore command most of our attention.

On a small scale it may be prepared by heating fragments of charcoal in a porcelain or iron tube to redness, and passing sulphur vapours through it. This is both a tedious and a dangerous way and never employed at present, as CS₂ is now made on a very large scale. Vertical iron or earthenware retorts, about 6 feet high and 22 by 12 inches internal diameter, are now used, capable of making from 4 to 5 cwts. per 24 hours. Great care is necessary to prevent all access of air into the apparatus, as bisulphide of carbon vapour mixed with oxygen or air forms a powerful explosive, which in itself often disastrous, is still further aggravated by the creation of two poisonous gases, thus:—



leaving the nitrogen as a third irrespirable gas. From this it will be seen that the greatest care is necessary to make all joints perfectly air-tight, and above all to exclude air from the generating retort, as no bisulphide is formed while oxygen is present, the sulphur having a greater affinity for this than for carbon. But this was at first by no means an easy matter, as the retort must have several openings for introduction of sulphur and charcoal—the former every few minutes—for the delivery of the vapours and the withdrawal of the ashes; while the necessarily high temperature makes it difficult to find a suitable cement to ensure tightness.

Another difficulty—and perhaps the greatest of all—is occasioned by the large quantity of uncom-

bined sulphur which distils over, and has a tendency to choke up the exit pipes and condensers. Hence every few days the apparatus has to be opened to remove this accumulated sulphur, an operation not at all free from danger, unless proper arrangements have been made to facilitate this part of the work.

From these preliminaries it will be easy to gather what should be the leading features of a good bisulphide of carbon apparatus, and may be summarised as follows:—

1. Absolutely air-tight joints throughout the apparatus.

2. Easy introduction of the sulphur, without admission of air.

3. Easy access to all parts for the purpose of removing sulphur.

4. The charging in of carbon should be quick, and while cleaning out the apparatus the condensing part should admit of being isolated from the retort to prevent sparks entering from the latter into the former.

These points will be more fully explained as I proceed to describe the modes generally employed.

The first to manufacture CS_2 on a commercial scale was Peroncel, in France, about 40 years ago. This apparatus being the oldest is necessarily the most imperfect. It is shown in Fig. 1. I have purposely selected this as one of my illustrations, since in noticing its defects it will afford us good opportunity to study what to do and what to avoid in the erection of a good plant.

The illustration is taken from Richardson and Watts' Technology, where the following description of it is given:—

"A is a metal cylinder carefully coated on both sides with fire-clay. It was fixed on a solid metal support, B, and the whole was surrounded with brickwork, C C. The lid was cast with two openings, E E, through one of which an earthenware pipe, c, descended nearly to the bottom of the cylinder, the lower end resting on hard burnt coke, with which the cylinder was filled. As carbon passed off during the operation, in combination with the sulphur, its place was supplied by fresh charges of coke, which were filled in through the other opening, E, in the lid. A metal arm, H, cast with the cylinder, was connected with a pipe, I, which was ground in at one end, the other passing into an earthenware carboy, J. A pipe with a cock, K, was attached to the bottom of the carboy, which carried the liquid into a Florentine receiver partially filled with water. This receiver discharged the bisulphide of carbon into a close vessel, O, by a pipe, M, from which it could be drawn off by a cock, N.

"The uncondensed vapour escaping from the carboy passed through another earthenware pipe, P P, to a worm G, made of zinc or earthenware, which was kept cool by a current of water. The bisulphide of carbon ran off at R into another close vessel, S, furnished with a cock.

"The space between the metal cylinder, A, and the brickwork, C C, is partially filled with fuel, which, when ignited, is supplied with air through the openings, D D, and the products of combustion escape at I.

"The fuel is now ignited, and the cylinder gradually heated until it becomes red, when pieces of sulphur are thrown down the pipe, c, at intervals of a few minutes. The sulphur is converted into vapour, which, coming in contact with the red-hot coke, combines with the carbon, producing the bisulphide of carbon.

"The cylinder," we are told, "lasts only about a week, and when made about 6 ft. long by 1 ft. diameter, it will produce about 2 cwts. of bisulphide of carbon per day."

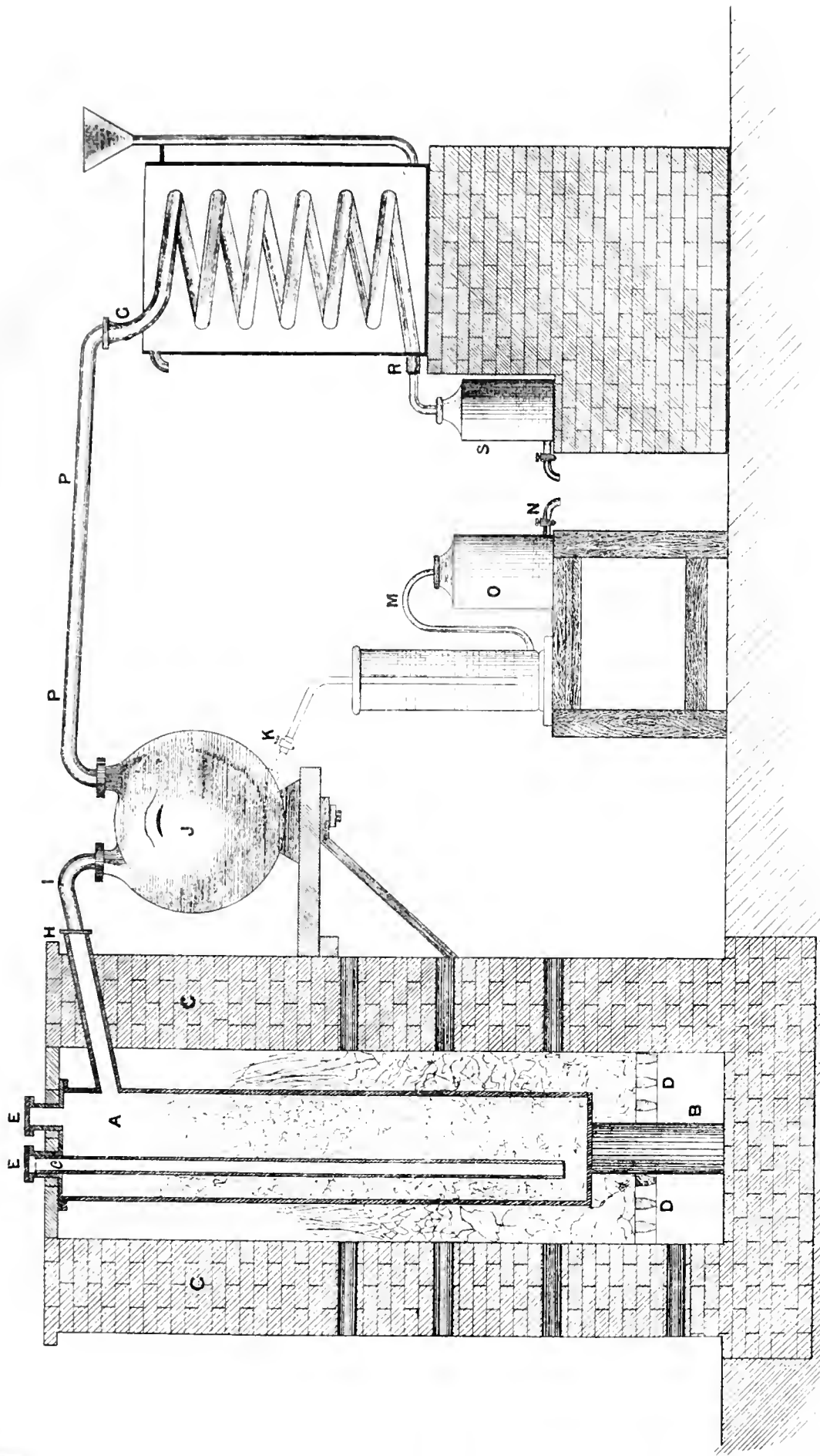
This last statement is in itself a very serious matter, as to remove the old and replace a new retort the furnace must first be allowed to cool down, portions of the brickwork removed, and subsequently restored again and heated up to redness, which would entail the loss of at least one week's work; besides this the heavy expenditure in labour, fuel, and material, all of which expenses would have to be borne by about 14 cwts. of the product. At present retorts are constructed to make at least 4 cwts. of bisulphide per day, and which last 60 days and more, thus spreading nearly the same expense over a quantity about 17 times larger than the former, lessening its cost in proportion. I may also mention that at present charcoal is used exclusively, it having been found to yield larger quantities than coke.

The furnace itself is constructed on bad principles, as it would consume more fuel for a given result than would otherwise be necessary. Instead of surrounding the retort to nearly half its height with fuel, whereby the lower portion of the retort is liable to be kept cool and result in a less yield, the fuel ought to be burnt in thin layers on a grate, as in boilers, and the air admitted from underneath the grate only, and so arranged that the flame and hot products of combustion should circulate all round and the whole length of the retort. By this not only a greater calorific effect would be obtained from a given quantity of coal, but the retorts would be more uniformly heated, and yield a larger quantity of bisulphide. Again, by placing several retorts in one furnace a great saving is effected in fuel, labour, and general expenses.

A great loss in bisulphide must have been occasioned by the frequent removal ("every few minutes") of the lid, c, for the purpose of introducing the sulphur, not to speak of the inconvenience caused by the sulphurous acid vapours to the men attending to this operation. But the worst feature in this apparatus is its condensing arrangement. As already pointed out, considerable quantities of uncombined sulphur pass over with the bisulphide, crystallising out on their passage through the condensers and causing great annoyance. This sulphur has to be removed from time to time, hence the condensing arrangement ought to consist of straight pipes only, worm condensers being altogether inadmissible. In Peroncel's arrangement the carboy, J, is evidently intended to retain this sulphur; but although the greater part of it would condense here, sufficient quantities would be carried over into the worm, whence its removal would be impossible without destroying the worm itself, while the carboy would present similar difficulties.

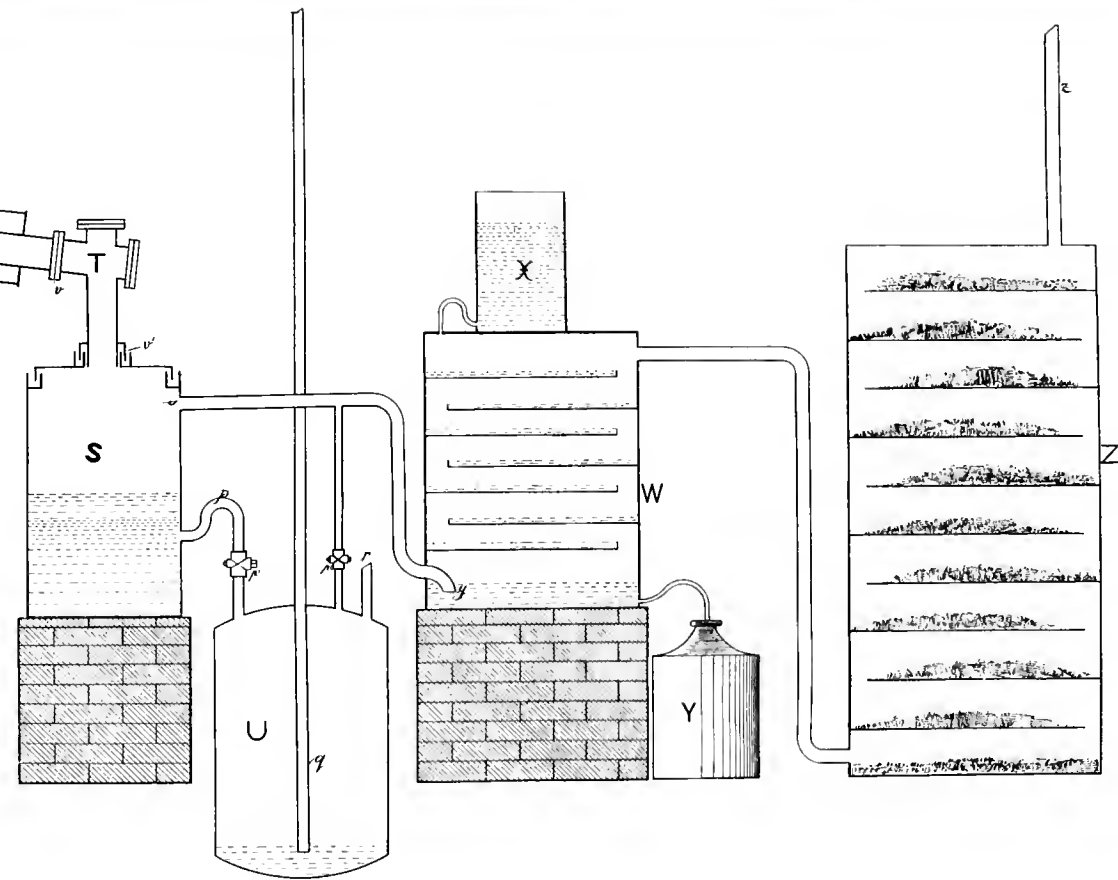
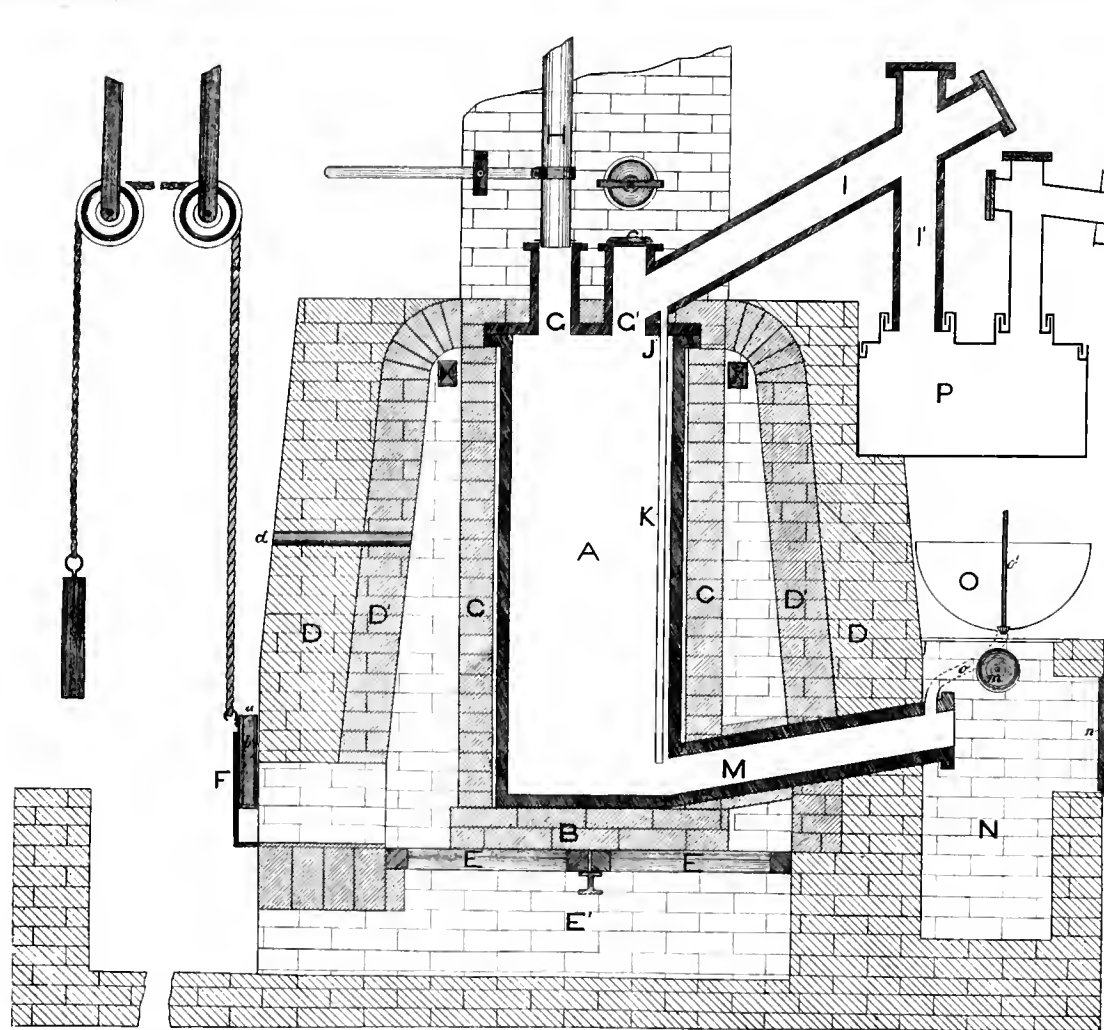
There is yet another point that demands attention, and for which no provision seems to have been made in this apparatus. The charcoal contains a considerable amount of hydrogen, which gives rise to the formation of sulphuretted hydrogen. When the retort is freshly charged with charcoal, no bisulphide of carbon is formed until all the hydrogen present has passed off in combination with sulphur. Means must be provided to carry off, and if possible, to absorb, these deleterious vapours. How this may best be done will be shown further on.

Among those who improved most largely on Peroncel's arrangement, Deiss deserves special mention. In Stolman and Engler's edition of "Payen's Industrial Chemistry," it is stated that





24



within a few years he reduced the price of bisulphide of carbon from 2 francs per ounce to 50 cents per pound. At present it can be manufactured at a cost price of 1*d.* per pound or thereabouts.

Without stopping, however, to trace the successive improvements that have been made since Peroncel, I shall now describe what I consider to be the best apparatus of to-day. Having manufactured this substance, I am well acquainted with all the technical difficulties attending its production; and in the illustrations following I shall make various suggestions by which some of the sources of annoyance yet existing might be obviated.

I hope I may be pardoned for entering rather fully into details, in which I think I am amply justified by the industrial importance this substance has of late achieved, especially if we consider that our literature has not kept pace with its rapid development, and that but few of our handbooks describe its mode of manufacture, and those only giving more or less obsolete methods.

Fig. 2 shows a side elevation in section.

A is a vertical cast-iron retort, or, better still, made of earthenware, glazed inside, of elliptical shape, about 66 ins. high and 20 by 12 ins. internal diameter. It rests on a support, B, made of fire-bricks, and is protected by a mantle of best fire-bricks, C, about 4 ins. thick, leaving a space of from $\frac{1}{2}$ to $\frac{3}{4}$ in. between it and the retort. The metal of the retort should not be less than 2 ins. in thickness. D D is the outer brickwork of the furnace lined on the inside with fire-bricks, D' D'. E E, fire grates; E' E', ash-pits; F F, furnace-doors, made of frames, *f*, into which a fire-proof slab, *h*, is inserted. The furnace doors are suspended by cables running over pulleys, and are counterpoised, so that they can be raised or lowered. At *d* is shown a small peep-hole, through which the temperature in the furnace may be watched, a matter of the greatest importance, as we shall see presently.

In the lid of the retort are cast two tubes, G and G', of about 5 ins. internal diameter, and not less than 1 in. in thickness; but it is advisable to have them made somewhat stronger, as the lid will then outlast several retorts. Over the opening G, a vent-pipe or flue, H, is suspended by a lever, so that it can be raised or lowered at will, one end of which passes through the roof. When fresh charges of charcoal are to be introduced into the generator A, which is done through the tubulure G', the lid closing the tube G is first removed, and the vent-pipe, H, quickly lowered, which serves the purpose of carrying off the noxious gases that would otherwise be injurious to the workmen. G' may now be opened, and the carbon fed in without the slightest inconvenience.

From the tubulure G' issues a pipe, I, inclined upwards, through which the bisulphide of carbon vapours escape. Most of the free sulphur passing over will condense here and run back into the retort. But the partially cooled sulphur falling on to the surface of the incandescent carbon would be immediately vaporised again, at the same time cooling down the top layer of the charcoal. To obviate this, I would suggest an opening should be made in the lower part of the pipe I, to which a hopper can be fitted, as shown at J, terminating in an earthenware pipe, K, reaching nearly to the bottom of the retort. By this means the sulphur distilling over uncombined would be conducted back to the bottom of the generator, the pipes would be less liable to be choked up, while the resulting product would be purer.

From the lower end of the retort, close to the bottom, a pipe, M, is branching off, a little upwards inclined, passing through the brickwork, and terminating in a chamber, N, with door *n*. During work this pipe is carefully closed by a lid. It serves the purpose of raking the ashes out of the retort, which is done once a week. At *m* a flue is shown, carrying the noxious gases into the chimney. The ashes are allowed to cool here before their removal. Adjoining this chamber is a hearth into which an iron vessel, O, is fitted, for melting the sulphur. It is heated by a flue from the furnace passing underneath it, provided with a damper to regulate the heat. (In Fig. 2 this sulphur vessel is raised so as to make it visible in the drawing.) A pipe, *o*, closed by a conical valve to which an iron rod *o'* is attached, connects the sulphur pot with the arm, M, of the retort, by which means the sulphur can conveniently be introduced into the latter.

The sulphur flowing down the incline of the arm, M, arrives at the bottom of the retort, where it is volatilised; the vapours passing upwards, combine with the carbon. The generated bisulphide vapours escape through pipe I, and then pass down the vertical tube, P, into a vessel, P', where any excess of sulphur is deposited. The lid of this vessel rests in hydraulic seals, and is connected with the inlet and outlet pipes by a kind of telescopic tubes made air-tight by water, as shown in drawing. When the vessel, P, is to be removed, the lid is raised, the vessel taken away, another similar one put in its place, and the lid lowered again. This should be done once a week only, and never while distillation is going on.

The bisulphide of carbon vapours, now freed from the greater part of uncombined sulphur, pass through a Liebig's condenser, G, about 30 feet long, into a receiver, S, partially filled with water. The cross-piece, T', connecting the Liebig's condenser with the receiver, is made so that it can be detached—being secured at *v* by flanges bolted together, and at *v'* by water seal—for purposes of cleaning, &c. From here the bisulphide is allowed to run through a syphon, *p*, direct to the storage tanks. A better plan, however, is to keep the storage tanks for the crude product on a high level, which greatly facilitates the after process of purification. In this case the bisulphide of carbon is allowed to flow into a *montejes*, U, as shown in drawing. A pipe, *q*, reaching nearly to the bottom, is passed through the cover of the *montejes* to the high-level tank. A second pipe, *r*, connects the vessel U with a force pump. On air being pumped into U through *r*, the stop-cocks *p*¹ and *p*² having been shut off, the bisulphide is pressed up through pipe *q* into the tank. This is a far better method than using pumps, as in the latter it is difficult to prevent leakage, the crude bisulphide having a very corrosive action on most metals. For the same reason the receivers, tanks, &c., for the crude substance should all be lined with sheet-lead, as wrought-iron vessels soon perish, while copper is even more energetically acted upon. Cast iron withstands corrosion much better, but is objectionable on account of its porosity. This might be remedied, however, by giving the vessels repeated coatings of dilute silicate of soda, both inside and outside, the vessels being first slightly heated with steam and the silicate applied while warm.

Near to the top of the receiver, S, is a pipe, *s*, for carrying off the uncondensable vapours—chiefly sulphuretted hydrogen. The gases are conducted into a rectangular vessel, W, where they are made to circulate in zig-zag over a series of shallow trays filled with a vegetable oil, to absorb any bisulphide

vapours which have escaped condensation. The oil can be made to trickle from a reservoir, H, as shown, through a goose-necked pipe, which, passing from tray to tray in an opposite course to that of the gases, finally trickles through X into a receiver, Y. When a sufficient quantity has accumulated here, the bisulphide is distilled off and the oil returned to X. Before the gases enter this absorber, they are "washed" by making the end of the pipe *s* dip into the oil as shown at *y*, whereby the apparatus is disconnected from contact with air. The gases are now passed through a second vessel, Z, similar in construction to the one just described, only substituting lime or oxide of iron for the oil, to absorb the H_2S , and are then allowed to escape into the open air through the pipe *z*.

Above the retort, A, and between it and the chimney set at right angles to each other, is a smaller retort, similar in construction to A, but only about one-third the capacity of the latter, and is heated by causing the products of combustion coming from the furnace to circulate round it before finally passing into the chimney. (Only the discharge hole, *h'*, corresponding to the arm *m* of the retort A, is visible in drawing.) As the generator, A, requires fresh charges of carbon every eight hours, it is very economical to keep this small retort always filled with charcoal, which by the time it is required will be red hot, and no more time need be lost than is required for transferring it from the one into the other retort. By this arrangement part of what would otherwise be waste heat is utilised, and a great saving in time and fuel effected. A still better plan is to make the charcoal on the spot, eight hours being more than sufficient to char the wood and to heat it up to bright redness. The spent dye-woods, tanners' refuse, or sawdust are excellent for the purpose, and as these would not require crushing—as when charcoal is bought in lumps—a saving in labour, possibly also in money, might be made, besides being more cleanly. By a small outlay the vapours might be condensed, and pyroligneous acid obtained as a by-product. I have used the sawdust from sandal wood, from which the oil had previously been extracted, for making charcoal in this way, with good results.

The apparatus is worked as follows:—After having allowed the brickwork to set and partially dry for a few days, the fires are started, at first gently, to prevent the brickwork from cracking, then gradually increasing the heat, until the retort becomes a dull red colour. The latter is now filled with small charcoal, and the smaller retort with chips, sawdust, &c., and the fires are now urged on until the retort and the charcoal in it have become a "cherry red." This heat should never be exceeded, nor should it be allowed to fall below this, as in either case it would result in a lesser yield of CS_2 . Sidot experimented with specially prepared charcoal at various temperatures, in each case employing 10 grms. of carbon and 40 grms. of sulphur, with the following results:—

Temperature.	Loss of Carbon.	CS ₂ .
	Grm.	Grm.
Dull red heat.....	5	17
Red heat.....	6.3	29
Bright red heat.....	7.5	19

or for a uniform loss of 5 grms. carbon in each case he obtained 17, 23, and 12.7 grms. of CS_2 respectively. These experiments—borne out by the practical experience of the manufacturer—show conclusively

the great importance of maintaining the heat at or about the proper temperature, which is not difficult if intelligent and reliable men are employed.

On having attained the proper temperature, the two openings in the lid of the retort are closed, the lids being screwed down tightly, with some clay made into a thick paste as a lute. I have found it difficult, however, to make good joints in this way, there often being a ring of a pale blue flame round the edge of the lids. A better way would be to cast in the top of these tubulures grooves, and the lids with a rim loosely fitting into these grooves, forming what is called a hydraulic seal, only using lead in the place of water. The heat there is sufficient to melt lead, but not so great as to prevent its use. This would form a much better lute, and could be opened and closed in much less time, which, in the case of bisulphide of carbon manufacture, is a great desideratum. Having previously secured all the joints throughout the apparatus, sulphur is now run in by raising the rod *o'* in the sulphur pot. A bubbling will immediately be heard in the gas-washer at *y*, caused through the escape of sulphuretted hydrogen, &c. In a few minutes this bubbling ceases, and CS_2 begins to distil over. Distillation is now proceeding, sulphur being charged in every five minutes, about 1½ to 1¾ lbs. each time, for seven hours, when the supply of sulphur is stopped, and one hour allowed to elapse before fresh charcoal is filled in. The lid is then removed from G, and the flue-pipe, H, lowered. G may now be opened, and lastly of all the lid *h'* is removed from *h* of the carboniser, and the red-hot charcoal raked from the carboniser, by means of a funnel or hopper, into the retort A. The retort is now closed, taking care that the openings communicating with the flue H is the last to be shut off, and work started again. At the end of each week neither coal nor sulphur is charged in for eight hours, after which the whole apparatus is cleaned out in the following manner:—

The flue H having been lowered on to G as described above, the cover *k* at the end of the delivery pipe, I, is removed, and wet bags or pieces of canvas are tightly rammed down the pipe I, and past its junction with the vertical pipe I', so as to isolate the condensers, &c. from the furnace. The ashes are now raked out through M, as described above, the retort refilled with fresh charcoal, and while this is getting heated up, the other portions of the apparatus are examined, and where sulphur is present it is removed.

With one such retort from 4 to 5 cwt. of CS_2 can be made per day, but it is much more economical, both in labour and fuel, to have several retorts—say four—in the same furnace.

The Purification of CS_2 .

The product obtained by the above process contains considerable quantities of sulphur in solution, also a large amount of H_2S and other sulpho-compounds, which impart to it a pale yellow colour and a very disagreeable odour. Of these impurities it can be easily freed by careful rectification, leaving a colourless, mobile, liquid, of an odour not at all disagreeable, and resembling that of chloroform. Commercial CS_2 is seldom pure, and in many instances differs from the crude substance only in containing a lesser quantity of free sulphur, while nearly all the other impurities which impart to it that disagreeable smell are still contaminating it. From the latter it cannot be freed by simple distillation, as the H_2S and other gases distil over with it and are re-absorbed during condensation.

From the many methods that have been suggested for its purification I shall describe the one only which alone can be employed on the large scale, the others being too expensive for commercial purposes without offering any special advantages.

I have employed the following simple method with very satisfactory results:—

A cylindrical vessel, about 30 inches in diameter and 6 feet high, is provided with a perforated coil of lead pipe at the bottom. Into this vessel I run the CS_2 to be purified to about one-third its height. I then pump lime-water into it, the latter being introduced into the vessel by means of a force-pump through the perforated coil. The lime-water, being specifically lighter than the CS_2 , rises to the surface, and while traversing the body of the bisulphide in a finely divided spray, the lime combines with the H_2S , &c. I continue this washing until the lime-water, which leaves this vessel through an overflow pipe near to the top, is perfectly clear. The CS_2 is now run into a still, about 1 per cent. its weight of a cheap, colourless oil added, and covered with a layer of about one inch of water, to which some sugar of lead may be added. The CS_2 is now distilled in a water-bath and condensed in the usual way. A very pure product is obtained in this way. I have treated in this way CS_2 bought from a Manchester maker, which was supposed to be "rectified." Its specific gravity was 1.292; after having washed it in the above manner it had a specific gravity of 1.289, which was reduced to 1.286 after distillation.

As the various handbooks on chemistry give ample information as regards the properties of this interesting compound, I shall not extend the limits of this paper by describing them, but will conclude by enumerating some of the leading uses to which it is already put. This list is by no means exhaustive, and is rapidly growing.

I. For the extraction of fats and oils from seeds, &c.

II. For the extraction and recovery of oils and fats from bones, stearine-waste, dried axle grease, the pressings (greaves) from tallow, sanza (the husks of the olives after leaving the presses), and a large number of other waste products.

III. From rags and cotton-waste used for cleaning machinery, leaving both oil and rags in a fit state for re-use.

IV. For cleaning wool and recovering the fat therefrom.

V. As a solvent for chloride of sulphur in vulcanising caoutchouc and in waterproofing.

VI. For the extraction of sulphur from poor ores, which used to be thrown away as being too expensive to extract by the old process.

VII. For the recovery of grease from soapsuds in wool-washing.

VIII. For killing weavils in grain. (A small quantity mixed with the grain in a closed chamber is said to kill even the larvæ.)

IX. In Australia it has been very extensively used for killing rabbits.

X. An emulsion of CS_2 with water, which is easily made by the addition of a small quantity of sulpho-ricinoleate, is used for killing parasites on plants, and is largely used in France and Germany for the extermination of the *phyllorhiza vastatrix*.

XI. In electro-gilding, as a solvent for phosphorus.

XII. In prisms, on account of its great refractive power.

Of late it has been proposed for use in steam-boilers instead of water, and several devices have recently been patented for the purpose.

CS_2 is also very useful for producing low temperatures and as an anti-putrescent.

DISCUSSION.

The CHAIRMAN remarked that, although Mr. Singer had addressed himself specially to those engaged in this industry, no one could have listened to his graphic account of the process without deriving considerable benefit and pleasure. If Mr. Singer could, in his investigations on bisulphide, discover a practicable method by which such bodies could be eliminated from coal gas, he would confer a great benefit, and especially on the people of that district.

Mr. H. L. TERRY had had some experience in the use of carbon bisulphide, and referred to the frequent occurrence in it of sulphuretted hydrogen. He had heard that this impurity was produced in the carbon bisulphide on standing, and he wished to know if Mr. Singer had noticed this to be the case. With regard to the explosive properties of this substance when its vapour was mixed with a certain volume of air, he had had convincing proof of this, as during one of the recent fogs a quantity of the vapour collected, and was exploded by a spark, doing serious damage to property. Users of this body were not sufficiently aware of this danger. Nothing had been said as to the deleterious physiological effects of the vapour. His experience was, that if some substitute could be found for it, it would be the better for the health of the workpeople who were brought in contact with it.

Mr. GEORGE E. DAVIS thought there could only be one opinion as to the great technical value of bisulphide of carbon. It showed, perhaps better than anything else, how necessary it was to follow up the process from the beginning. In the erection of chemical plant on a large scale, sufficient consideration was not given to the danger arising from defective construction causing an accumulation, through the apparatus becoming choked, and the necessity of making a hole to admit of an escape.

Mr. WATSON SMITH said that for scrubbing the final gases from the apparatus, coke-packed scrubbers were fixed at the end of the system with which he had worked, and filtered anthracene oils were allowed to flow down them. The oil was afterwards collected and steamed. Thus, bisulphide of carbon was recovered and sulphuretted hydrogen removed in the condensed water. With regard to the methods for preventing the bisulphide of carbon affecting those who came in contact with it in india-rubber works, he thought Mr. I. Frankenburg deserved great credit for covering over the channels conveying the bisulphide, and other apparatus with glass, in order to prevent the fumes from affecting his workpeople. A slow draught was thus caused to circulate through the system, so that bisulphide vapours could not escape, though air might be slowly sucked in.

Mr. SINGER, in reply, said he would rather use bisulphide of carbon than any other substance. It had the advantage of being heavier than water, and if fairly used, with proper apparatus, nothing was easier to handle.

Newcastle Section.

Chairman: T. W. Stuart.

Vice-Chairman: P. P. Bedson.

Committee:

Alfred Allhusen.	H. R. Procter.
G. T. France.	B. S. Procter.
G. Gathral.	W. W. Procter.
John Glover.	W. L. Remnoldson.
T. W. Lovibon I.	C. H. Ridsdale.
John Pattinson.	J. E. Stead.

Hon. Local Secretary and Treasurer:

J. T. Dunn, The School, Gateshead.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held in the Durham College of Science,
Thursday, February 7th, 1889.

MR. T. W. STUART IN THE CHAIR.

ANALYSES OF SALT STALACTITES.

BY PROF. P. P. BEDSON.

PROFESSOR BEDSON communicated the results of analyses of stalactites of salt, found in some of the disused workings of Redhenge Colliery, Gateshead. The stalactites were of considerable length, some colourless or white, others reddish-brown. The analyses were executed by Mr. W. H. Dunn, junior, a student in the College of Science, and the following are the results:—

Results of analysis of the white salt, which was entirely soluble in water:—

Moisture	0.28
Magnesium	0.04
Calcium	0.19
Sodium	39.06
Chlorine	60.11
	<hr/> 99.95

Chlorine required..... 60.16

Analysis of brown salt stalactites, not entirely soluble in water. The insoluble matter consisted chiefly of ferric oxide:—

Moisture	0.28
Insoluble matter	0.69
Magnesium	0.03
Calcium	0.16
Sodium	38.81
Chlorine	59.81
	<hr/> 99.78

Chlorine required..... 60.11

Professor Bedson afterwards conducted the members through the rooms of the chemical department of the new building of the College of Science, and explained the various provisions and devices to facilitate lecture and laboratory work. A hearty vote of thanks was awarded to Dr. Bedson.

A NEW VALVE ARRANGEMENT FOR REGENERATIVE FURNACES.

BY H. LE NEVE FOSTER.

THE invention of the regenerative gas furnace by the late Sir William Siemens, and its application for the manufacture of open-hearth steel, glass, and heating purposes, &c., &c., has necessitated a valve

by means of which the inlet of gas and the outlet of products of combustion can be reversed at will.

For this purpose Sir William Siemens designed what is termed the butterfly valve, which has been used for a number of years. The disadvantages of the butterfly valve are that the flap or butterfly becomes hot and warps, and consequently there is a leak of gas to the chimney, which becomes larger and larger until the flap has to be replaced at considerable inconvenience.

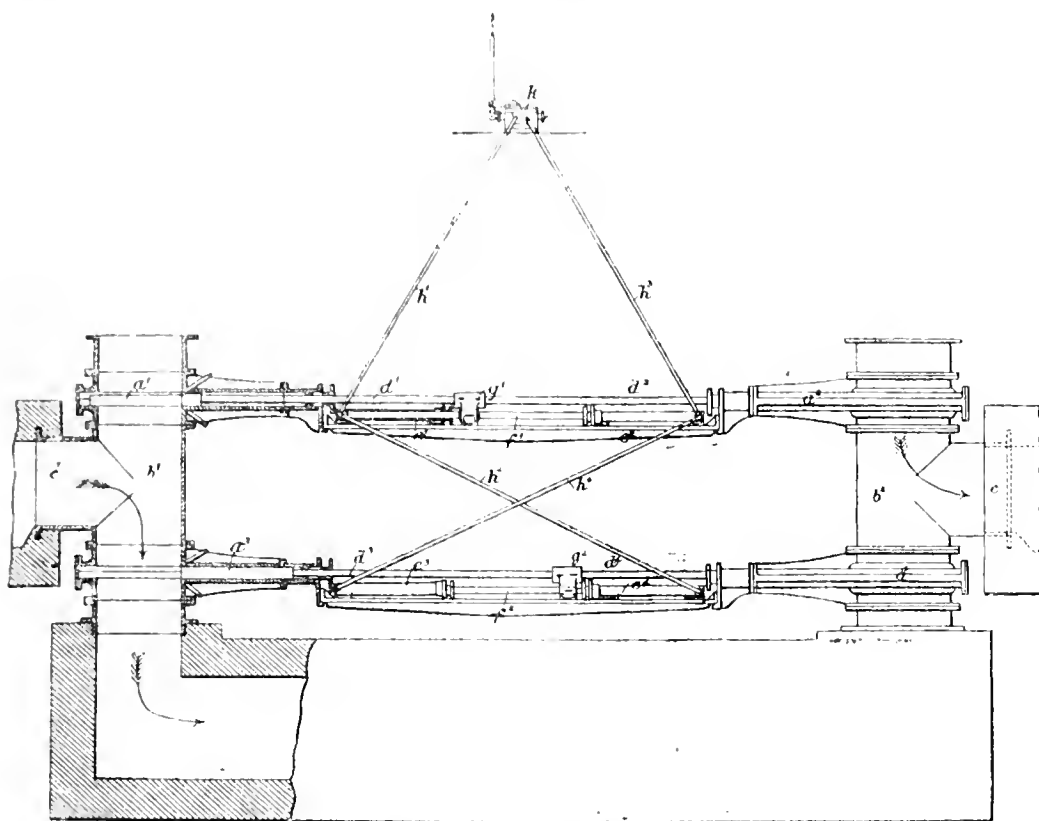
Sir William Siemens in his original furnaces used as a rule to recommend the use of cooling tubes, and in some of the works erected by him these cooling tubes were several hundred feet long, so the gases were comparatively cold before passing through the valve; at that time there was not nearly so much trouble with the valve. Now the most modern works have abandoned cooling tubes as much as possible, all tubes being lined with brickwork, so that the gases pass through the valves at a much greater temperature. I think I am correct when I say that all the open-hearth steel works in the North of England, which has now become the largest centre for the manufacture of mild steel for shipbuilding purposes, have abandoned the butterfly gas valve for their melting furnaces, though this class of valve is still used for reversing the air current, and, for this purpose, answers admirably.

The double mushroom valve is now being used, but this also has many drawbacks and does not work as satisfactorily as it should do, consequently the seats and valves themselves often have to be replaced.

I will now describe the accompanying drawing, which illustrates partly in sectional view, and partly in elevation, a set of valves, a^1, a^2, a^3, a^4 , with their operating mechanism, two valves being provided in the usual position in each of the flues or passage b^1, b^2 , that is one above and the other below the branch flues or passages, c^1, c^2 , through which the gases are admitted to the passages b^1, b^2 , or escape therefrom as the case may be.

In the drawing the valves a^1, a^4 , are closed, and the valves a^2, a^3 , are open. In this position of the valves the gases are passing from passage c^1 into the vertical passage b^1 , have their course diverted downwards as indicated by arrows, whilst the escaping gases entering passage b^2 from above, have their course diverted into the branch passage c^2 also as indicated by arrows.

If the position of the valves is exactly reversed it is obvious that the direction of the currents through the passages will be correspondingly changed, and that by reversing the valves from time to time the requisite succession of changes in the current of the gases can be effected in the well-known manner required in working a regenerative furnace. In order to operate the valve simultaneously the valves in the passage b^1 are fitted in the position so as to be exactly opposite respectively to the valves in the passage b^2 , so that by connecting the spindles d^1, d^2 , of the valves a^1, a^2 together, and the spindles d^3, d^4 , of the valves a^3, a^4 , together, the valves can be coupled together in pairs in the manner illustrated in the drawing. By providing suitable mechanism, such as a spur wheel mounted on a spindle in such a position as to gear into racks provided on the valve spindles, that is one rack fixed to the united spindles d^1, d^2 , and the other rack to the united spindles d^3, d^4 , the valves will be all operated together by the rotation of the spur wheel, and will be moved in the required manner, that is the upper pair of valves a^1, a^2 , in one direction, and the lower pair of valves a^3, a^4 , in the opposite direction, thus affording the requisite control of the passages between the regenerative chambers and the furnace. It is, of course, obvious that



other means can be devised for operating the valves in the same manner, as for instance by a hydraulic motor applied in the manner illustrated in the drawing, in which c^1, c^2, c^3, c^4 are hydraulic cylinders provided in the positions shown for the reception of the plungers f^1, f^2 , which are secured by means of coupling pieces g^1, g^2 to the valve spindles, so that any motion imparted to the plungers is simultaneously shared by the valves. h^1, h^2, h^3, h^4 are pipes communicating from the pump i to the cylinders c^1, c^2, c^3, c^4 , that is, water pumped into pipe h^1 enters the cylinder c^1 , and by means of pipe h^2 at the same time enters the cylinder c^4 , thus driving the plunger f^1 in one direction, and the plunger f^2 in the opposite direction. Similar water pumped into the pipe h^3 drives the plungers back again.

This is the plan I myself prefer, and is now being used in the valves which have been erected by the West Cumberland Iron and Steel Works; these valves have also been supplied with a water-jacket. This tends to keep the valve-casing from getting red-hot. These valves have now been in use some considerable time, and there is no leakage of gas whatever, and up to the present time they have required no repairs whatever, though some double mushrooms valves which were put in at the same time have had their mushroom replaced.

Another advantage is that there is a considerable saving in fuel. A new furnace with my valve arrangement only required one block of producers, that is four fires instead of two blocks of producers or eight fires, which were required for smaller furnaces next to it.

I think this helps to show that the waste of gas through a leaky valve is much more than one would anticipate.

Glasgow and Scottish Section.

Chairman: R. R. Tatlock.

Hon. Vice-Chairmen: { E. C. C. Stanford.
 { Sir J. Neilson Cathbertson.

Committee:

J. Addie.	T. P. Miller.
G. Beilby.	E. J. Mills.
A. Crum Brown.	J. M. Milne.
J. Christie.	T. L. Patterson.
W. S. Curphey.	J. Pattison.
W. Dittmar.	F. J. Rowan.
D. B. Dott.	D. R. Stewart.
R. Irvine.	A. Whitelaw.

Hon. Treasurer: W. J. Chrystal.

Hon. Local Secretary:

G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Errata.

In Mr. F. J. Rowan's paper on "Evaporation by Multiple Effect," in the January number of the *Journal*, the illustrations Figs. 1 and 2 were accidentally transposed. Fig. 1, p. 33, which purports to be the Smith triple effect apparatus, is really a view of the Yaryan evaporator, and Fig. 2, p. 34, is the Smith triple effect apparatus, not the Yaryan evaporator as stated.

In the 2nd column, page 32 of the same paper, lines 16, 17, and 18 should read as follows:—"and of those for dealing with liquids, the stills of Dorn, Derosne, and Coffey illustrate the class," &c.

The Fourth Meeting of the Session was held in the Rooms, 14, South St. Andrew Street, Edinburgh, on Tuesday, 5th February 1889.

MR. GEORGE BEILBY IN THE CHAIR.

THE MANUFACTURE OF PARAFFIN OIL.

BY D. R. STEUART, F.I.C., F.C.S.

THERE have been several papers on shale distillation and paraffin extraction read before the Society of Chemical Industry, but there has been no description given of the general operations of refining. In this paper I mean to give a short sketch of the whole paraffin oil manufacture as carried on at Broxburn, and in such a manner that outsiders, who at present know nothing of the subject, may get a general notion of all our methods of working. Many members of the Society visited the works last year, but only a small proportion I think, could have heard the explanations given. I shall have to go over ground familiar to anyone that has taken any interest in the manufacture, and describe apparatus and operations that have been described elsewhere, but in publications difficult to get at.

On the table I show samples of the bituminous shale from which we get all our products, and of the products themselves: sulphate of ammonia, naphthas, burning oils, lubricating oils, solid paraffins, gas oils, still coke. The naphthas are 730 and 740 sp. gr.—used as solvents, for burning in special lamps and for paraffin refining; the burning oils are 7800 to 7840, and the lubricating oils 7865 to 7895. There is soft paraffin, melting point 100° F., used largely for dipping the sticks of matches and for hand-lamps, and paraffin wax, semi-refined and refined, with melting points from 118° F. to 130° F., used for candle making. Solid paraffin and paraffin oil are now much used for washing clothes.

The shale field, which since 1877 has been worked by the Broxburn Oil Company, Limited, was taken on lease by Mr. Robert Bell in 1858, and in 1861 the distillation of the shale was in full operation. This was the beginning of the shale industry in Scotland. For the 10 years previous to this, during which the paraffin oil manufacture had existed, the Boghead or Torbanehill coal was the mineral used. This mineral gave 120 gallons of crude oil per ton. In 1862 it ceased to be worked for paraffin oil, and it was soon after completely exhausted.

The shale we work at Broxburn at present is what is known as the Broxburn seam. Its position geologically is in the lower carboniferous series, 740 fathoms or so above the Camps or Burdiehouse limestone (see Journ. VI., 128). There are seven other seams at least worked in the Lothian shale field, and these lie some above and some below the Broxburn seam, and within 300 fathoms of it. They vary in thickness and quality in different districts, what is thick and rich in one district being poor or thin in another. The shales differ in character also, the Pumpherston seams, for instance, being poor in oil but rich in ammonia. The Broxburn seam averages in the Broxburn Oil Company's field about 5 feet in thickness, part of this thickness giving over 40 gallons per ton and part little over 20 gallons. It is worked in the same manner as coal. Where the retorts are placed there is none of this

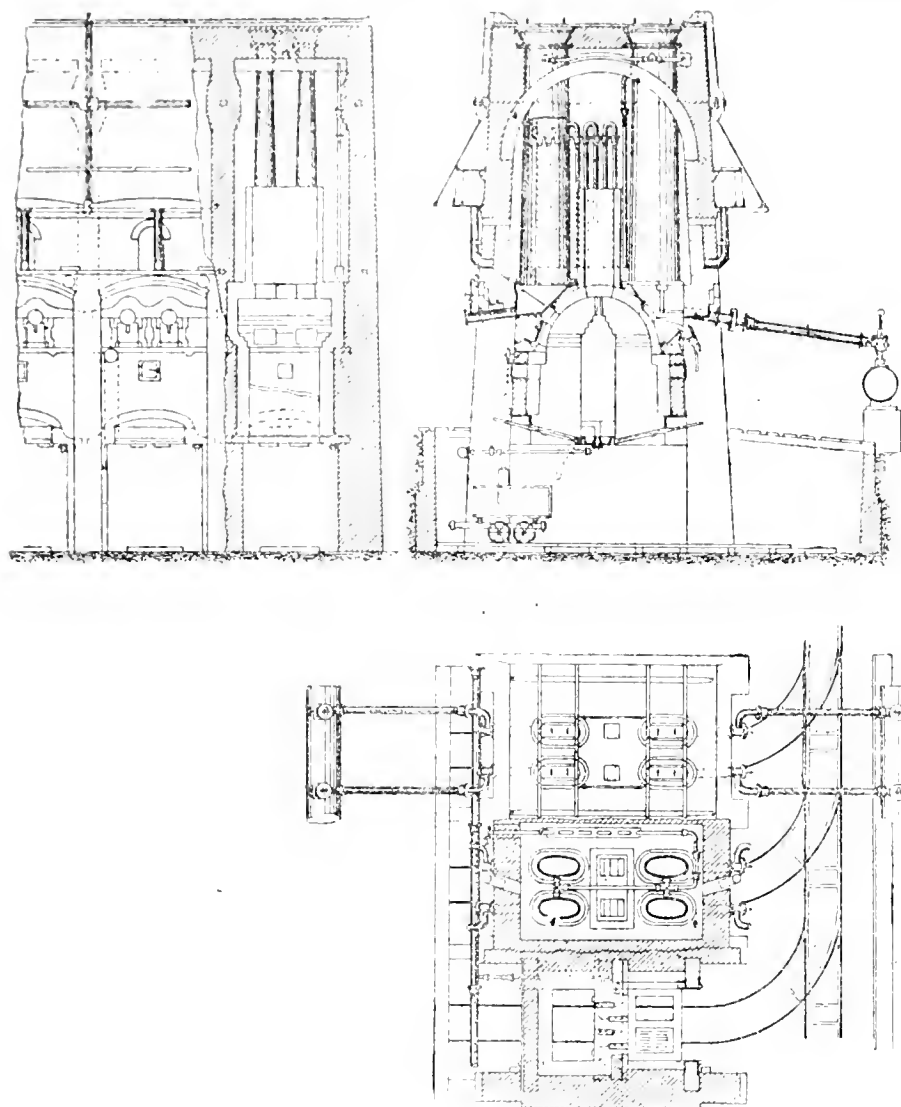
seam below, but it comes to the surface all round quite close to the works, and can be worked open-east. It gradually gets deeper, and mines are sent out radiating in all directions to get the shale at hand. The shale from these is brought by wire-rope arrangement in the mine hutches direct to the breaker, and the platforms for the hutch-railways are a conspicuous feature in the first glance at the crude oil works. Pits are sunk in various directions a mile or two further out to get the deeper shale, which is brought to the breaker by railway. The shale all passes through the breaking machines, where between two toothed iron rollers it is broken into pieces the size of a fist. The shale falls from the breakers into hutches, which are taken by endless rope to the top of the retorts, and tipped directly in. Manual labour is done away with as much as possible.

The first chemical process of the works is the destructive distillation of the shale. The shale contains by analysis: carbon, 20 per cent.; hydrogen, 3 per cent.; nitrogen, 0·7 per cent.; sulphur, 1·5 per cent. The compounds of these elements are no doubt of vegetable or animal origin. On treating powdered shale with shale naphtha or ether, the solvents remain quite clear and colourless, and dissolve nothing, proving that our products do not exist in the shale as such, but are all created by the destructive distillation. About 1,000 tons of shale are distilled at Broxburn per day, and the products are—

Volatiles:	Per Cent.
Crude oil.....	12
Ammonia water.....	8
Permanent gas.....	4
	24
Non-volatile (spent shale):	
Combustible.....	9
Ash.....	67
	73
	100

To get a good quality of crude oil the temperature of distillation must be low, a red heat invisible in daylight and faintly visible in the dark. In general, a higher temperature produces a heavier darker crude oil, giving more loss in refining, and less solid paraffin, but a higher yield of ammonia. The only retort now used at Broxburn is Henderson's patent retort. Of these there are 784, arranged in 16 benches. As you see from the drawings (Fig. 1) it is a vertical retort. It is of cast iron, 14 in. thick, 15 ft. long, and of oval section 2½ ft. by 1 ft. The charge is 18 cwt., and it lies in the retort for 16 hours, distilling off the crude oil, ammonia-water, and permanent gas. After this the spent shale, which still contains 12 per cent. of combustible matter, is dropped hot into the furnace below to act as fuel. Four retorts are built into one oven and are connected with the one furnace, one retort being dropped every four hours to keep up the succession of heat. The products of combustion are taken off at the bottom of the oven instead of the top, so as to produce the gentle draught required by the weak fuel. The permanent gas of the distillation is also burned as fuel. It used to be passed among the spent shale, but it is now burned in the bottom of the retort oven. Steam, superheated by passing through pipes in the oven, is passed into the top of the retort. It introduces the right temperature throughout the mass of the shale, and sweeps the distillation products rapidly out of the heat, where they would undergo decomposition. No coals are required for fuel, except to make a start after a

Fig. 1.



stoppage. The products pass off from the bottom of the retort to the main and condensers. The condensers are a series of vertical iron pipes cooled by the atmosphere. The crude oil and ammonia-water flow from the condensers through a small vessel called a separator, where they at once part from each other by gravitation, the oil being the lighter, and pass into their several tanks. The non-condensable gases are drawn up through large towers, where they are washed, by water trickling down, from any remaining ammonia. Some naphtha is here condensed by the cold of the water, but several gallons of light naphtha per ton of shale, which we used to catch in blue oil, are at present allowed to go with the permanent gas. There are fans to suck the products from the retorts. After the spent shale has been burned, the bottom of the furnace folds down so as to drop the ash into an iron hutch below. The hutch with its glowing contents is run into the pond for dirty water, which it causes to evaporate, and after being quenched

the residuum is taken by endless rope to the refuse bing.

This retort gives, without skilled labour or particular attention, the right temperature for making good crude oil. The mild temperature prevents the yield of ammonia from being nearly so high as it is with some high temperature retorts; but against this defect we have the long life of the retort, the good quality of the crude oil, and the economy as to fuel. The temperature of the oven is from 900° to over $1,000^{\circ}$ F.; the steam as it goes into the retort 630° F.; the shale inside the retort, 1½ ft. from top, three hours after charging, 630° F., 16 hours after charging 730° F.; and the products of distillation at the exit pipe 500 to 600° F.

It has often been suggested that reagents should be put into the retorts in order to get an increase of ammonia and a purer crude oil; but as far as my experience goes with this particular retort, neither lime nor soda has any appreciable effect of any kind, and the dust, when the spent shale

was dropped, made it very painful for the men. Solid reagents in the quantities that can be given on the large scale do not seem to come into sufficient molecular contact with the vapours. Gas reagents may be considered a little more promising. Mr. Tervet (*Journ. II.*, 445) got a greatly increased yield of ammonia by passing hydrogen into retorts at the end of the distillation. Mr. Irvine, by passing ammonia through retorts when the shale contained sulphur, got an increase in the solid paraffin. And Mr. Beilby got an increase of paraffin by passing air into his retort (*Journ. III.*, 220). In the Young and Beilby retort the large yield of ammonia from the hot part in passing through the part of the retort distilling the oil may help to give a higher yield of paraffin than would otherwise be the case at such a temperature; but how can air increase the paraffin? Can any of the oxygen reach the distilling oil so as to act on the sulphur or otherwise, or does the air act only by modifying the temperature?

A gas reagent used in all retorts is steam. It acts mechanically in protecting the ammonia and the complex hydrocarbon molecules from decomposition. At 1,000° C., according to Ramsay and Young, ammonia in presence of iron is nearly completely decomposed into its elements; but where steam is used in excess, as in the Groven method of analysis, all the nitrogen of organic compounds is at this temperature converted into ammonia, sulphur appears as sulphuretted hydrogen, the oxygen combines with the carbon, while some hydrogen is left free. Steam at such a high temperature is a powerful chemical reagent. At the comparatively low temperature of the Henderson retort its action is very gentle, but it does act on the carbon to some extent to give nascent hydrogen to help to build up ammonia and solid paraffin, and the yield of these is a good deal more than in the old vertical retorts worked at the same temperature.

Of the 1.5 per cent. sulphur in the shale, more than 1.4 per cent. remains with the spent shale when dropped from the retort, and 1 per cent., even after burning; 0.025 per cent. goes to the permanent gas, 0.028 per cent. to the crude oil, and 0.02 to the ammonia-water.

The nitrogen in the shale is equal to 70 to 90 lbs. of sulphate of ammonia per ton of shale. Of this we get no more than one-fourth, while nearly one-half remains with the spent shale. Mr. Beilby has studied the nitrogen very carefully in connexion with his retort products. (*Journ. III.*, 216.)

I got samples of crude oil taken from a retort every two hours, and tested specific gravity, setting point, loss with oil of vitriol, and loss with caustic soda. I found there was a gradual increase throughout in the specific gravity—from 863 to 888, and in the setting point—from 78° to 87° F. The loss with oil of vitriol gradually increased from 5½ per cent. at the beginning to 10 per cent. in the middle, and then fell to 5½ per cent. at the end. The loss with soda gradually increased from 2.6 per cent. to 3.8 per cent. The quantity of oil coming for some hours at the end was comparatively small.

Each ton of shale produces in the works on an average 30 gallons of crude oil, 65 gallons of ammonia-water, and nearly 2,000 cubic feet of permanent gas.

The permanent gas is sufficient in quantity to light up the crude oil works, fire the retorts along with the spent shale, and have a considerable quantity left to help to raise steam.

The crude oil is of a dark-green colour. It is semi-solid at ordinary temperatures, quite fluid when

gently warmed, but setting or ceasing to flow at 80°, from the amount of solid paraffin in it. Our crude oil averages about .865 in specific gravity. The crude oil of other works is sometimes .880 or .890 sp. gr. Our own shale distilled in the gasworks at a red heat gave about 4,500 cubic feet of rich gas; nine gallons of crude oil of .952 sp. gr., which was a thin mobile liquid, containing little solid paraffin, and 8½ lbs. of sulphate of ammonia per ton. The small yield of ammonia shows the influence of the high temperature in the absence of steam.

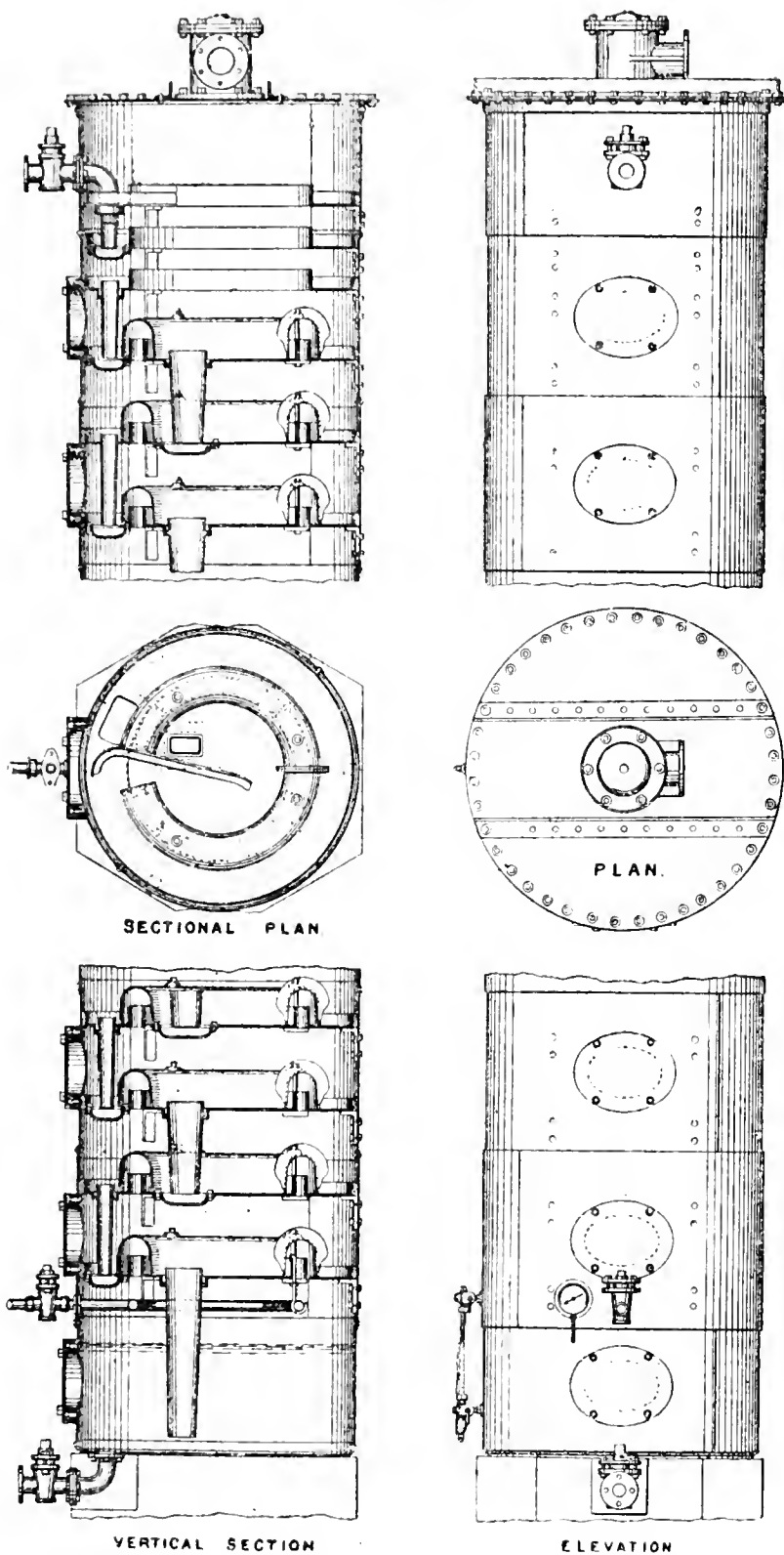
The ammonia-water averages 21° Tw., or sp. gr. 1.012. It contains ammonia equal 0.277 lbs. of sulphate per gallon, principally in the form of carbonate. There is a small proportion of sulphur present as sulphide, and traces of sulphite, sulphate, and thiosulphate; but no cyanide or sulphocyanate. The amount of fixed ammonia is small, and no lime is used in the distillation. The still we use is a column still of the form shown in the drawing (*Fig. 2*), 22 ft. long, 5 ft. in diameter, and with 14 trays. The three upper trays are open-topped annular channels; and the rest consist of an annular outer part, a disc-shaped central part, and a space between covered by an inverted piece which dips to the bottom of both the annular part and the disc part. The inverted piece is notched below, up to within half an inch of the surface of the liquid in the tray. The ammonia-water enters at the top, flows from tray to tray, and is discharged at the bottom exhausted. Steam of 25 to 30 lbs. pressure, introduced by a 2-in. pipe at the bottom of the column, rises through the space surrounding the disc, and passes through the notches of the inverted piece to bubble through the water of each tray. The system is a continuous one, and 35,000 gallons are passed through each still per day. It is found to be very economical in regard to labour and fuel, as well as in first cost of plant.

The volatile ammonia compounds are passed from the still into weak sulphuric acid. This acid has been used for refining the oil, and has been separated from the bulk of the tar with which it was combined. There are still strong bases in solution, and these are precipitated by the ammonia in the saturator-boxes in the form of a black tar which rises to the surface. After separating the tar, the solution of sulphate of ammonia is evaporated down in vessels heated by coils of steam pipes. The salt as it separates falls to the bottom and is fished out with a perforated ladle, and put up to drain and dry. In several days it is ready to be passed through a crushing mill into bags for the market. Neutral sulphate of ammonia on boiling gives off a little free ammonia, so the evaporating solution is always slightly acid in reaction. The temperature of the boiling solution rises to 225° F. Our sulphate is of a grey colour from a trace of impurities got from the acid. When the ammonia gases are passed into oil of vitriol, white sulphate of ammonia separates out and is fished direct from the saturator-box. It was at Broxburn that ammonia was first made from the ammonia-water of this manufacture, viz., by Mr. Robert Bell in 1864.

The operations of the oil refinery are (1) distillations; (2) treatments with chemicals; (3) cooling and pressing the heavy oil containing paraffin so as to separate the solid from the liquid.

The oil all gets several distillations—for purification, and for thorough fractionation of the different gravities of oil from each other. Between the distillations the oil is treated first with oil of vitriol, and, after settling, with caustic soda, and these separate all the compounds present except the products which

Fig. 2.



we want. The old method of refining was, first, to distil to dryness in cast-iron round-bottomed stills. Naphtha came over first below the temperature of boiling water, the temperature gradually rose, distilling light oils, intermediate oils, heavy oils and paraffin, until at the end, when still-grease came over, the bottom of the still was of a red heat. After cooling, the coke left in the still, 1½ ft. thick or more, was cleaned out and the still was recharged. In some works the distillation was stopped short of coking, and the residue run out as pitch. After chemical treatment the oil was redistilled from stills of malleable iron, which from their shape are called boiler stills. When the distillation was fairly started, oil was run into the boiler still, which kept distilling lighter oil only, until the heavy oil accumulated in the still, when the feed of oil was stopped and the heavy oil distilled off until there were only a few inches left. The firing was stopped, and the residue, after cooling a little, was run into a coking still (similar to crude stills) to be distilled to dryness. The boiler still was cooled, cleaned out, and recharged. The stills in this old system were all half their time cooling down, cleaning, and heating up. Steam was used in all the distillations, and had to be constantly altered as the distillation proceeded, and its manipulation often caused the still to froth over into the distillate and pollute it.

The present system of distillation is a continuous one, in which the stills are connected together into a series. One set of drawings show (Fig. 3) wagon-shaped stills connected with residue or coking stills, such as we use for crude and lubricating oils. Let us take the crude oil as an example. The wagon-shaped stills are charged up at first (2,000 gallons) and the fires lighted, and when distillation is commenced the cocks on the connecting pipes are opened, and the feed oil is run into the central still I. The feed is always heated on its way to the first still by the vapours of the distilling oil in a feed-heater of special safe construction shown in the drawings. Still, I, receives the oil at the front, and the oil travels along the length of the still, distilling off "green naphtha" of 753 sp. gr., which is condensed by an ordinary worm-tank condenser. The oil not distilled in passing through still I., is conveyed by pipes which proceeds from the back of this still to the back of stills II. and along the length of stills II. till they empty themselves at the front. The oil travels along these boilers distilling off a higher boiling fraction, 835 sp. gr., and from the back of II. a pipe conveys the concentrated oil to the residue or coking still III. The hot oil is run into an empty coking still, which for safety has been previously fired up gently, and the air thoroughly blown out with steam. One of these stills remains connected in the series for eight hours, when it is disconnected and distilled to dryness by itself, and another coking still takes its place. The distillate from these stills runs from 860 sp. gr. to 965. This set of stills can put through 35,000 gallons of crude oil per day.

Other drawings (Fig. 4, p. 107) show three ordinary boiler stills connected with each other and with residue stills. The old form of boiler stills can be cheaply connected in this way. This kind is used at Broxburn for all the after distillations except that of the lubricating oil. The charge for each still is 3,000 gallons.

Steam, more or less, is passed into all the boiler stills. There is considerable power of adjustment as to gravities of distillate by the cocks on the connecting pipes, the firing and the steam, and once adjusted they require little altering. There is no

danger of frothing over. Stills connected in this way can put through twice as much oil as when worked each by itself on the old plan. There is great saving in labour and fuel, as the boiler stills never require to be stopped or cleaned, and so do not require to be cooled down and heated up. There is also less cost in maintenance, as they are not subjected to the contractions and expansions of the cooling down and heating up of the old system. The fractionation is also more perfect and the distillates purer, giving less loss in refining, as the oils are always distilling from comparatively pure oils, and not, as in the old system, from concentrating impurities. For the last nine months our total loss in refining the crude oil has been only 26·7 per cent.

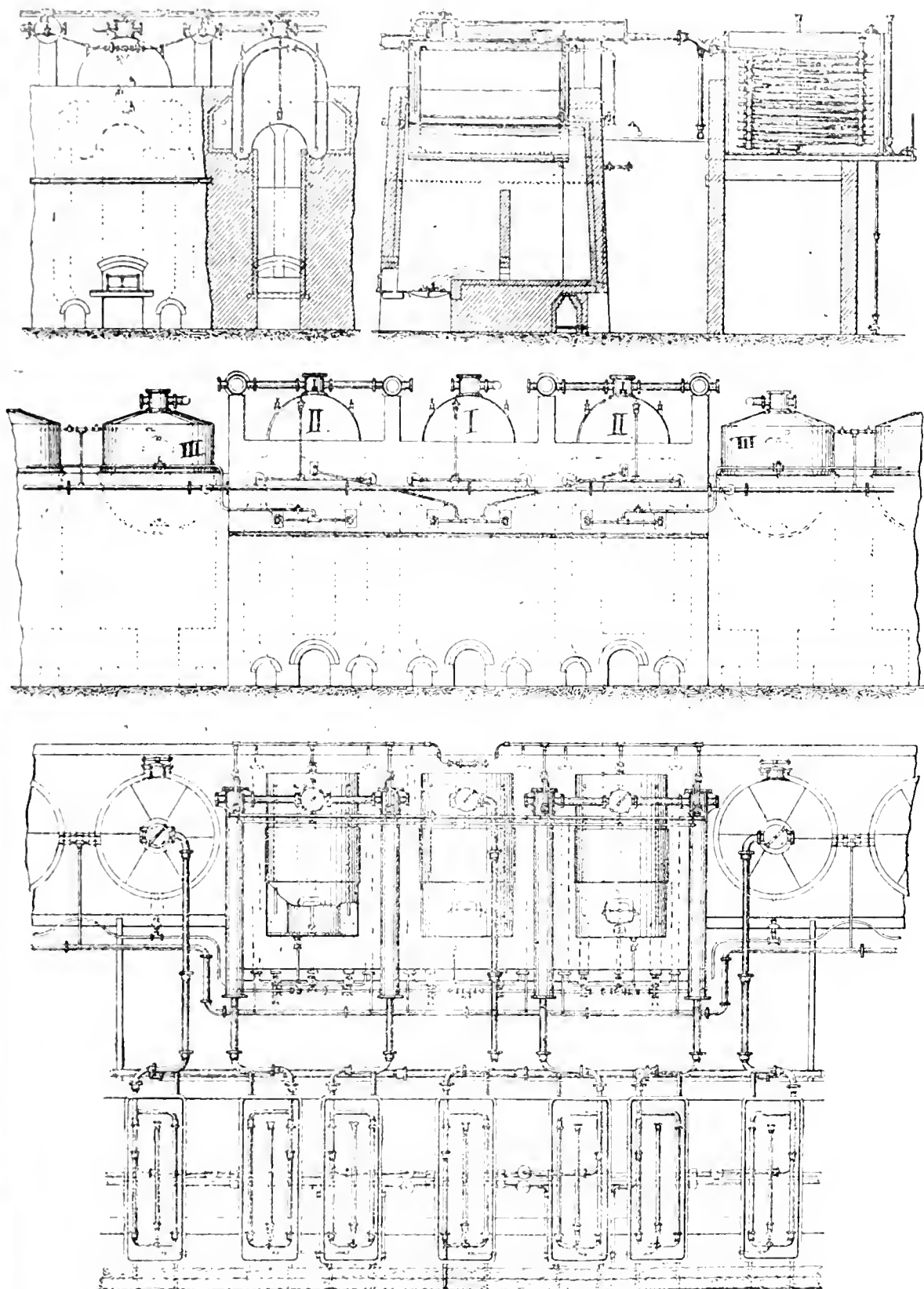
The stills have behind them a row of charging tanks raised above the level of the stills so that the feed oil runs from them to the stills by gravitation. Behind the charging tanks there is a row of tanks on the ground to receive the various distillates. Where it is possible the stills are arranged so that the products of combustion from one still requiring a high heat are used for firing another still requiring less heat.

When the crude oil is pumped from the retorts to the refinery it first gets a distillation, and by it is fractionated into green naphtha and green oil with gravities of 753 and 858, the distillates of stills II. and III. being run together in our present way of working. The naphtha gets a treatment with chemicals and a distillation, and is then ready for the market. The green oil is treated and distilled, fractionating into light oils and heavy oils containing solid paraffin. The light oils require one or two treatments and distillations to make them ready for the finishing treatment. The heavy oil and paraffin after cooling and separation of the solid paraffin is called blue oil. With a treatment and distillation it is ready for its final treatment as lubricating oil. This is an outline of the course of the bulk of the oil, but at each distillation there is fractionation, and some small fractions get a greater number of distillations than I have mentioned to bring them to right gravities for the market, or to fit them for special purposes.

The treatments take place in boiler-shaped tanks of malleable iron with paddle-shaped stirrers. Air stirring, which, I believe, is most commonly used in other works, is little used in ours. As we use only the strongest sulphuric acid, and have the mineral oil thoroughly settled from water, the iron is little acted on by the acid. The acid is stirred in the oil for an hour or so, and the mixture allowed to stand until the acid combined with the basic impurities goes to the bottom as a black tar, and is run off below. The oil flows by gravitation into another stirrer, where it gets caustic soda of 60° Tw. strength (sp. gr. 1·300), and this precipitates the acid impurities, which settle to the bottom, and are run off also.

As to the quantity of acid used, we aim at giving at each stage as much acid as we can without acting on the olefines. With the proper quantity of acid given the soda tar is black, but if too much acid has been used the soda tar is a voluminous white blubbery mass. For the green oil or oil once distilled we use the vitriol tar of the final treatments to some extent, but the total treatment is equivalent to about 3 per cent, by volume of oil of vitriol. The intermediate treatments are small, but the finishing treatments are larger, and with them we designedly use acid sufficient to act slightly on the hydrocarbons, and get a white blubbery tar with

Fig. 3.



soda. We have to give sufficient acid to produce the right colour in the finished product, and when we give the right quantity we generally get the soda tar to settle out clear at once.

It is best to have the oil well refined before the final treatment, so as not to require to give much acid at this stage, for if much acid is required, although the oil may get quite bright after the soda, soda compounds are persistently retained in solution by the oil. These compounds should be easily washed out, and this should be thoroughly done. A finishing treatment, properly conducted, always lowers the gravity of the oil, but a badly conducted one sometimes increases the gravity, from the soda compounds retained. For the finishing treatment, weak caustic has to be used, or soda carbonate solution. After the washings the finished oils are put into shallow tanks, exposed to light for 24 hours, to get bright. A thing that happens sometimes, and has to be guarded against, is that, when the soda is added, a whole tank of oil may set into a solid jelly. This takes place as readily with light oil as with heavy. It would happen unexpectedly, without any apparent cause. It was some time before we discovered that if the oil was brought very slowly to the neutral point after the acid, it was sure to set. Five per cent. of soap dissolved in warm burning oil causes it to set into a jelly on cooling, so that soap can be easily made to take up and retain paraffin oil; but, with the soda compound we have to deal with, less than 0.5 per cent. is sufficient to cause the oil to set. The amount of acidity left in burning oil on settling from oil of vitriol of a finishing treatment is equal to 0.1 per cent. of SO_2 . The temperature of treatment with acid for the first treatments, particularly when much paraffin is present, may be over 100° F., but the finishing treatments are best at 60° F. or below it.

The vitriol tar is washed from sulphuric acid by agitation with hot water, and burned. It is blown into spray by a jet of steam, and the spray burns as if it were gas, giving a very high temperature, and producing little smoke. The acidity of the chimneys is practically no higher than when coals alone are burned.

Our products all belong to the two series of hydrocarbons—paraffins and olefines. Both series are represented in the permanent gas, naphtha, and burning oils, but when we come to the higher members of the series, the paraffins appear as solid paraffin, and the olefines as viscous liquids. Lubricating oil consists of olefines mixed with some liquid or low-melting paraffins. The impurities which we have to get quit of in refining have been little investigated. They are tarry substances that cannot be got to give crystalline compounds, and, on distilling, a large proportion is decomposed with formation of olefines and a little paraffin. There is a proportion of strong bases that have been partly investigated, belonging to the leucoline and the picoline series. A portion of the impurities are ready to unite with either caustic soda or sulphuric acid, and are reckoned as partly belonging to the phenol group. Except these, there are no compounds of the benzene or anthracene type. The crude oil of our retorts requires a destructive distillation to begin. If refining were started by chemical treatment, the loss would be increased, as substances are extracted which would by distillation be converted into products. Solid paraffin cannot be got from crude oil by cooling and pressing, and the paraffin exists partly in an amorphous form, and partly compounds are present which require distillation to convert them into paraffin. The paraffin, as

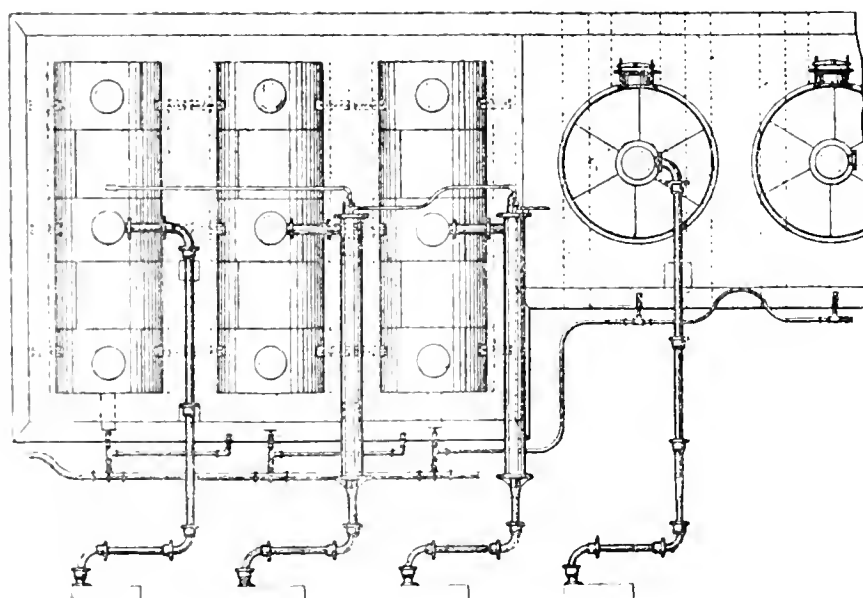
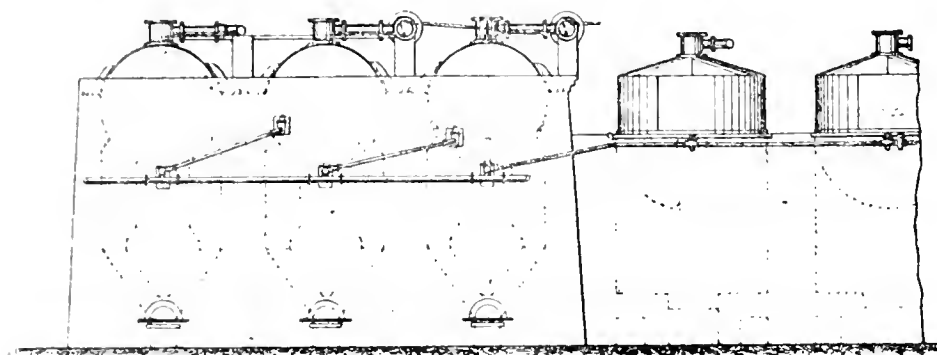
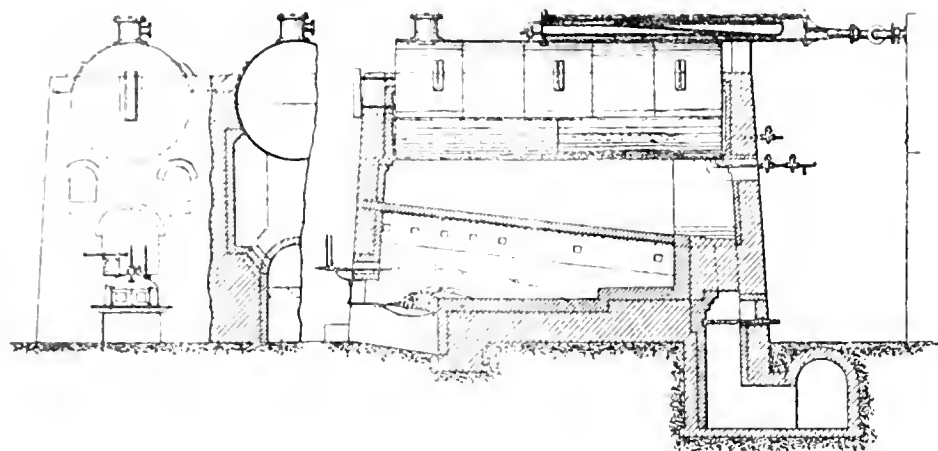
determined in crude oil by Engler and Boehm's method, is about 8 per cent., while in the works we get fully half as much again. Zoloziecki proved that the oxidised compounds present in petroleum were converted by distillation into paraffins, and no doubt the same is the case with crude oil.

If too much steam is passed into the crude stills, the oil distils over very little changed, and the steam has to be restrained so as to make the distillation truly a destructive one. All the distillations are to some extent destructive at the end, and too much steam is often hurtful with the heavy residues. Steam is used pretty largely for the purpose of preserving the viscosity of the heavy oil, but if overdone it only causes extra loss with the chemical treatments. When the breaking up is fairly started at the end of a distillation, volumes of permanent gas are given off which, according to Beilby and McArthur, are very rich in light-giving properties. These products of decomposition also tend to give lubricating oil a low flash point if not looked after. Even light-burning oils in distilling deposit a little coke on any solid body their vapours may come in contact with, but there is no decomposition to speak of except with the very heavy oils. From what I hear of the Americans cracking up the intermediate oils of their petroleum so as to reduce them in gravity to burning oils by manipulating the firing of the stills, I am sure that the oils they have to deal with are much more easily decomposed than ours, and Russian petroleum seems to be even more easily decomposed. Cracking up is not required by us nowadays, as there is a good market for intermediate oils of all gravities for gas making, burning in special lamps, &c. Water, on being converted into steam, increases in volume nearly 1,700 times, while burning oil increases less than 200 times, heavy oil less than 100 times, in being converted into vapour. So in distilling heavy oil without steam a great deal of oil has to be converted into vapour before it mounts up to the point of exit from the still, and as the specific heat is low it is easily condensed to fall back into the still again. The steam blown into the still is useful in preventing condensation, and in carrying the vapour over mechanically into the condensers. Two non-miscible liquids distilled together have the temperature of boiling very much lowered, sometimes a good deal below the boiling point of the lowest one; and oil distilling into vapour of water boils at a much lower temperature than when distilling into its own vapours. Some heavy residues we distil without steam, some with steam blown over the surface of the oil, and others with superheated steam blown into the bottom of the still. Solid caustic soda is put into the residue stills in the last distillation of all the heavier oils.

Steam is of great importance also for fractionation. Thorough fractionation is the great secret in oil refining. A little naphtha in burning oil lowers the flash point, of course; a little intermediate oil in it reduces the capillarity and harms the burning; intermediate oil present in lubricating oil decreases the viscosity much more than in proportion to the quantity, and so on, each kind harming the others when mixed. As a thorough fractionation cannot be made in one distillation, all advantage possible must be taken of the distillations given to make the separations required.

In regard to the separation of the solid paraffin, this is done in two stages. The heavy oil and paraffin got in the second distillation is cooled and pressed, and the expressed oil, after distillation, which helps to concentrate the solid paraffin, is again cooled and pressed. In both cases the cooling is first done

Fig. 1



by the atmosphere and then further with freezing machines. The atmospheric cooling is done either in flat tanks of a foot deep, arranged in a cool airy shed, or in long tubes of 3 ft. diameter, in which the mass is kept gently stirred by a paddle which goes the whole length of the tube. From the flat tanks the mass passes by a pipe, 1 ft. in diameter, into a stirrer, when it is broken up to be caught by a pump and thrown into the cooler to get artificial cold. In our works, for the first pressing, the refrigeration is done by ether machines, and in the second by an ammonia machine, and the cold is carried to the coolers by a brine of chloride of calcium. The coolers are tanks 10 ft. long by 6 ft. wide, of form shown in the drawing (Fig. 5). They are divided into compartments 6 ins. wide, in which the paraffin mass is put, alternating with compartments about 1 in. wide, through which the cold brine is kept flowing. In the old system of applying the cold, the refrigeration was effected suddenly—from 60° or 70° F. to 30° F. or so in a few seconds—and the solidified paraffin was partly got in an amorphous form impossible to separate completely from the oil. In the present apparatus the refrigeration is done more slowly, allowing time for the crystals to form and grow. In the first cooling the mass remains in the coolers 3½ hours, in the second eight or nine, and get cooled to 30° F. and 15° F. respectively. As the mass is a bad conductor of heat, it would take a long time to get cooled throughout if left motionless, so a scraper slowly revolves in it, constantly renewing the surface exposed to the cold. The paraffin is got in good crystalline form, in which it is easily separated from the oil. In the system Mr. Beilby described to the Society of Chemical Industry (Journ. IV., 321), the cooling is done even more slowly, requiring at the same time a proportionately larger plant. A paddle-stirrer at the bottom of the tank prepares the mass to be caught by a pump to be pressed through the filter-presses. From the filter-presses the oil runs with a setting point of 30° F. in the first cooling, and from 15° to 22° F. in the second, according to the gravity of the oil. The solid taken from the filter-presses is put into cloths and pressed in plate-presses with hydraulic ram at 30 cwt. and 20 cwt. per inch, giving hard scale and soft scale respectively. The slow method of cooling gives an extra quantity of solid paraffin and a lubricating oil improved in setting point and viscosity. Solid paraffin, when dissolved or melted, gives a thin mobile liquid deficient in viscosity, so any left in the oil, besides being a loss in itself, deteriorates the quality of the lubricating oil. Solid paraffin, when liquefied, is equal in gravity to an oil which at 60° F. is about 810 sp. gr. A heavy oil of 863 sp. gr. and setting at 42° F., after losing 10 per cent. of paraffin, has its specific gravity raised to 872, and its setting point reduced to 20° F.

All the apparatus shown in the drawings are inventions patented by Mr. Henderson, the works manager.

In refining the paraffin scale, the processes used are of three kinds: treatment with chemicals, sweating, and treatment with naphtha. If refining is wholly done with chemicals, the quantity of oil of vitriol required is large, the temperature has to be very high, the loss is great, and the refined paraffin not particularly good in colour. We use comparatively small treatments with oil of vitriol, carefully avoiding a temperature above 140° F., and this we find helpful to further refining. The soda compounds have to be very carefully washed out, otherwise they make the paraffin greasy and amorphous and difficult to refine. In the sweating process, the scale is melted and run

into shallow tins to cool. On cooling, the highest melting-point paraffins will separate first, and act as centres around which layers of lower and lower melting-point paraffins will crystallise, concentrating the colouring matters in the oil and the softest paraffins. On putting the cakes of paraffin into warm chambers, the low melting-point paraffins melt, and, along with the oil, flow out from the crystals of hard paraffin, carrying the colouring matters with them in solution. Our best refined paraffin is made by washing with naphtha. The scale is melted, and 25 or 30 per cent. of shale naphtha is stirred into it, and the mixture run into square shallow tins, where it solidifies into cakes suitable for the plate-presses. On pressing, the naphtha runs out, carrying all the colouring matter. The presses are enveloped in a thin metal hood, which is raised or lowered as required by a counterpoise weight, and this helps to prevent loss of naphtha by evaporation. Two naphtha treatments are required. The melted wax has steam blown through, to rid it of the small quantity of naphtha still retained, and after settling from water, the wax gets a small treatment with char from the prussiate works, is settled, and filtered through cloth and paper, and on cooling into blocks, is fit for the market or the candle-maker. In our busy season we make 14 or 15 tons of paraffin candles a day. Zoloziecki has some very interesting experiments on char recorded in "Dingler's Journal." His char seems to have contained much more alkali salts than the char we get in this country, with the result that our char can be recovered by distillation to be as powerful as ever, while his could not. In his case the alkali salts fused around the particles of char in the retort when recovering, which rendered it comparatively useless until washed free of alkali. We find that if the char remains too long in contact with the wax, the wax begins to take back the colouring matter to some extent.

A few words before I close regarding the properties of oils. All kinds except naphtha should have a high flash point, and should be free from acidity and from soda compounds. Oils for ordinary lamps should all distil over under 300° C. (572° F.). Light-house oil is a good example of what a burning oil should be: it distils all over under that temperature, and its flash is over 160° F. Our ordinary burning oils have a very small residue boiling above 572° F., and a flash point of about 30° above the Government safety test of 73° F. Burning oils are sent into the market in two forms, namely, distilled oils and treated oils. Distilled oils have more colour and smell, and as their refining is finished with a distillation, there should be no danger of chemicals to encrust the wick. The treated oils, if not rightly managed, may be acid in reaction and have soda compounds in solution. If acid in reaction, however pretty they may be at first, they soon get dark in colour; and when burning, the free sulphuric acid tends to char the wick for some distance under the burner. If the soda compounds are not thoroughly washed out of the oils, they cause a hard crust to form on the wick, and they often decompose in the heat of the burner, giving free sulphuric acid, and causing the wick to char. Treated oil, properly refined, burns as free from crust or acidity as a distilled oil, and the colour and smell are much better. Wicks of themselves are often acid—from the chemicals used in bleaching the cotton, I suppose. The acidity of an oil is easily tested with methyl-aniline-orange. It has to be shaken very thoroughly, and afterwards settled quite clear, before the result is certain. I have sometimes got samples of oil from ship-tanks that had been spoiled

by oxidation. The oil tank had been situated in a hot place near the engine when the oil, by the motion of the ship, had been kept shaken up with air, perhaps for months, with the result that the oil had darkened, become slightly acid, and burned badly. In ships the oil often gets contaminated with vegetable or animal oil, and a very small percentage of these causes the oil to burn very badly, or even, in a short time, to go out completely. Marine sperm used in ship lamps has a gravity of 0.830 and flash of 230° F.

In lubricating oils the flash point lies between 320° and 400° F., according to the gravity, and little should distil over under 600° F. The body or viscosity we test by passing the oil through a pipette at 60°, and noting the number of seconds required, and comparing with a standard oil. Lubricating oils, besides the ordinary form having the bloom or fluorescence characteristic of mineral oils, are sold also as bloomless oils. Dark bloomless oils are produced by oxidation with nitric acid or air, and the pale bloomless oils are made by dissolving nitro compounds in them, such as dinitrobenzol, dinitrotoluol, or nitronaphthalin. When mixed with vegetable or animal oil, the bloom generally shows itself pretty strongly again.

The paraffin oil manufacture is carried on in Scotland by 14 companies, nine of which do refining, and the production is about 60 million gallons of crude oil per annum from 2 million tons of shale, and the value of refined products about 1,500,000/. The capital invested is about 2,000,000/, and the men employed about 10,000.

DISCUSSION.

The CHAIRMAN said that all present would agree that Mr. Stenart had in his paper given a very valuable contribution, not only to the Scottish Section of the Society, but to the Society at large. Mr. Stenart had brought forward some very interesting and novel facts, the results of his own observations. Among others the actual observations on the temperatures found within a Henderson retort at various stages of the distillation, and the statements as to the distribution of the sulphur of the shale among the various products of distillation, had specially struck him. With reference to the working of the ammonia still described, perhaps Mr. Stenart would say afterwards whether there was any trouble caused by the rather complicated form of the still, seeing the liquid was not very clean. Even simpler forms of stills he knew were sometimes troublesome, unless the liquor was well settled and clean, and he would like to know what was Mr. Stenart's experience with the still in that respect.

Mr. HAMILTON said that they were very much indebted to Mr. Stenart for bringing forward a number of facts which, as the Chairman had said, were quite novel. Mr. Stenart had of course mainly referred to the operations as they were conducted at Broxburn, and had mentioned that there was little decomposition of the carbon in the Henderson retorts. That might be due to the character of the shale distilled there, but in his works they used a very much higher temperature than at Broxburn. When the spent shale was dropped from the Henderson retort into the furnace below, a very large amount of it was white or grey—showing that the steam introduced had burnt out the carbon—and possibly also increased the yield of ammonia. If the

heat were not maintained the yield of oil would be deficient. That he believed was entirely due to the character of the shale. As to continuous distillation, he could only give the result of three years' experience of it at his works, and that was that it had been most successful. At his works the stills were shut down after working a fortnight or so. He was astonished to hear that Mr. Steuart's loss by refining was only 26 per cent., as that showed a marvellous advance in finished products. To get 4 per cent. increase showed great skill and care in manipulation. In his opinion Beilby's cooler was much superior to the Henderson cooler. The crystals from the former were beautifully formed, whereas from the latter only a considerable amount of previous coolings gave any crystals at all worth speaking of. In the Henderson cooler at his works they had been told to leave the stirrer quiet until the bulk of the oil cooled. They tried it once, but not again, as they had simply to melt the oil up again.

Mr. D. A. SUTHERLAND said it was hardly necessary for him to say more on the subject, as Mr. Steuart had so exhaustively dealt with it. There was one point, however, to which his attention had been drawn by Mr. Hamilton's remarks. Mr. Hamilton spoke of finding the spent shale white on being dropped from the retort into the combustion chamber. He had occasionally noticed the same thing in the works with which he was connected, viz., those of the Burntisland Oil Company, Limited. He had usually found that this was due to too great a suction, or that the doors were imperfectly locked, in either case air being drawn in. Further, Mr. Hamilton had obtained a higher yield of oil by using a higher heat; his own experience, founded on a number of experiments, was that by the application of a strong heat more ammonia, but less oil, was obtained. There was, of course, an intermediate heat at which the most advantageous yield of both could be obtained. If the heat was high he had found the specific gravity increase to .880 or higher. He might as well mention, as being of interest, with reference to the quality of shale, that the yield of Burntisland shale corresponded closely with that mentioned as obtained at Broxburn, having a specific gravity of .865, and a setting point of 80° F. Mr. Steuart spoke of solidifying burning oil with 5 per cent. of soap; he would add that he had gelatinised lubricating oil with about .5 per cent. The thickened oil referred to as occurring occasionally in the process of refining seemed, as a rule, to be caused by over-treatment with acid, and was formed in the subsequent washing with soda; it was known as "glut," and was a splendid detergent. It might be of interest to some members to know, what, of course, would be familiar to Mr. Steuart, that this glut could usually be cut down by agitation with a saturated solution of common salt.

Mr. HAMILTON said that he should like to add that the specific gravity of their crude oil never exceeded .864.

Mr. STEVENSON would like to make one remark concerning the dissolving of the soap. It was found that it required a pretty large percentage of soap to make lubricating oil set; experiment showed that 2½ per cent. was not sufficient, and that 5 per cent. was required, so that this substance which was in the oil, and which produced the jelly, was something of a far better nature than an ordinary soap.

Mr. SUTHERLAND: Was any other medium used?

Mr. STEVENSON : No.

Mr. SUTHERLAND : In the case I refer to methylated spirit was used.

The CHAIRMAN had understood that the soap must be dry.

Mr. HAMILTON had understood the same.

Mr. W. HUME said he would like to ask a question with regard to the minimum melting point of solid paraffins, and also regarding the transparency of the paraffins. In the Glasgow Exhibition he saw a case containing paraffin of this transparent nature, and he would like to know if any special treatment was required to make it thus.

Mr. HAMILTON said that it might be interesting to mention that within the last month or so he had been trying sulphated olefines (or "white water," as he called it) in one or two paper works. They had been in the habit of using paraffin oil, but it used to leave specks on the paper; but this "white water" not only left no specks but also effected a saving in bleaching powder. He was now having it tried in yarn bleaching works, and, so far as he could learn, it was likely to prove an equal success.

Mr. TATLOCK said that Mr. Stewart's remarks with regard to paraffin wax had attracted his attention. During the references to the specific gravities and melting points of certain paraffins, it occurred to him that a paraffin or mixture of paraffins of constant specific gravity and melting point might be employed as a standard of light. The candle commonly used for that purpose was of a very uncertain composition and of varying luminosity—though it might burn at a fixed rate in a given time. He would like to ask Mr. Stewart whether a mixture of paraffins of certain melting point and specific gravity would be likely to burn with constant luminosity other conditions being equal. He should also like to ask whether the effect of moderate pressure on paraffin was to increase its specific gravity. His experience had been that it did.

Professor DITTMAR said that the melting point of paraffin rose when the pressure rose. Hence, supposing a paraffin, after having been fused, to be cooled down to its natural fusing point, there were two means for causing solidification, and thereby formation of an amorphous cake. They might either suddenly lower the temperature at ordinary pressure, or maintain the temperature and raise the pressure to say 10 or 20 atmospheres.

Mr. STEWART, in reply, said, that while the several gentlemen were speaking, many things occurred to him that he might speak about, but he did not know whether he could now recollect them all. As to the ammonia column still, if it should happen to choke, the obstruction was easily got at from the side doors and removed, so that there was very little trouble from this cause. The stills were cleaned out once a year. He had never noticed the whitening of the shale, attributed to the steam acting on the coke, although the spent shale was sometimes left in the retort some hours beyond the usual time in order to increase the yield of ammonia. Where it had happened he suspected that air had been sucked in. Mr. Hamilton was surprised at their increase in refined products during the year. He had not the figures with him, but there was no doubt that the amount of loss had been gradually reduced from year to year. Last year it would be about 27 per cent.

if he remembered rightly. Regarding the cooler, Mr. Henderson originally intended that the paraffin should remain at rest during cooling, and that the stirrer should only be put on at the end to bring it down, but the difficulty was to get the stirrer to move. It was found that by sending it slowly round all the time a paraffin was got that separated quite readily from the oil, and gave an oil of sufficiently low setting point. Of course, the more rapidly the cooling took place the more economically it could be carried out. In regard to the amount of steam used in residue stills he, of course, had gone into that pretty fully in his paper. But it was found, in the case of green oil residue, that if a great amount of steam was passed into the still the paraffin scale extracted from the distillate was green and difficult to refine, and that no extra loss was incurred by restricting the steam according to the circumstances of the case. It was also asked what was the minimum melting point of paraffin. It could be got in quantities about 80° F., but the difficulty was in finding a market for such very low melting points. A question had been asked as to whether there was any special treatment required to make the paraffin transparent, as was the case with some shown at the Glasgow Exhibition. Paraffin wax was no doubt in itself transparent, but in its ordinary state it appeared opaque from the substance existing in the form of small crystals, with free spaces between. When gently warmed paraffin became plastic, and when pressed in this state the interspaces were done away with, and the mass became transparent, like glass. The interspaces being reduced by pressure was no doubt also the explanation of the increase in specific gravity which Mr. Tatlock had remarked.

Regarding Mr. Tatlock's remarks as to getting a constant luminosity, he had no doubt that paraffin could be made of such a homogeneous structure that it would be practicable to get a constant luminosity; but the matter of wick entered considerably into the question as to whether a constant light could be got from the candles or not, but he had not made any experiments on the subject.

Ad libitum.

I find that up till 1885 our total loss in refining was 30 per cent. on the crude oil, but much lower ever since. The cost of refining in 1879 was 1.38*d.* per gallon of crude oil. For the last nine months it has averaged 0.77*d.*

In regard to retorts, I neglected to state that the total fuel required for breaking the shale, raising steam, haulage, pumping, and everything else connected with the crude oil, was 1 cwt. coals per ton of shale.

We cannot put caustic soda into the boiler stills, but it can always be put into the residue stills, which are the last of each series.—D. R. S.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements in Machines with Spiked Appliances for Reducing or Pulverising Superphosphates and other Materials. H. D. Salomonson and J. Laubheimer, Kralingshe Veer, Holland. Eng. Pat. 17,094, December 12, 1887. 8d.

THE essential features are a spiked roller in combination with a roller reciprocating on its axis, so that the spikes of the one "take in" between those of the other and keep them clear.—J. M. H. M.

Improvements in Pumps for Gases and Vapours. M. C. Bannister, Liscaud. Eng. Pat. 17,430, December 19, 1887. 8d.

THE invention relates to improvements in the valves and pistons of air-pumps such as are used in connexion with ice-making machinery, also to a method of transferring motion from one piston to one or more others by means of an enclosed body of water, for the purpose of avoiding waste in the cylinder passages, and in the power required for working such pumps. For particulars the specification and patent drawing should be consulted.—B.

An Improvement in Filters. R. Morris, Blackheath. Eng. Pat. 211, January 5, 1888. 8d.

THE improved filter is constructed so as to secure a zigzag path for the liquid through the filtering material, which

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Rander Luck, Controller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	½d.
Above 8d., and not exceeding 18. 6d.	1d.
" 18. 6d. " " 28. 6d.	1½d.
" 28. 6d. " " 38. 6d.	2d.

occupies annular spaces between partitions projecting upwards from a basin below and alternate with partitions projecting downwards from a vessel inverted above.

—C. C. H.

Improvements in the Construction of Filters, mainly designed for the Filtration of Water for Manufacturing Purposes, but applicable generally to the Filtration of Water in Quantities. W. A. Nicholl, Sowerby Bridge. Eng. Pat. 606, January 14, 1888. 8d.

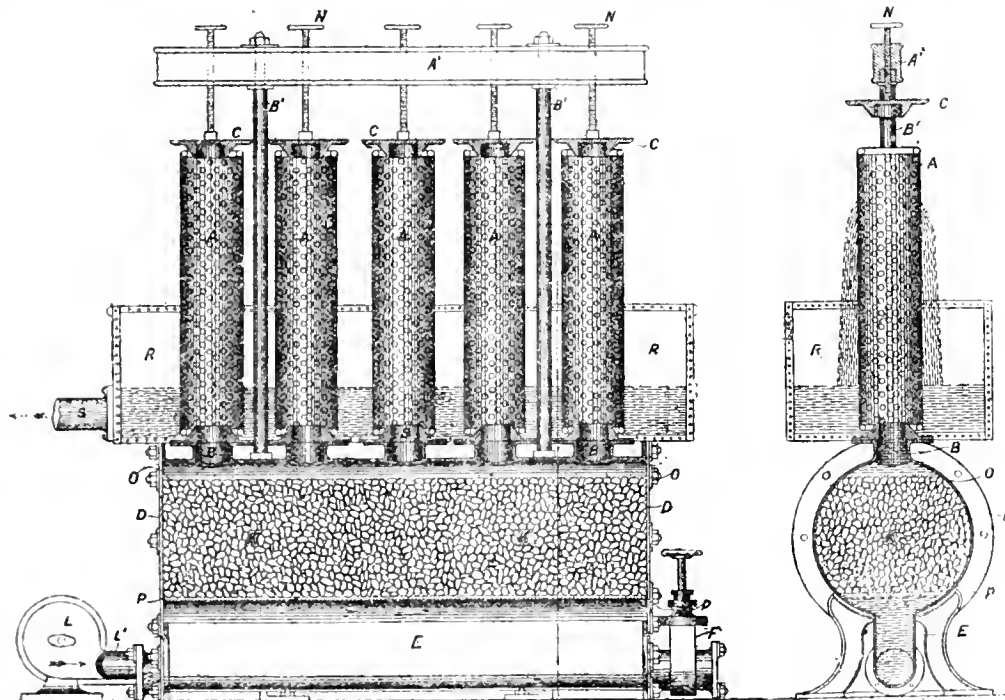
A TANK or cistern is divided into three parts by two diaphragms, one of which is perforated at the bottom, and the other at the top; between the two the filtering material is packed, coarse material, e.g., broken bricks, pebbles, &c. at the bottom, and finer material, e.g., charcoal, at the top. The water enters the end compartments and flows through the perforations at the bottom of the first partition, ascends through the bed of filtering material, overflowing into the receiving portion of the tank through the holes in the upper part of the second diaphragm.—C. C. H.

Improvements in Means or Apparatus for subjecting Substances or Articles to the Action of Air or Gases for effecting the Drying, Disinfecting, Oxygenating, or other Treatment thereof. H. J. Peck, London. From H. G. Downton, Sydney, New South Wales. Eng. Pat. 2057, February 10, 1888. 8d.

THE substance with which the air is to be charged or dried is placed on a perforated floor in a chamber with a bell-mouthed cover communicating by means of a pipe, which may pass through a boiler flue when the air is to be heated, with the bottom of a chamber having a perforated floor, on which the material to be treated is placed. A bell-mouthed pipe from the highest part of the reception chamber passes to an air ejector worked by steam, thus ensuring the passage of a good current of air through the system described; the air may be passed through the furnace of the steam boiler to destroy any noxious vapour, &c. removed from the substances treated.—C. C. H.

An Improved Method of Filtering and Apparatus therefor. H. F. Clayton and G. H. Holdroyd, Huddersfield. Eng. Pat. 13,936, September 27, 1888. 6d.

THE apparatus is shown in adjoining figures. The water is forced into the pipe E by pump L, and rising through the



filtering bed K, with which the cylinder D is packed, enters the perforated cylinders A, which are each covered with a filter cloth, through which it passes, and is collected in cistern R.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

Discovery of Natural Gas Wells at Narrabeen, near Sydney, New South Wales. Sydney Daily Telegraph, Nov. 28, 1888.

WHILST boring for coal in the neighbourhood of Narrabeen, about seven miles from Manly Beach, a party of miners, working for Mr. John Coghlan, have tapped a reservoir of natural gas. Since natural gas is almost always found in conjunction with petroleum at various depths in the earth, great expectations have been raised by the discovery. Mr. Coghlan had put down his diamond drill amongst the picturesque scenery in the midst of which Mr. van Bieren had previously tried in vain to procure wood suitable for the charcoal used in the manufacture of gunpowder. It is not far from the lagoon, about half-way between Manly and Newport, and at the foot of a range of hills. It is "poor" country, covered with out-cropping rock and barely clothed with impoverished gum-trees. Beneath the surface, to unproved depths, the strata are composed of sandstone and conglomerate. After boring for two or three years, probing 1,556 feet down, and finding no trace of coal, the miners observed an inflammable vapour issuing from the side of the bore. Mistaking it for marsh gas, and never dreaming of the existence of natural gas in Australia, they paid no attention to it, and proceeded to go deeper and deeper into the rock.

At length, with nearly 2,000 ft. of tubing down, the vapour increased in volume and intensity. Then Mr. Coghlan invited Dr. Storer, a chemist, and Mr. Key, a mining engineer, to inspect the bore. These gentlemen visited the scene of operations, and offered the opinion that the gas was similar to that discovered at Pittsburg, in America, in all respects. The bore measured 3 ins. in diameter, and the gas issued through it in spite of a pressure of water equal to 800 lbs. to the square inch. It is proposed to form a company and lay service pipes to Sydney, using the raw gas for fuel, and mixing coal gas with the rest, for illuminating purposes.

Natural gas is rarely if ever found in the immediate neighbourhood of coal, i.e., it is not actually found in conjunction with coal. As far back as 1842, Prof. Beek traced its connexion with bituminous matter other than coal, and with petroleum, which he said was generally diffused through the strata of sandstone and slate in the same localities.—W. S.

PATENTS.

Treatment of Air, Gases, Liquids, and Furnace Chimney Products. H. J. Wilson and J. W. Wilson, Sheffield; and A. French, Lead Hills. Eng. Pat. 5239, December 21, 1878. Second Edition. 11d.

HEREIN is described a process for bringing any gas into intimate contact with water or some other washing liquid. It consists in distributing the said gas in numerous small streams beneath wire gauze or other permeable screens submerged in suitable liquid. To secure the greatest efficiency the interstices of the screens must be greater than the solid particles to be removed from the gas, so that no clogging or choking can occur, and the liquid carried mechanically upward through the screens must be provided with separate unimpeded passages for its return. Full drawings are appended to the specification.—A. R. D.

Improvements in Apparatus for Generating Gas. H. Hutchinson, London. Eng. Pat. 17,799, December 27, 1887. 8d.

At the bottom of a generator of the ordinary cupola type is a steam air-injector, the upper or delivery end of which

is surmounted by a cap of iron or fire-clay. This cap is perforated round its base and forms a superheater, as the mingled air and steam have to pass in contact with its inner surface before escaping through the perforations into the mass of superjacent fuel. In addition to this, four pipes from the central blower deliver air and steam to the outer parts of the fuel in the generator. Provision is made for injecting liquid hydrocarbon into the lower part of the generator, if desired, and the apparatus includes a "hydrocarbon converter" or fixing chamber, where the mixed gases are rendered permanent by contact with heated brick or other material.—A. R. D.

Improvements in Apparatus to be used in the Purification of Coal Gas. W. T. Walker, London. Eng. Pat. 14,925, October 17, 1888. 8d.

THE gas is made to pass in contact with a number of wetted surfaces, as in Eng. Pat. 1478 of 1880. The surfaces are contained in boxes open at the bottom and at each end, and these boxes are attached to a shaft having a reciprocating vertical motion, so that at each downward movement they are completely submerged in any suitable liquid. The operation is carried on in a number of tanks placed one above the other, and of which each is isolated from its neighbours by a water-tight seal. The specification is accompanied by detailed drawings.—A. R. D.

An Improved Method of Solidifying Petroleum and other Explosive Oils for Safer Transport, as well as a Fuel for Cooking, Lighting, and Heating. H. O. A. E. Grünbaum, London. Eng. Pat. 15,492, October 27, 1888. 4d.

It is proposed to solidify petroleum by the admixture of glutinous or gelatinous matter, such as fish-glue. With this may be incorporated any kind of finely divided combustible, and the whole compressed into any suitable form.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

PATENT.

Improvements in and Relating to the Treatment of the Acid Residua or Tars resulting from the Refining of Mineral Oils by Concentrated Acids. C. Rave, Malines, Belgium. Eng. Pat. 607, January 14, 1888. 6d.

THE (sulphuric) acid tars, generally, are treated with iron turnings and water. Sulphate of iron is formed and removed by repeated washings. The residue is freed from water by heating, concentrated to any desired consistency, and thus transformed into a neutral bitumen, having all the properties of natural bitumen. The very fluid acid tar, formed by purifying naphtha with sulphuric acid, gives off large quantities of sulphurous acid when heated. This is utilised for preparing sulphites and bisulphites. Neutral tars treated with sulphuric acid yield hydrocarbon oils and acid tars, which latter are decomposed with iron turnings, as above. The bitumens so obtained are well adapted for asphalt making, and have various other industrial applications.—A. R. D.

IV.—COLOURING MATTERS AND DYES.

On some Derivatives of Anthraquinone. A. G. Perkin and W. H. Perkin, jun. J. Chem. Soc. 1888, 831—844.

SODIUM anthraquinone monosulphonate, when submitted to destructive distillation, gives a brownish-red distillate,

containing *m*-oxyanthraquinone, anthraquinone, and a new substance crystallising from glacial acetic acid in small orange-red needles, having the composition $C_{28}H_{11}O_6$. This is insoluble in alkalis, and gives with zinc dust and caustic soda solution the anthraquinone reaction. By fusion with potassium hydrate it is converted into alizarin. Nordhausen sulphuric acid at 190° C. forms with it two sulphonic acids, the mixed sodium salts of which, fused with potassium hydrate, produce a mixture of anthrapurpurin and flavopurpurin.

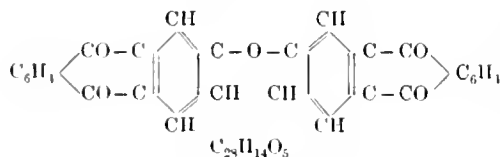
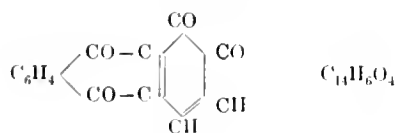
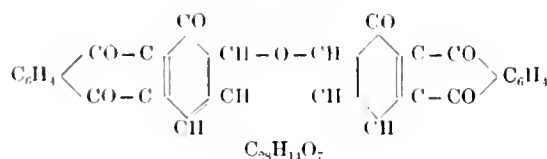
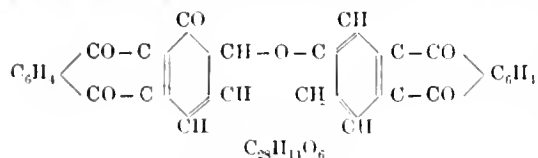
Heated with hydriodic acid in a sealed tube, it is converted into anthraquinone and dihydroanthracene, but if hydriodic acid is gradually added to a hot solution of the substance in glacial acetic acid a yellow crystalline product of the formula $C_{28}H_{11}O_5$ is formed.

Chromic acid acts energetically on a solution of $C_{28}H_{11}O_6$ in glacial acetic acid, producing a white crystalline substance having the formula $C_{11}H_6O_3$, which is converted by fusion with potassium hydrate into alizarin and anthraquinone. This $C_{11}H_6O_3$ forms, with Nordhausen sulphuric acid at 190° C., two sulphonic acids, the sodium salts of which, when separated, give on fusion with potassium hydrate, respectively, flavopurpurin and anthrapurpurin.

The orange red substance, $C_{28}H_{11}O_6$, dissolves in cold fuming nitric acid, producing a substance having the composition $C_{28}H_{11}O_7$, which crystallises from a mixture of aniline and alcohol in minute colourless needles. Fusion with potassium hydrate also converts this into alizarin, but at the same time reduction takes place, a portion being reconverted into $C_{28}H_{11}O_6$. With Nordhausen sulphuric acid a mixture of two sulphonic acids are obtained, the sodium salts by fusion with potassium hydrate giving a mixture of anthrapurpurin and flavopurpurin. Chromic acid in glacial acetic acid solution converts $C_{28}H_{11}O_6$ into the substance $C_{11}H_6O_3$, described above.

A boiling mixture of nitric acid and sulphuric acid acts on $C_{28}H_{11}O_6$ with the formation of a nitro-compound, very similar in its properties to dinitro-anthraquinone, with which, however, it is not identical.

From a study of these properties the authors assign the following constitutional formulae to the substance $C_{28}H_{11}O_6$, and its derivatives:—



Penta-ethylbenzene. O. Jacobsen. Ber. **21**, 2814—2819.

PENTA-ETHYLBENZENE is prepared by the action of aluminium chloride and ethyl bromide upon benzene. 160 grms. of the purified product are added gradually to 500 grms. of

chlorosulphonic acid and the resulting paste is mixed with snow and filtered. This consists mainly of the sulphochloride and sulphone of penta-ethylbenzene. The former, by digesting with alcoholic caustic soda, is converted into the sodium sulphonate, which crystallises on cooling. The sulphone is obtained from the alcoholic mother-liquor by evaporation and extraction with water.

Penta-ethylbenzene is a viscous oil, boiling at 277°. The sulphone is a crystalline body, melting at 76°. The author has prepared a series of salts of penta-ethylbenzene sulphonic acid.

Action of Sulphuric Acid on Penta-ethylbenzene.—Fuming sulphuric acid at 120° converts penta-ethylbenzene into a solid resinous body, which consists mainly of hexa-ethylbenzene. The penta-ethyl compound is mixed with an equal volume of ordinary sulphuric acid, and then sufficient fuming acid added to form a clear solution. The mixture is allowed to stand 4–5 days, until no more of the hexa-ethylbenzene separates, when it is filtered, washed, and crystallised from alcohol containing toluene. In the filtrate the sulphonic acid of tetra-ethylbenzene is contained. Hexa-ethylbenzene is a solid body, melting at 129°.—J. B. C.

Tetra-ethylbenzene. O. Jacobsen. Ber. **21**, 2819—2821.

ON sulphonating tetra-ethylbenzene with chlorosulphonic acid (the hydrocarbon being obtained by the action of ethyl bromide and aluminium chloride on benzene) a mixture of adjacent and symmetric tetra-ethylsulphonates are obtained. Apparently the third unsymmetric sulphonate is also present. If the crude mixture of the tetra-ethylbenzene be dissolved in ice-cold chlorosulphonic acid, and the solution exposed to the air at 0° and finally diluted with the addition of ice, an oily layer separates, which consists of sulphones and chlorosulphonic acids. These may be separated with ether, and on distilling off the latter and digesting with alcoholic soda solution the sodium salts of the sulphonic acids are formed, from which the sulphones may be extracted with petroleum spirit. The different sulphonic acids may be separated by fractional crystallisation of the sodium or barium salts.—J. B. C.

Synthesis of Prehnitene (Tetramethylbenzene).

O. Jacobsen. Ber. **21**, 2821—2828.

PREHNITENE may be obtained not only by the action of sulphuric acid on penta-methylbenzene or durene, but also from adjacent bromopseudocumene and dibromometaxylene by Fittig's synthesis.

Bromopseudocumene, $C_6H_2CH_3 \cdot CH_3 \cdot CH_3 \cdot Br$, [1:3:4:2] is the liquid product of the bromination of pseudocumene, 1 kilo. of pure pseudocumene yields 320 grms. of the crude adjacent bromopseudocumene. The author has prepared a series of derivatives from this body. 25 grms. of the pure compound, when heated with 40 grms. of methyl iodide and 14 grms. of sodium in thin flakes in presence of the necessary quantity of ether, yield a product boiling at 200–204° which is nearly pure prehnitene. The author points out the interesting fact that symmetric bromopseudocumene may be converted into the adjacent modification by the action of fuming sulphuric acid, which yields adjacent bromopseudocumene sulphonic acid.

Dibromometaxylene [1:3:4:5]. This body is the liquid product of the bromination of metaxylene. That it has the constitution $C_6H_2 \cdot CH_3 \cdot CH_3 \cdot Br \cdot Br$ [1:3:4:5] has been shown by the author by preparing from it orthodiamidometaxylene. Prehnitene is prepared from the dibromocompound in the manner described under that from pseudocumene. As in the case of bromopseudocumene, symmetric dibromoxylene may be converted by strong sulphuric acid at 230°–240° into the adjacent compound.

—J. B. C.

Adjacent Metaxylenol. O. Jacobsen. Ber. 21, 2828—2829.

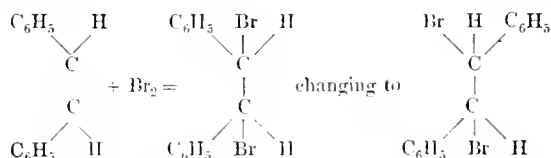
The author has prepared metaxylenol from *p*-oxymesitylenic acid by heating with hydrochloric acid. The melting point, 47°—48°, agrees with that observed by Nölting, who obtained the same body from metaxylidine.—J. B. C.

Metadiethylbenzene. A. Voswinkel. Ber. 21, 2829—2831.

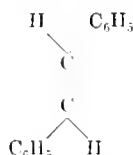
The author prepared this body by the action of ethyl bromide and aluminium chloride on benzene. It may be separated from the para-compound formed at the same time, by converting the hydrocarbon into the sulphonic acid and the acid into the barium salt. The barium salt of the para-compound is much more soluble than that of the meta-derivative. It is purified by converting the sulphonic acid into the amido-compound and decomposing the latter with hydrochloric acid. It boils at 181—182°, and does not solidify at 20°. The author has prepared a series of derivatives of the hydrocarbon.—J. B. C.

Stilbene. L. Aronstein and A. F. Holleman. Ber. 21, 2831—2834.

ACCORDING to Wislicenus' theory, there must be two geometrically isomeric stilbenes, and it seems possible to pass from one to the other according to the following scheme:—



This, on removing HBr and replacing the other Br atom by H, should yield—



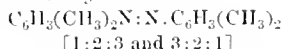
or vice versa.

The authors find that by the reduction of monobromostilbene either with sodium amalgam or zinc dust and glacial acetic acid the original product is obtained. Zinc dust and alcohol acts similarly. An attempt to prepare the isomeric stilbene by the reduction of tolane with sodium and methyl alcohol yielded ordinary stilbene. The authors have, however, obtained an oil by the action of alcoholic potash on monobromodibenzyl, which they consider may turn out to be the isomer in question.—J. B. C.

On the Azoxylenes, Diamidodixylyls and Colouring Derivatives of the latter. E. Nölting and T. Strieker. Ber. 21, 3138—3149.

THE authors prepared the hitherto unknown azoxylenes from the five isomeric nitroxylenes (perfectly pure). The reduction was carried out in alcoholic solution with caustic soda and zinc dust; in some cases, however, sodium amalgam was preferred. The hydrazo-compounds were either obtained by using a larger amount of the reducing agent, or from the azo-compounds by means of sulphuretted hydrogen in an alcoholic solution of ammonia. The zinc dust which was used contained 90 per cent. of metallic zinc.

Adjacent Azo-orthoxylenes—

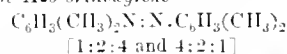


20 grms. of *o*-nitroxylenes, 20 grms. of caustic soda solution (containing 32 per cent. of NaOH), and 100 cc. of alcohol, are heated at the reversed condenser, 20 grms. of zinc dust being gradually added. The reaction is completed in about

an hour. After filtration and partial evaporation of the alcohol, crystals are obtained, which are treated with dilute hydrochloric acid to get rid of any hydrazo-compound. After several recrystallisations from alcohol, orange-yellow needles are obtained, easily soluble in alcohol, ether, benzene, and melting at 110°—111° C.

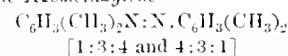
Adjacent Hydrazo-orthoxylenes was prepared from the azo-compound by sulphuretted hydrogen. It forms needles, melting at 139°—141° C. and is easily oxidised in the air.

Unsymmetric Azo-orthoxylenes—



To prepare this body it is essential to use more alcohol and less caustic soda than in the preceding case, else the formation of a red body takes place, which is probably a stilbene derivative. This azo-orthoxylenes is more difficultly soluble in alcohol than its isomer; it forms red needles, melting at 140°—141° C. Its hydrazo-compound is obtained in the manner already described. Yellowish-white needles, melting at 106°—107° C.

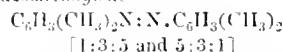
Unsymmetric Azometaxylenes—



It is best prepared from 25 grms. of nitrometaxylenes, 25—30 grms. of zinc dust, 15 grms. of caustic soda solution, and 300 cc. of alcohol. The azo-compound forms red needles, melting at 129° C.

Its hydrazo-compound is best prepared from the nitroxylenes, by using the following proportions:—30 grms. of nitroxylenes, 30 grms. of caustic soda solution, 40 grms. of zinc dust, and 250 grms. of alcohol. Beautiful white needles, melting at 120°—122° C.

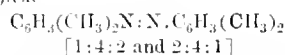
Symmetric azometaxylenes—



10 grms. of symmetric nitrometaxylenes, 10 grms. of caustic soda solution, 10 grms. of zinc dust, and 60 cc. of alcohol, are used. Orange needles, melting at 136°—137° C.

Its hydrazo-compound forms white needles, melting at 124°—125° C.

Azo-paraxylenes—



is prepared by using 20 grms. of nitroparaxylenes, 16 grms. of caustic soda solution, 16—20 grms. of zinc dust, and 200 cc. of alcohol. Yellow needles, melting at 119° C.; probably identical with Werigo's azoxyxylenes (melting at 120° C.)

Its hydrazo-compound forms white needles, melting at 145°, and is best prepared by using 30 grms. of nitroparaxylenes, 25 grms. of caustic soda solution, 45 grms. of zinc dust, and 250 cc. of alcohol.

To prepare the diamidodixylyls, the hydrazoxylenes are heated either dry or in alcoholic solution with moderately dilute hydrochloric acid. The solution is then rendered alkaline, the base extracted with ether, and the hydrochlorides precipitated with gaseous hydrochloric acid. The hydrazo-compound corresponding to the unsymmetric nitrometaxylenes forms, however, mostly azoxyxylenes and xylidines. The latter is removed from the diamidodixylyl by distillation with steam. The hydrazo-compound obtained from the unsymmetric nitro-orthoxylenes did not yield any diamidodixylyl by the above treatment with hydrochloric acid. Schultz's method, treating the azoxyxylenes with stannous chloride and hydrochloric acid, produced the desired result.

Stilbene Derivatives from asymmetric-nitro-ortho- and nitro-metaxylenes.—Klinger obtained from *p*-nitrotoluene and alcoholic caustic soda a red condensation product, which, when treated with tin protochloride and hydrochloric acid, was converted into diamidostilbene. In the same way the nitroxylenes, in which the nitro-group is in the para position to a CH₃ group, yield red [nitro-orthoxylenes] or brownish-red [nitrometaxylenes] condensation products, nearly insoluble in all ordinary solvents. By treating the former with stannous

chloride and hydrochloric acid a base is obtained which is doubtless diamidodimethylstilbene. All these bases, diphenyl and stilbene derivatives, yield when diazotised and combined with certain phenols or amines colouring matters, which dye vegetable fibres without mordant. The authors have also prepared the tolidines from *p*- and *m*-nitrotoluenes.

The following table contains the results compared with those obtained from benzidine, tolidine, and diamidostilbene.

The following colours were obtained by diazotising the bases named in the first column, and combining them with the compounds named in the second, third, and fourth columns.

	Naphthionic Acid.	α -Naphthol α -sulphonic Acid.	β -Naphtholdisulphonic Acid R.
Benzidine $\text{NH}_2\cdot\text{C}_6\text{H}_4\cdot\text{C}_6\text{H}_4\cdot\text{NH}_2$ [1:1 and 1:1].	Red [yellowish Congo.]	Blue violet.	Blue violet.
Tolidine from <i>o</i> -nitrotoluene $\text{NH}_2(\text{CH}_3)\text{C}_6\text{H}_4\cdot\text{C}_6\text{H}_4(\text{CH}_3)\text{NH}_2$ [1:3:1 and 1:3:1].	Red bluish Benzopurpurin.	Blue violet, but not so blue as the above.	.. ..
Tolidine from <i>m</i> -nitrotoluene [4:2:1 and 1:2:4].	Red [yellowish]. Does not dye well.	Claret red. Dyes well.	Bluish red. Dyes well.
Tolidine from <i>p</i> -nitrotoluene [6:3:1 and 1:3:6].	Red [yellowish]. Dyes badly.	Bluish red. Dyes badly.	Bluish red. Dyes very badly.
Diamidodixyl from [1:2:3 nitro-ortho]xylene $\text{NH}_2(\text{CH}_3)_2\text{C}_6\text{H}_3\cdot\text{C}_6\text{H}_3(\text{CH}_3)_2\text{NH}_2$ [1:3:2:1 and 1:2:3:4].	Orange red. Dyes well.	Bluish red. Dyes well.	Bluish red. Dyes badly.
Diamidodixyl from [1:2:4 nitro-ortho]xylene [6:4:1:3 and 1:3:4:6].	Yellowish red. Dyes badly.	Bluish red. Dyes badly.	Bluish red. Dyes badly.
Diamidodixyl from [1:3:4 nitro-meta]xylene [6:5:3:1 and 1:3:5:6].	Yellowish red. Dyes badly.	Orange red. Dyes well.	Red. Dyes badly.
Diamidodixyl from [1:3:5 nitro-meta]xylene [1:6:2:1 and 1:2:6:4].	Yellowish red. Dyes well.	Yellowish red. Dyes well.	Red. Dyes badly.
Diamidodixyl from [1:4:2 nitro-para]xylene [4:5:2:1 and 1:2:5:4].	Very bluish red. Dyes badly.	Violet. Dyes badly.	Violet. Dyes badly.
Diamidostilbene $\text{NH}_2\cdot\text{C}_6\text{H}_4\cdot\text{C}_2\text{H}_2\cdot\text{C}_6\text{H}_4\cdot\text{NH}_2$ [1:1 and 1:1].	Red.	Blue.	Blue.
Dimethyldiamidostilbene from [1:2:4 nitro-ortho]xylene $\text{CH}_3(\text{NH}_2)\cdot\text{C}_6\text{H}_3\cdot\text{C}_2\text{H}_2\cdot\text{C}_6\text{H}_3(\text{NH}_2)\text{CH}_3$ [6:4:1 and 1:4:6].	.. ..	Violet. Dyes well.	.. ..

—A. L.

On the Adjacent Metaxyldine and its identity with Wroblewsky's Orthoxyldine. E. Nölting and B. Pick. Ber. 21, 3150—3154.

NÖLTING and PICK proved some years ago that on nitration of metaxylylene besides asymmetric nitrometaxylylene adjacent nitro-metaxylylene is also formed (compare this Journal, 1886, 27 and 28). The commercial xylydine must therefore contain it. To isolate it, xylydine is converted into its sulphate; this is allowed to crystallise and from the mother-liquor the base is liberated by alkali. This is distilled and the part boiling from 212°—216° is converted by acetic anhydride into the acetyl compound. The *v*-meta-acetylyldide is not attacked by boiling dilute sulphuric acid containing 25 per cent. of H_2SO_4 , whilst its isomers are decomposed. The crude acetyl compound is therefore boiled with four times its weight of 25 per cent. sulphuric acid for several hours, and on cooling the *v*-meta-acetylyldide crystallises out. After recrystallisation from hot water it

melts at 176° C. It is decomposed into *v*-metaxylydine by heating with three parts of 70 per cent. sulphuric acid to 200° C. for some time.

The hydrochloride, nitrate and sulphate of *v*-metaxylydine were prepared and analysed.

Some years ago Wroblewsky described a xylydine, which he at first considered as α , and later as *v* orthoxylydine. But according to its properties it is neither one nor the other, but impure *v*-metaxylydine. Its acetyl compound, which probably was impure, was said to melt at 131°, but the properties of the salts were identical with those of *v*-metaxylydine.

The authors prepared some salts of the orthoxylydines, and estimated their solubility.

The ortho-metaxylydine is distinguished from the others by the great solubility of its sulphate, by the difficulty with which it is acetylated, by the high melting point and the difficult saponification of its acetyl compound.

	<i>v</i> -Orthoxylydine.	Asymmetric orthoxylydine	<i>v</i> -Metaxylydine.	Wroblewsky's so-called Orthoxylydine.
Hydrochloride.....	+ 1 H_2O	+ 1 H_2O	+ $\frac{1}{2}$ H_2O needles	+ $\frac{1}{2}$ H_2O
Solubility in 100 of H_2O at 18° C.....	11·2	Very soluble.	9·2	Very soluble.
Nitrate.....	Anhydrous.	Anhydrous.	Anhydrous.	Anhydrous.
Solubility in 100 of H_2O at 18° C.....	6·6	4	2·2	2·7
Normal sulphate.	Anhydrous.	Anhydrous.	Anhydrous.	Not prepared.
Solubility in 100 of H_2O at 18° C.....	1·4	5·6	Very soluble.	..
Acid sulphate.....	Is not formed under ordinary conditions.		+ 2 $\frac{1}{2}$ H_2O	+ 2 $\frac{1}{2}$ H_2O
Solubility in 100 of H_2O at 18° C.....	..	..	6·2	Very soluble.

The xylol prepared from the base in the ordinary way forms white needle, melting at 48°C ., difficultly soluble in water, easily in alcohol, ether, &c.—A. L.

On Orthonitroanilinesulphonic Acid and some of its Derivatives. R. Nietzki and Z. Lerch. Ber. **21**, 3220—3223.

If acetyl sulphanilic acid be treated with nitric acid, *o*-nitrosulphanilic acid is obtained, which is probably identical with the one described by Goslich. To prepare this compound one part of acetanilide is dissolved on the water-bath in 2—3 parts of sulphuric acid containing 18—20 per cent. of sulphuric anhydride, then two parts of sulphuric acid are added, and a mixture of the required amount of nitric acid with an equal volume of sulphuric acid gradually dropped in. The mass is poured on to ice and the free nitrosulphanilic acid separates in yellowish needles. It is very soluble in water, difficultly in dilute sulphuric acid and concentrated hydrochloric acid. On boiling for some time with caustic potash, ammonia is given off and nitrophenolsulphonic acid formed. If an aqueous solution of the nitrosulphanilic acid be treated with hydrochloric acid and sodium nitrite, light yellow needles of nitrodiazobenzenesulphonic acid separate out of the solution. On reduction with stannous chloride and hydrochloric acid this compound forms a hydrazine. With phenols colouring matters are formed. On heating *o*-nitrosulphanilic acid with tin protochloride and hydrochloric acid, *o*-phenyldiaminesulphonic acid is formed, the hydrochloride of which separates out of the solution in small colourless needles. This salt is very easily decomposed, and after several recrystallisations from water the free sulphonic acid is obtained. On exposure to air its colour changes to a greenish blue. Ferric chloride produces in its solution a red-brown colouration, but no crystals are precipitated, as is the case with *o*-phenyldiamine. It forms combinations with orthoquinones as with erconic and rhodizonic acids.

If *o*-nitrodiazobenzenesulphonic acid be added to a well-cooled strongly acid solution of tin protochloride, small light-yellow needles of the corresponding hydrazine are formed. It is more difficultly soluble in cold than in hot water, but is decomposed by continuous boiling. It dissolves in caustic alkalis and carbonates with a reddish-brown colour. It yields a tartrazine colour with dihydroxytartaric acid. By treating with an acid solution of tin protochloride and an excess of tin, nitrohydrazinesulphonic acid is converted into the amidehydrazinesulphonic acid. It is remarkable that the latter is not capable of producing a tartrazine colour with dihydroxytartaric acid.—A. L.

On α -Naphtholbidiazobenzene and α -Naphthylaminebidiazobenzene. C. Krohn. Ber. **21**, 3240—3242.

Two molecules of diazobenzene chloride are gradually added to an alkaline solution of one molecule of α -naphthol. After 12 hours standing a brownish-black powder is precipitated, which is boiled with caustic soda, to remove mono azo- α -naphthol. It is then crystallised from aniline. It melts at 183°C ., is soluble in chloroform, ether, benzene difficultly soluble in petroleum spirit, alcohol, and glacial acetic acid. On reduction with tin and hydrochloric acid, it is converted into aniline and diamido- α -naphthol. Its constitution is therefore:— $\text{C}_{10}\text{H}_5(\text{OH})(\text{N}:\text{N}.\text{C}_6\text{H}_5)_2$ [1:2:4].

The preparation of α -naphthylaminebidiazobenzene is more difficult than that of α -naphtholbidiazobenzene. It is impossible to obtain it in alkaline or neutral solution. If, however, one molecule of diazobenzenechloride be added to one molecule of naphthylaminemonazobenzene, dissolved in alcohol and containing sodium acetate, the colour of the solution is changed from red to brown; after 12 hours standing the reaction is finished. α -naphthylaminebidiazobenzene is difficultly soluble in most solvents, easily in chloroform. It crystallises from aniline in red needles, melting at 189° . It forms salts, which are decomposed by water. Its acetyl compound melts at 265°C . On reduction with tin and hydrochloric acid, aniline and triamidonaphthalene are formed, the latter of which forms

with phenanthrenequinone an azine. There is, therefore, in the original compound one azo-group in the ortho position to an amido-group and its constitution is—



Action of Sulphuric Acid on α -Nitronaphthalene. W. Palmaer. Ber. **21**, 3260—3264.

According to Clève the chief product obtained by the action of sulphuric acid on α -nitronaphthalene is α -nitronaphthalene sulphonic acid. The present paper treats more in detail with the products formed.

Nitronaphthalene was warmed with two parts of ordinary and one part of fuming sulphuric acid, and after 10 hours was poured into water. The α -acid separated out for the most part. From the mother-liquor the calcium salts of the α - and β -acids were obtained, and from the mother-liquor of these were obtained potassium salts, which gave two chlorides with PCl_5 , melting at 167° and 126° respectively.

The chloride melting at 167° is that of the δ -acid, obtained also by nitrating naphthalene- β -sulphonic acid; δ -nitronaphthalene sulphonic acid is thus an α -nitro- β -sulphonic acid. The chloride melting at 126° is that of β -nitronaphthalene sulphonic acid, which is identical with the third acid obtained by sulphonating α -nitronaphthalene. It is evident from this that the nitro group in β -nitronaphthalene sulphonic acid occupies the α -position. A number of salts of the δ acid are described.—T. L. B.

δ -Amidonaphthalene Sulphonic Acid. P. T. Clève. Ber. **21**, 3264—3267.

A DESCRIPTION of various salts and derivatives of the acid.

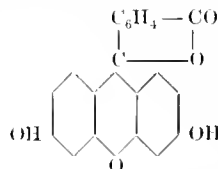
By suspending the amido-acid in absolute alcohol and treating with nitrogen trioxide, the diazo acid is obtained, $\text{C}_{10}\text{H}_6\text{N}_2\text{SO}_3$. By treatment in aqueous alcohol a violet azo-colour is obtained, which is changed into brown on the addition of alkalis. It is soluble in water.—T. L. B.

γ -Amidonaphthalene Sulphonic Acid. P. T. Clève. Ber. **21**, 3271—3276.

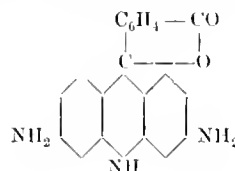
THE various salts and derivatives are described. Nitrogen trioxide acts very slowly on it, with formation of γ -diazonaphthalene sulphonic acid.—T. L. B.

Fluoresceïn. R. Meyer and O. Oppelt. Ber. **21**, 3376—3378

THE constitution of fluoresceïn is known, only the position of the oxygen atoms belonging to the resorcinol nuclei towards the methane carbon atom is not yet clear. If it be in para-position to one oxygen atom and in ortho to the other, its formula will be—



By the action of ammonia a body ought to be produced, which, in place of the oxygen residua of resorcinol would contain the ammonia residua—



If, then, the lactone ring could be broken, and a molecule of carbonic acid and water were given off a symmetric diamidophenylacridine would be formed, isomeric with chrysianiline and identical with benzothavine, which could be easily converted into phenylacridine. The authors have succeeded in preparing a body of the above formula by the action of ammonia on thiorescein. It is a yellow colouring matter which dyes wool a beautiful yellow. It forms a salt with caustic soda, crystallising in fine needles. By acidulating and precipitating with ammonia the original base is reformed. If, however, the alkaline solution be reduced with zinc dust a nearly colourless solution is obtained, which yields no precipitate on treatment with hydrochloric acid and ammonia.—A. L.

On Chromogenic Carbinols and the Constitution of Rosaniline Salts. V. v. Richter. Chem. Zeit. 12, 1641.

According to Richter, chromogenic carbinols are a class of compounds whose colour-producing properties depend on the replacement of hydrogen atoms, which are directly combined with carbon, by basic or negative radicals. Accordingly we have to distinguish between basic carbinols and carbinol acids. The latter are formed by the replacement of two or three hydrogen atoms in methane by a corresponding number of negative radicals, especially by nitrophenyl groups. With alkalis these give intense violet and blue salts, in which the carbinol hydrogen is replaced by alkali metals. The basic carbinols, on the other hand, contain amidophenyl groups and produce coloured salts with acid radicals. The rosaniline salts should be looked upon as belonging to this class.—F. W. T. K.

PATENT.

A Method for the Production of New Colouring Matters suitable for Dyeing and Printing. C. Dreyfus, Manchester. Eng. Pat. 9280, June 26, 1888. 6d.

PRIMULINE (this Journal 1888, 179) when diazotised and combined with an alkaline solution of β -naphthol, forms a red colouring matter. Hitherto this could not be applied directly for dyeing or printing purposes on account of its insolubility. The present invention consists in dissolving primuline in water, acidifying the solution, diazotising it with nitrous acid, and pouring the mixture into an alkaline solution of β -naphthol. The insoluble colouring matter is then filtered, washed, pressed, and dried, and rendered soluble by heating it (in a closed vessel or in one connected with an inverted condenser) with about $2\frac{1}{2}$ times its weight of sodium bisulphite of 50° Tw. to 100° C. The filtered solution is treated with salt, which precipitates the new product in the form of a yellow powder, which is very easily soluble in water and is decomposed by caustic alkali, with the formation of the above red colouring matter. If the soluble colouring matter be used for printing and afterwards developed on the fabric by steaming, a red colour is produced which is very fast to soap. In a similar manner maroons and oranges can be produced by substituting α -naphthol and resorcinol respectively, for the β -naphthol in the process described above.—T. A. L.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

PATENTS.

Improvements in Scouring or Dyeing Woollen Rugs or Skins with or without the Wool or Fur upon them, or any Woollen Fabric or Leather, and in Apparatus to be used for the Purpose. J. and J. C. Morland, Glastonbury. Eng. Pat. 329, January 7, 1888. 8d.

THIS apparatus for scouring skins, rugs, furs, or leather, consists of a revolving cylinder which has a number of brushes attached to its circumference and parallel with its axis, the cylinder being enclosed within a fixed casing. "The skin to be treated is laid on a table with the wool side uppermost, and whilst held by the workman is drawn forward, by the action of the brushes, over the surface of a roller which is parallel with the brush cylinder, and at such a distance from it that the brushes as they revolve act against and brush the wool. The roller may be prevented from turning by a pawl and ratchet wheel, so as not to allow the skin to be drawn in too rapidly, but can freely turn in the opposite direction when the skin is drawn back." Above the roller is a perforated pipe for the supply of the water, scouring-liquor, or dye-liquor, to the action of which the wool has to be subjected.—W. E. K.

Improvements in Machinery for Dyeing Yarns. J. B. McKay, Galashiels. Eng. Pat. 336, January 9, 1888. 8d.

THE bunks of yarn to be dyed are held in a distended condition upon vertical frames, each frame having a small reel at its upper end and a roller at its lower end. Each reel is fast on a horizontal shaft, and the sides of the vertical frame are hung loosely on the shaft, which rests on guide rails fixed along the sides of an oblong rectangular vessel, which constitutes the dye-vat. Suitable provision is made for a supply of steam for heating the dye-liquor contained in the vat. The series of shafts are moved gradually from one end of the vat to the other, and whilst being so moved are turned, so as to change the position of the bunks on the reels and rollers, by means of pinions which are fixed on the shafts and gear with a toothed rack fixed along one side of the vat. The shafts are moved along the vat by means of endless pitch chains at the sides, these chains having fixed to them studs which act on the shafts. The sprocket wheels which move the endless chains are by preference turned by means of ratchet wheels and driving pawls worked by eccentrics on a rotating shaft driven in any convenient way. When each shaft, with its vertical frame, has been moved from one end of the vat to the other, it is lifted up out of the vat by means of two other endless pitch chains at the sides, worked by means of continually rotating sprocket wheels. By these transferring pitch chains the frames are carried above the level of the vat and returned into the vat at the entering end, and this passage of the frames through the dye vessel may be repeated as often as necessary. There is also provision for lifting the whole of the frames simultaneously, to admit of any desired alteration being made in the dye-liquor.—W. E. K.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Experiments with Breisgan and Russian Hemp. F. G. Stebler. Oesterreich. landw. u. forstw. Wochenbl. 42, 331—332.

See under XV., page 125.

VII.—ACIDS, ALKALIS, AND SALTS.

On the Preparation of Phosphorescent Sulphides of Calcium and Strontium. E. Becquerel. Compt. Rend. 107, 892—894.

THE author has previously shown that by adding to a mixture of lime and sulphur before igniting, a small quantity of a certain substance, a much more brilliant phosphorescence is obtained. He has since discovered that the action of the latter compound is often only observed when that substance is impure or consists

of a variety of different bodies. Thus on calcining perfectly pure carbonate of lime with sulphur, the product is but slightly phosphorescent. If, however, previous to heating, traces of soda be added, the product becomes strongly luminous with a green light after the exposure. On the other hand, if traces of manganese or bismuth be added to the carbonate, after igniting with sulphur, the sulphide is hardly luminous, but becomes so if before calcining 0.5—1 per cent. of soda be added, showing a brilliant yellow or blue phosphorescence. Lithia acts like soda on carbonate of lime, causing the sulphide to emit a very intense green light after exposure. Potash, when quite pure, has no effect. On calcining oyster and other shells a phosphorescent fiery red mass is often obtained. The same effect was observed by the author when sodium carbonate containing traces of rubidium were added to the lime and sulphur before igniting.

The sulphide of strontium is, generally speaking, less luminous than that of lime. When prepared from the pure carbonate it shows a slight bluish-green phosphorescence; when traces of soda are present the colour is green.—A. R.

Action of Carbon Bisulphide on Clay—Production of Carbon Oxy-sulphide. A. Gautier. *Compt. Rend.* **107**, 911—913.

A PORCELAIN tube is filled with kaolin, previously calcined at a red heat, and placed in a combustion furnace heated to a white heat, the air replaced by CO_2 , and a current of dry CS_2 then passed over the kaolin. The gas which leaves the tube consists of 60—64 per cent. of carbon oxy-sulphide, 35—39 per cent. of CO , traces of H_2S and CO_2 , and the remainder of "sulphocarbonic acid" (probably meant for carbon bisulphide). The higher the temperature the more COS is formed. The gases traverse a flask cooled with ice water, where most of the CS_2 is deposited; they are then washed in caustic potash, which removes H_2S and CO_2 , whence they pass through a column of acid cuprous chloride to absorb the CO . Any remaining traces of CS_2 are then removed effectually by alcoholic aniline, and the gas is finally passed over pumice stone saturated with sulphuric acid. It is then perfectly pure COS . The residue in the tube is found, on carefully breaking the latter, to contain at the extreme end brilliant white crystals of sulphide of silicon. In place of the kaolin there is a substance of a leaden appearance in which numerous very hard crystals are embedded. The latter emit H_2S in moist air. Water acts on them with difficulty and gives gelatinous silica and alumina. It appears likely that sulphur has taken the place of O, and a kind of polysulphate of alumina has been formed. When carbon bisulphide is passed over ignited alumina very little COS is formed. The gas is, however, obtained almost pure by passing the vapour of sulphur over a mixture of alumina and charcoal at a white heat.

—A. R.

Salt Beds in New South Wales. "Sydney Daily Telegraph," November 28, 1888.

WHAT may be a discovery of great value has been made at Ellalong, near Maitland, and about 16 miles from Allandale station. There a deposit of crystallised salt, 4 ft. thick in places, has been found, and it is expected that a body of rock salt will be reached below. Mr. Hilton, an expert, expresses the opinion that a similar deposit will be discovered at Ellalong. Something like 100,000 tons of salt per annum are used there, and the price is 5l. 10s. per ton. Thus, such a discovery would be of great value. A syndicate has secured 400 acres of the land, and the value of the latter will be thoroughly tested.—W. S.

PATENTS.

Improvements in the Method of and Apparatus for Manufacturing Hydrated Phosphates and in Recovering By-products therefrom. L. G. G. Daudenart, Brussels, Belgium. Eng. Pat. 17,181, December 14, 1887. 11d

THE phosphate to be treated is in all cases first washed with water to dissolve out all soluble matter, and to remove

the lighter earthy impurities. It is then treated with hydrochloric acid from a subsequent operation forming a solution of calcium chloride and acid phosphates of lime. To this is added magnesium hydrate, whereby the bicalcium hydrated phosphate is precipitated and calcium and magnesium chlorides remain in solution. Magnesium carbonate is added and carbonic acid gas passed in under a pressure of two to three atmospheres, the whole of the lime being rapidly thrown down as carbonate, the solution now containing only magnesium chloride. The inventor states that the conversion is much more rapidly effected in this manner than if magnesia be merely suspended in the liquid and carbonic acid gas passed in. The chloride of magnesium solution is evaporated until it has the composition $\text{MgCl}_2 + 17 \text{H}_2\text{O}$, this is thrown in regulated quantities and at regular intervals upon the red-hot sole of a special basin-shaped orin of furnace. Hydrochloric acid is at once given off, associated with 16 molecules of water, and this is again used in the first process. The anhydrous magnesia remaining can either be re-hydrated by boiling with water at a pressure of two or three atmospheres, or, if overheated, dissolved in hydrochloric acid and the chloride worked up again. Hydrated magnesia may also be obtained from seawater by treating with lime, and hence the manufacture of hydrated bicalcium phosphate may be united with the extraction of magnesia from this source.—S. G. R.

Improvements in the Treatment of Alkali Waste to obtain Sulphuretted Hydrogen and other Products, and in Apparatus Employed to obtain these Substances. Jas. Hargreaves, T. Robinson, and Jno. Hargreaves, Widnes. Eng. Pat. 1371, January 30, 1888. 6d.

I. ALKALI waste is mixed with sufficient clay "to combine and form cement with the lime contained in the waste." The mixture is formed into bricks, which are placed in a series of chambers, superheated steam being passed through the mass, in order to drive off the sulphur as sulphuretted hydrogen. The heating of the mass is then continued to form cement.

II. Oxidised alkali waste is mixed with both coal and clay before heating, in order to reduce the sulphur-oxygen compounds to sulphides.

III. If it be intended to treat alkali waste with carbonic acid in order to obtain sulphuretted hydrogen, a chamber is employed, with a series of shelves placed one above another, and upon which shelves, by mechanical means, the waste is constantly moved, so as to expose fresh surfaces to the carbonic acid. The waste is allowed to fall from one shelf to another below, whereas the carbonic acid passes through the chamber in an opposite direction. After carbonation the waste is exposed to the air, in order to oxidise any undecomposed sulphides to sulphate. The latter is removed by washing, and the residue intimately mixed with clay. The mixture is heated with highly superheated steam, whereby carbonic acid is liberated, which is caused to act on fresh alkali waste, while cement is produced at the same time.—S. II.

Improvements in Treating Sulphides of Sodium and Potassium to obtain Sulphuretted Hydrogen, and in Apparatus Employed therein. A. M. and J. F. Chance, Oldbury. Eng. Pat. 1495, February 1, 1888. 8d.

POTASSIUM of sodium sulphide is dissolved or mixed with water and introduced into a series of vessels connected by pipes, and furnished with inlet and outlet ways. Gases rich in carbonic acid, preferably gases from a closed lime-kiln, are then pumped into the first vessel of the series. The carbonic acid at once decomposes the sulphide, sulphuretted hydrogen being evolved, which is driven forward into the second vessel, where it meets with further quantities of sulphide, whereby it is dissolved with the production of sulphhydrate. The gases finally issuing from the last vessel contain no sulphuretted hydrogen, and are allowed to escape into the air. Gradually nearly all the sulphide is decomposed in the first vessel, when the carbonic acid acts on the sulphhydrate in the second vessel, the evolved gases rich in sulphuretted hydrogen being

conducted to a gasholder. As soon as the evolution of sulphuretted hydrogen diminishes, the gases are again passed through a vessel filled with sulphide for the purpose of forming sulphhydrate and so forth. The apparatus employed is described in Eng. Pat. 8666, of 1887 (this Journal 1888, 210).—S. H.

Improvements in Making Sulphide of Zinc. J. Wilson, Leith. Eng. Pat. 1516, February 2, 1888. 4d.

A SOLUTION of sodium sulphide free from carbonic acid is used for precipitating zinc salts to produce zinc sulphide. The sulphide of soda made by calcining sulphate of soda with coal, may be freed from carbonic acid by treatment with sulphate, chloride or sulphide of lime or magnesia, or with sulphide or chloride of barium or strontium. The sulphide of soda may also be obtained free from carbonic acid by mixing the sulphate of soda with sulphate of lime, barium, or strontium before calcining it with coal, or the sulphide of soda may be made by treating sulphate of soda with sulphide of lime, barium, or strontium.—E. E. B.

Improvements in the Manufacture of Chlorine. H. W. Deacon and F. Hurter, Widnes. Eng. Pat. 2104, February 11, 1888. 6d.

THIS invention relates to the Deacon process, wherein chlorine is produced from hydrochloric acid gas by means of oxygen and a catalytic substance. It has been found that it is of great advantage to introduce the hydrochloric acid gas into the decomposer in as dry a condition as possible. In order to secure the dry condition of the gas, the mixture of hydrochloric acid and steam, as given off during the process of manufacturing salt-cake, is first cooled and afterwards made to ascend a tower, where it meets with a descending stream of strong sulphuric acid.—S. H.

Improvements connected with the Manufacture of Chlorine. H. W. Deacon and F. Hurter, Widnes. Eng. Pat. 2311, February 15, 1888. 6d.

THE gases passing out of a decomposer used in the Deacon chlorine process always contain some hydrochloric acid, which has passed undecomposed through the apparatus. It was customary to remove the hydrochloric acid by washing with water, but the aqueous acid thus produced was so dilute as to be valueless. It is now proposed to remove the hydrochloric acid by bringing the gases into intimate contact with "Weldon mud." The latter readily absorbs the hydrochloric acid gas, thereby evolving chlorine. In order to carry out this intention, Weldon mud is run down a tower, filled with flint, whereas the gases from the decomposer pass upwards through the tower. The amount of Weldon mud run down is so regulated as to leave a little manganese dioxide undissolved. The resulting black liquid is ultimately worked off in an ordinary Weldon still.—S. H.

Improvements in the Manufacture of Sulphuric Anhydride, and Apparatus to be Employed therein. E. B. Ellice-Clark, London. Eng. Pat. 3116, March 1, 1888. 8d.

Pure, dried oxygen gas is pumped through a pyrites, brimstone, or other sulphur burner in sufficient quantity to burn all the sulphur into sulphurous anhydride, and further to convert this into sulphuric anhydride. The burner is closed to prevent any admission of air, and is provided with concentrating pans for the utilisation of the waste heat. The mixture of sulphurous anhydride and oxygen is passed through a chamber in which any dust is deposited, and then through a series of tubes filled with material which exerts a catalytic action, preferably platinised asbestos, the temperature being carefully regulated. The sulphuric anhydride formed, mixed with traces of sulphurous anhydride and oxygen, is condensed, and the last traces of sulphuric anhydride then removed by passage through concentrated sulphuric acid. The residual sulphurous anhydride and oxygen, if any, pass back again through the pump. A drawing of the apparatus is given.—S. G. R.

Improvements in Treating the Liquors known as Yellow Liquors draining from Alkali Waste Heaps to obtain Sulphuretted Hydrogen, and in Apparatus Employed therein. A. M. and J. F. Chance, Oldbury. Eng. Pat. 3182, March 2, 1888. 6d.

THE yellow liquors which contain calcium sulphhydrate, together with polysulphides, are placed in closed vessels and treated with gases containing carbonic acid in the manner described in Eng. Pat. 8666 of 1887 (this Journal, 1888, 210). The yellow liquors may be also worked up along with alkali waste, by mixing the latter with yellow liquors instead of with water, and carbonating the two together.—S. H.

Improvements in the Manufacture of Sulphide of Sodium or of Sulphide of Potassium from their respective Sulphates. F. H. Gossage and T. T. Mathieson, Widnes. Eng. Pat. 3218, March 2, 1888. 4d.

THE object of this invention is to manufacture alkaline sulphides from their sulphates without destroying the lining of the furnace in which the reduction is performed. For this purpose the inventors add to the mixture of sulphate of soda, or sulphate of potash, and coal, a sufficient quantity of sodium chloride, the presence of which prevents the injurious action of the sulphide on the lining. Eight parts of common salt to 20 parts of the sulphate are generally found sufficient. The mixture of sulphide and salt formed by the fusion in the furnace may be drawn into open vessels and cooled before lixiviation without danger of oxidation. The mass is then lixiviated and the solution worked up for various purposes.—S. H.


Improvements in the Manufacture or Production of Sodium-Meta-Sulphite. A. Boake, F. G. A. Roberts, A. Shearer, and W. B. Giles, Stratford. Eng. Pat. 4262, March 20, 1888. 8d.

SULPHUR dioxide gas is passed through a solution of sodium carbonate, bicarbonate, or hydrate. The solution is kept at from 110° F. to the boiling point of the liquid, preferably gently boiling. When the gravity of the liquid is about 1.450, and no more sulphur dioxide is absorbed, the solution is run off, cooled, and allowed to crystallise.—S. G. R.

Obtaining Sulphur, &c. F. B. Rawes, Stratford. Eng. Pat. 1393, March 22, 1882. (Second Edition.) Amended November 2, 1888. 11d.

THE emendations consist in the deletion of part of the second claim, and the whole of the third and sixth claims, relating to apparatus for purifying carbon dioxide; for treating hydrogen sulphide with iron oxide to obtain free sulphur; and also to the use of by-products obtained by such processes. (See this Journal 1882, 454.)—O. H.

Apparatus or Appliances in combination with Furnaces for Roasting Pyrites and other Minerals containing Sulphur, for Cooling the Sulphurous Gases given off therefrom. H. Albert, C. Fellner, and C. Ziegler, Bockenheim, Germany. Eng. Pat. 15,980, November 5, 1888. 8d.

THE very hot gases issuing from the burners, which are often injurious to both Glover tower and chamber, are passed on their way to the Glover tower through a brick chamber subdivided by a partition and furnished with ranges of pipes. The pipes are  shaped, and the gases pass over them in a descending and ascending direction, and in the reverse way to that in which the air or other cooling medium travels within them. The heat thus taken up may be utilised for heating, drying, evaporating, or other purposes. The specification is furnished with plans.—S. G. R.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

PATENTS.

Improvements in and connected with the Manufacture of Cement, and Apparatus for Use therein. W. Joy, Northfleet. Eng. Pat. 1978, February 9, 1888. 11d.

THE patentee charges cement kilns partly with a mixture of slurry and fuel, and partly with slurry unmixd with fuel. The constituents may be used either wet or dry. The kiln is started and then feeding continued according to Eng. Pat. 9154 of 1885, or 15,751 of 1885 (this Journal, 1886, 327), until the lower portion of the charge is converted into a "clinker." After this, feeding is continued alternately with a mixture of slurry and fuel, and with neat slurry, wherever a glow appears on the surface. The relative quantities of mixture to neat slurry are decreased as the kiln fills up. When a kiln has been sufficiently charged it is allowed to burn out.

In preparing the slurry the chalk is crushed by passing through rolls and then run into the pan of an edge-runner mill. The clay to be mixed with the chalk is placed, with or without water, in the pan, and the mixture passes through the perforated or grated bottom into a chamber below, where it is further mixed by means of stirrers. From this chamber it passes into a horizontal cylinder, where it is still further mixed and along which it is propelled by means of screw-like arms. It may then be delivered on to rolls or mill-stones, or taken direct to the drying floors.

In the drying of the slurry the products of combustion from the kilns are utilised.—T. L. B.

Improvements in and relating to the Manufacture of Lime and of Natural and Artificial Cements. M. H. Heys, Swancombe. Eng. Pat. 1980, February 9, 1888. 6d.

ALTERNATE layers of fuel and raw material are packed in the kiln and the charge burnt from the top. As soon as the fuel is burnt through to the bottom the eye of the kiln is closed to prevent access of air. After cooling the mass is slaked; the portions remaining unslaked may then be ground and used as plaster, and the fine portions may be mixed as a slurry with siliceous material and recalcined.

—T. L. B.

Improvements in the Manufacture of Artificial Stone. J. Brunton and L. Griffiths, London. Eng. Pat. 2803, February 24, 1888. 6d.

CRUSHED granite, slag, or limestone is mixed with an alkaline silicate, an alkaline carbonate, an acid (such as azotic, sulphuric, acetic) and hydraulic lime or Portland cement. The compound can be formed in moulds. When hard, the blocks may be immersed in a bath of silicate of soda or potash for about 48 hours to still further harden them, after which they are dried. Colouring matters may be introduced. Metal bars or the like may be imbedded in the material to give strength.—T. L. B.

X.—METALLURGY, MINING, Etc.

On the Accuracy of the Dry Assay for Silver. Dingl. Polyt. J. 270, 468—471.

See under XXIII., page 137.

Cyanide of Potassium as a Lixivation Agent for Silver Ores and Minerals. L. Janin. The Eng. and Min. Journ. 46, 548—549.

THIS paper consists of a description of a series of experiments undertaken, in consequence of contradictory state-

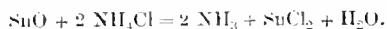
ments, to ascertain the solubility of silver and some of its compounds in solutions of potassium cyanide. Sulphide of silver dissolved to the extent of 30 per cent. when submitted to an excess of a 1 per cent. solution for 12 hours at a temperature of about 35° C. Under similar conditions the solubility rapidly increased as the solution was made more concentrated, until 10 per cent. was reached, when 98.5 per cent. of the sulphide was dissolved. With a 20 and a 25 per cent. solution the amount dissolved was 99.8 per cent. In the presence of oxide and other compounds of copper the solubility was reduced. Cement silver was next tried, and it was found that as the strength of the solution increased the solubility decreased, 24.7 per cent. dissolving in 500 cc. of a $\frac{1}{2}$ per cent. solution after 12 hours, whilst only 17.6 per cent. dissolved in the same time in a similar quantity of a 25 per cent. solution. The explanation suggested is that more hydrogen is liberated in the stronger solutions and causes stronger polarisation. Samples of various silver ores were then experimented upon with a 5 per cent. solution, and the results are given side by side with the results obtained by Russell's process. In 19 out of the 22 cases cited, an advantage is shown over the latter method, in some cases two or three times the amount of silver being extracted. As a rule the advantage is greatest when the ores are base. When the ore is roasted and chloridised the cyanide solution possesses a slight advantage over hyposulphite. Cyanide dissolves considerable quantities of gold from raw and roasted auriferous pyrites, and experiments on a few tailings showed a superiority of the cyanide method over Russell's process in this respect.

The author recommends the use of cyanide for silver extraction, and the electrolytic method for obtaining the silver from solution, potassium sulphide and flowers of sulphur being impracticable. The following objections to the process are pointed out:—1. The poisonous quality of the solution. 2. The solution when strong is easily decomposed by exposure to heat and air. 3. The excessive cost of the chemical. 4. Its great solvent powers for base metals. This last objection is the only valid one, and is more emphatic with roasted than with raw ores. But even this can be overcome by first washing the roasted ore with water, leaching with hyposulphite, and using the cyanide only to extract a further quantity of silver.—A. W.

The Oxidation and Cleansing of Tin. L. Vignon. Compt. Rend. 108, 96—98.

CRYSTALLINE tin, which has been deposited upon zinc from neutral solutions of stannous or stannic chlorides, contains, after a few days' exposure to the air, a fourth or third of its weight of stannous oxide; its surface being coated with oxide it does not fuse when heated, but burns like tinder. The same properties are to be observed in powdered tin, made by shaking molten tin in a wooden box.

This throws light upon the necessity for the use of zinc chloride, ammonium chloride, resin, &c. in tinning and soldering. For if the infusible tin be heated with solid zinc chloride a bright button and a brown dross are obtained; the latter is soluble in water with formation of a white precipitate, which dissolves in hydrochloric acid, giving stannous chloride. Again, if infusible tin be heated with ammonium chloride, ammonia is evolved and stannous chloride formed:



It is evident, then, that the use of these fluxes is to dissolve the oxide of tin and obtain a bright surface. This shows that tin is notably oxidised in both dry and moist air at the ordinary temperature. (Compare this Journal 1889, 62.)—A. G. B.

Alloys. W. Chandler Roberts-Austen. J. Soc. Arts, 36, 1111—1118; 1125—1133; 1137—1146. Three Cantor Lectures.

THE lectures commence with a sketch of the early investigations on alloys, and the development of views in

respect to their constitution from the time of Réaumur in 1722 to that of Matthiessen in 1860. Réaumur, who studied the molecular change produced in a metal by heat, explained the hardening of steel by stating that when hot steel is rapidly cooled the "sulphur and salts" cannot return to the molecules, but remain in the interstitial spaces, which comes very near to the modern view that a metal may, under certain conditions, pass from one allotropic state to another. Muschenbrock examined the cohesion of alloys and made experiments on their tensile strength, and pointed out in the early part of the 18th century the importance of working on the tenacity of metals. Duhamel appears to have been the first to show the necessity of using, for experiment, pure materials, and Regnault showed that the specific heat of certain fusible alloys was greater, near 100, than the mean specific heat of their constituents. Matthiessen's very important work on the electrical resistance of metals and alloys led him to the conclusion that metals exist in many cases in allotropic forms.

Alloys can be produced in three ways:—(1) by fusion; (2) by compression of the powders of the constituent metals; (3) by electro-deposition. The following metals evolve heat when united by fusion:—aluminium and copper, platinum and tin, arsenic and antimony, bismuth and lead, gold and just-melted tin; while lead and tin in uniting absorb heat. Equivalent proportions of the powders of tin, lead, and bismuth mixed with eight equivalents of mercury, produce a reduction in temperature from $+17^{\circ}\text{C.}$ to -10°C. Sprig's work on the production of alloys by compression was next described. He produced by the compression of the powders of certain metals solid blocks of the same, having the same physical properties as the metals produced by fusion; thus bismuth became crystalline, &c., and he was led to the conviction that alloys could be produced in the same manner. The powders of bismuth, lead, tin, and cadmium in the proper proportions were compressed, and an alloy produced which melted below 100°C. Instances of the electro-deposition of alloys were given, such as the deposition of brass from a solution of copper and zinc sulphates, and the production of red, rose-coloured, and green gold by using suitable mixtures of gold, silver, and copper.

The separation of the constituent metals of alloys by electrolysis has so far not been effected. After referring to Obach's attempts to decompose sodium amalgam, the author describes his own experiments with alloys of lead and gold, and lead and silver. By melting the alloy in two cavities in a fire brick communicating one with the other at the base by a narrow channel, and passing a strong current of electricity through it, it was found that no separation of the metals took place even while the current was passing through the alloy.

The second lecture is devoted very largely to the influence of traces of impurities on metals. 0.05 per cent. of tellurium converts bismuth into a minutely crystalline mass. 0.2 per cent. of bismuth renders gold useless for coinage. 0.01 per cent. of antimony in copper spoils it for the manufacture of brass—a small quantity of tin or other impurities reduces the conductivity of copper enormously, and so important is this commercially, that as Preece points out, a cable made of the copper of to-day will carry twice the number of messages that a similar cable of less pure copper would in 1858, when the influence of impurities in this respect was not understood. Prof. Roberts-Austen then describes his own recently-published research* on the effect of traces of impurities on the tensile strength of gold, and which is of extreme importance, inasmuch as it establishes a law in connexion with the effect of these impurities. Gold was chosen for the following reasons:—it is possible to purify it to a high degree; it is not liable to oxidation; and the accuracy of the results is not affected by the presence of occluded gases. Pure gold has a tensile strength of 7 tons per square inch with 25 per cent. elongation, and its atomic volume is 10.2. Small quantities of impurity about 0.2 per cent. were added, and the metal tested with the following results:—

Name of added Element.	Tensile Strength. Tons per Sq. In.	Elongation per Cent. (on 3 Ins.).	Impurity per Cent.	Atomic Volume of Impurity.
Potassium ..	0.5 (less than)	Not perceptible	0.2 (less than)	15.1
Bismuth....	0.5 (about)	"	0.210	20.9
Tellurium...	3.88	"	0.186	20.5
Lead.....	4.17	4.9	0.240	18.0
Thallium...	6.21	8.6	0.193	17.2
Tin.....	6.21	12.3	0.196	16.2
Antimony...	6.0 (about)	Qy.	0.203	17.9
Cadmium...	6.88	44.0	0.202	12.9
Silver.....	7.10	33.3	0.200	10.1
Palladium ..	7.10	32.6	0.205	9.4
Zinc.....	7.54	28.1	0.205	9.1
Rhodium...	7.76	25.0	0.210 (about)	8.4
Manganese .	7.99	20.7	0.207	6.8
Indium.....	7.99	26.5	0.200	15.3
Copper.....	8.22	13.5	0.193	7.0
Lithium....	8.87	21.0	0.201	11.8
Aluminium .	8.87	25.5	0.186	10.6

These results prove that metals having a high atomic volume, when present in small quantity, diminish the tenacity and extensibility of gold, while those with an atomic volume the same as gold, or less, either increase or do not affect these properties. This law is supported by outside evidence in the case of other metals: thus, iron with an atomic volume 7.0 is rendered more tenacious by small quantities of carbon with a low atomic volume, and is prejudicially affected by sulphur, arsenic, and phosphorus, with atomic volumes 15.4, 13.3, and 14.8 respectively. The effect of manganese on iron is not yet proved, but from its having the same atomic volume it may be surmised that it does not act prejudicially.

The third lecture relates chiefly to the colours of metals and some of the various means employed to utilise them artistically, such, for instance, as the production of a patina on metals and alloys by pickling. Analyses of some of the alloys and the compositions of some of the pickling solutions used by the Japanese, who are proficient in this art, are given. The latter all contain verdigris and sulphate of copper, and there may also be present vinegar, nitre, salt, and sulphur. The colour of the patina is regulated by the solution used as well as by the impurities in the metal or the composition of the alloy. There is another Japanese metallurgical art which the author is desirous of seeing established in this country, viz., "mekumé" or "wood-grain."

It is made by soldering together thin sheets of various metals layer upon layer, drilling conical holes into them, and hammering flat or punching prominences and filing those down to the surface of the metal, thus producing complicated sections of the banded alloys, and developing the colours by pickling.—A. W.

PATENTS.

Improvements in the Manufacture of Sodium and Potassium. P. M. Justice, London. From H. Y. Castner, New York, U.S.A. Eng. Pat. 7395, June 2, 1886. (Second Edition.) 6d.

See this Journal, 1886, 538, and 1887, 174—176.

Improvements in Apparatus for Producing Aluminium and other Metals and their Alloys and Operating the same. W. L. Wise, London. From "The Schweizerische Metallurgische Gesellschaft," Laufen, Switzerland. Eng. Pat. 16,853, December 7, 1887. *Sd.*

The apparatus consists of an iron box or framework in which blocks of carbon united by a cement, such as coal-tar, are packed so as to form a kind of crucible, with a small channel from its base through the iron case to the exterior. This crucible is connected by suitable means with the negative pole of a dynamo. Inside the crucible are suspended a series of carbon blocks, and these are connected to the positive pole. Granulated copper is introduced into the crucible and the current passed, whereby the copper is melted and becomes the negative electrode. Clay or alumina is now added, the positive electrode being raised just out of contact with the copper. Aluminium bronze is produced and can be tapped through the bottom, fresh material being added at the top. Aluminium can be produced by using alumina alone, and silicon will enter into the aluminium bronze if a silicious clay be used. Drawings of the apparatus are given.—A. W.

Improvements in the Manufacture of Sodium, Potassium, and Metals of the Alkaline Earths, and in Apparatus therefor. H. H. Lake, London. From C. Netto, Dresden, Germany. Eng. Pat. 17,412, December 17, 1887. *Sd.*

This is a continuous method for making sodium from caustic and carbon at low temperatures. The apparatus consists of a vertical iron retort placed in a convenient furnace, with a condenser at the top, and with a hydraulic trap or other suitable arrangement at its base. It is filled to about one-half with incandescent charcoal, and fused caustic soda is continuously fed in at the top, falling on to and trickling through the charcoal. Sodium distils over and the carbonate of sodium produced runs down to the bottom of the retort, and can be syphoned off continuously or intermittently, and thus prevented from interfering with the continuous action of the process. By this means sodium can be produced at a much lower temperature and more regularly than when the carbonate of sodium is not removed. A vertical section of the plant is given, together with various means for drawing off the fused carbonate without admission of air to the apparatus.—A. W.

An Improved Process for the Manufacture of Sodium. H. S. Blackmore, Mount Vernon, U.S.A. Eng. Pat. 15,156, October 22, 1888. *6d.*

The following mixture is heated in an iron cylinder to dull redness for 20 minutes, and afterwards to a white heat:—27.5 parts of calcium hydrate, 31.1 parts of ferric oxide, 30.9 parts of dry sodium carbonate, and 10.5 parts of charcoal, or other carbonaceous matter. Caustic soda is first produced, and the organic matter reduces the ferric oxide to metallic iron, which in turn reduces the soda; the metallic sodium distils off and is suitably condensed. The residue consists of ferric oxide and quick lime, and it is only necessary to slake the latter when the mixture can be used repeatedly for treating fresh quantities of sodium carbonate and charcoal.—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improvements in the Utilisation of Waste Products from Electrical Batteries. O. C. D. Ross, London. Eng. Pat. 208, January 5, 1888. *6d.*

The waste solutions from electrical batteries still contain a considerable proportion of sodium or potassium nitrate and

free nitric or nitrous acid partly or wholly dissolved or decomposed. These partially exhausted acid solutions are mixed with about an equal weight of bones or coprolites, and the mixture allowed to stand for two to four weeks, whereby the phosphate present is converted into the superphosphate. The undissolved solid portion is afterwards boiled in the resulting phosphate solution and the whole evaporated to a partially solid magma. To the mixture is then added some dry substance useful as a manure, such as bone-meal, powdered coprolites, straw, bran, potassium, or calcium sulphate. The application of the waste products of electric batteries in the stead of sulphuric or hydrochloric acids is the peculiar object of the patent.—V. H. V.

Improvements in Voltaic Batteries. E. Tyer, London. Eng. Pat. 3312, March 3, 1888. *Sd.*

This invention relates to a electric cell so arranged that the extent of the contact of the zinc pole with the exciting liquid can be readily varied or entirely prevented without exposure of the pole to atmospheric action, and with constant maintenance of the amalgam on the surface. This is effected by placing at the bottom of the cell an annular trough charged with mercury, into which is immersed a vertical hollow cylinder of zinc. Over this is placed a bell of glass or ceramic ware made with a stem projecting upwards through a guide hole provided with a setting screw, so that the bell may be fixed at any desired height. At the lowest position of the bell the exciting liquid is prevented from coming in contact with the zinc; but by raising the bell more or less a greater or less surface of the zinc is exposed to the exciting liquid. From the mercury trough an insulated wire is led to a terminal screw. A boss arrangement may be fixed in the centre of the element to occupy part of the space within the bell, so that on alteration of the position of the bell there is less displacement of the level of the liquid within the bell.—V. H. V.

Improvement in the Manufacture of Electrical Dry Elements. C. Gassner, junior, Mayence, Germany. Eng. Pat. 10,415, July 18, 1888. *4d.*

The object of this patent is to facilitate the formation of a layer of hydrated oxide of iron on the carbon electrode described in Eng. Pat. 16,810 of 1886 (this Journal, 1887, 674). This is effected by bringing carbon saturated with ferric chloride in some liquid which shall react with the chlorine, thereby precipitating hydrated peroxide of iron. Of the various mixtures and solutions proposed are the alkaline hydroxides, ammonium chloride, zinc chloride, or oxide; or glue, gelatine and other such substances in the presence of an ammonium salt, so that the ammonia liberated by the current combines with the chlorine. The depolarisation by the freshly-precipitated hydrated oxide is effective and permanent.—V. H. V.

Improvements in Galvanic Batteries. D. Humphreys, New York, U.S.A. Eng. Pat. 14,522, October 9, 1888. *Sd.*

The object of the invention is the distribution of a current of air over the negative pole of galvanic cells, and the agitation of the liquid partly by a mechanical device and partly by the air current. By means of a crank-shaft, perforated cross tubes or rods are alternately dipped into and removed from the acid liquid, while by the same crank-shaft a current of air is forced from a pair of bellows through the perforations. The poles are also removable from the acid liquid by a vertical rod, working on a cross-piece provided with a cam wheel. A bichromate cell to which this mechanism is attached shows a high electromotive force and a low resistance. The aerating process agitates the liquid, thus causing a uniform reduction of the bichromate, while at the same time the air not only removes sedimentary matters, but also dislodges and in part combines with the liberated hydrogen. The mechanism which produces the vertical motion of the cross-rods, and forces the air through the liquid is described fully in the specification.—V. H. V.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

The Testing of Lards. Meeting of Society of Chemists in Hamburg. Chem. Zeit. 12, 1660.

LANGFURTH has been carrying out experiments for the purpose of discovering a method of distinguishing between ordinary and artificial lard. The latter is imported from America, and similar products are manufactured in Europe. All artificial lards prepared from vegetable oils (purified cotton-seed, especially earth-nut oil) and stearin (chiefly suet pressings obtained in the manufacture of artificial butter) are coarsely crystalline on solidifying, and show a more or less polished surface, whereas true lard, whether crude or refined, exhibits a finely-crystalline structure and a dull wrinkled surface. When cotton oil is present, artificial lards slowly turn brown on the addition of concentrated nitric acid of 1.4 sp. gr.; they give an immediate blood-red colour on treatment with concentrated sulphuric acid, carbon dioxide being evolved at the same time. In the elaidin test, brown drops are formed in the crumbly mass. Artificial lards all show a high melting point ($46-48^{\circ}\text{C}$), as well as a very high iodine value ($60-64$), and a very high specific gravity ($0.862-0.864$, at 100°C). The quantity of oleic acid calculated, according to Darcian, from the solidification point, is always lower than that obtained by the iodine method, whereas with pure fats we get the reverse, or, more usually, agreement of the values. The European artificial lards usually contain a small quantity of borax and too high a percentage of water. Since the investigation of lards which solidify at 40° is difficult, especially when the colour tests have to be applied, Langfurth proceeds in the following manner:—1 kilo. of the lard under examination is wrapped up in strong linen, and slowly pressed and filtered at the ordinary temperature; a limpid yellow oil is obtained. With artificial lards this represents 30–40 per cent., and contains most of the vegetable oils. In this case it has a higher specific gravity ($0.916-0.918$, at 18°C) than the oil obtained from pure lard ($0.912-0.914$ at 18°C). The iodine value bears a fixed relation to the specific gravity. The oil should always be carefully filtered and dried before the above colour reactions are tried, and comparative tests with oil from true lard should be carried out. Free fatty acids, too, must be absent. The usual analytical tests serve for the detection of other vegetable oils, such as palm oil, cocoa-nut oil, and sesame oil.—F. W. T. K.

Vegetable Fats. H. Jacobson. Zeits. f. physiol. Chem. 1888, 32.

THE crude fats investigated were prepared from the seeds of beans, peas, vetches, and lupines respectively, in the chemical factory of H. Trommsdorff, in Erfurt. The powdered seeds were first extracted with strong alcohol. The residue obtained after expelling alcohol was next treated with ether. After saponifying the fats with strong soda lye the dry soap was treated with ether, petroleum spirit, or chloroform, and it was found that these removed a considerable quantity of some unknown substance. After extraction with ether the residual soap was decomposed by boiling with dilute hydrochloric acid. The free fatty acids formed green masses which were fairly soft at the ordinary temperature. On digesting these with a little water and a large excess of lead oxide, a hard mass was obtained. This mass was ground up and then treated for several days with ether, in order to dissolve the greater portion of the lead salts. The residue was boiled with hydrochloric acid in order to obtain the solid fatty acids.

In this way the crude fats were split up into four parts:—(1.) Mother-liquor of the soap lye. (2.) Ether extract of the sodium soap. (3.) Ether extract of the lead soap. (4.) Solid fatty acid.

The fat from beans contained only a small quantity of volatile fatty acid, probably valerianic acid. According to the quantity of phosphorus found, the fat contains

19.27 per cent. of lecithin. Probably a portion of the phosphorus originates from some other source than lecithin. From the ether extract of the sodium soap a substance was obtained which closely resembled animal and vegetable cholesterins. The crude fat contains 76 per cent. of oleic acid and 13.5 per cent. of solid fatty acids, the latter chiefly consisting of palmitic acid.

The fat obtained from vetches contains only a small quantity of volatile fatty acids. Lecithin and cholesterol were shown to be present. A portion of the fatty acids is probably present in the form of compound ethers of cholesterol.

The fat from peas contains rather more volatile fatty acids than the two preceding fats. It also contains lecithin, cholesterol, and another body which is probably ceryl alcohol. Stearic acid is not present, or at the most as a trace. The solid fatty acids consist mainly of palmitic acid and contain traces of a fatty acid which melts at $74-75^{\circ}$.

The fat from lupines contains only a small quantity of volatile fatty acids. Lecithin and a considerable quantity of cholesterol were found, and an alcohol obtained which was probably ceryl alcohol. The solid fatty acids chiefly consist of palmitic acid and a small quantity of what is probably arachidic acid.—F. W. T. K.

PATENTS.

Improvements in Machines or Apparatus for Testing Lubricants. A. J. Van Alstein, Antwerp, Belgium. Eng. Pat. 1986, February 9, 1888. 8d.

IN this patent a machine is described which is arranged to indicate automatically on a scale the lubricating power of any sample of oil. A testing roller rotates under the bearing of one end of a compound lever, along the furthest arm of which a weighted runner is moved by a screw motion. When the pressure is so strong as to prevent the oil from any longer exercising its lubricating action, the machinery is automatically thrown out of gear, and the position of the weighted runner on the arm of the lever indicates on the scale the lubricating power of the oil. Drawings of the machine are given.—W. L. C.

An Improved Mucarial Antiseptic Soap. J. Thomson, London. Eng. Pat. 6939, March 9, 1888. 6d.

CARBOATE of mercury, prepared by heating yellow oxide of mercury with carbolic acid at a temperature of 212°F ., and then adding caustic potash or soda in excess, or a biacyanide of mercury, is mixed with soap in suitable proportions. The proportions the patentee considers advisable are such that the finished soap may contain, of mercury, for toilet soap, $\frac{1}{10}$ to 1 per cent., for antiseptic soap, 1 to 3 per cent.

—C. C. H.

An Improved Soap powder, and the Method or Means of Manufacturing the Same. J. M. McCallum, Eng. Pat. 9796, July 5, 1888. 4d.

PARAFFIN oil (usually about 9 per cent. on the total other ingredients) is incorporated with soap, with alkali recovered from the manufacture of caustic lye, and with other salts. The mass is then dried and ground to a fine powder.

—W. L. C.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Oxalate of Manganese. J. Castelaz. Bull. Soc. Chim. 50, 645–647.

THIS salt, which is used extensively for mixing with drying oils, is best prepared by neutralising the perfectly pure carbonate, free from lime and iron, with a solution of oxalic acid. When the oxalate is heated with oil to

150° C. the same decomposition takes place as when it is heated alone, viz., carbon monoxide and dioxide are given off and manganese monoxide remains behind.

Discussing the advantage oxalate of manganese has over other drying agents for oil, the author remarks: Lead oxides or the acetate give a varnish which is both liable to crack and tarnish.

Manganese dioxide is practically insoluble in oil. The sulphate requires a high temperature for its decomposition, and as in the case of the nitrate, the mineral acid set at liberty spoils the quality of the oil. Borate of manganese, otherwise excellent, has the disadvantages that the boric acid, not being volatile, remains in the oil. With the acetate the only drawback is the deep brown colour imparted by the decomposition products of acetic acid. All these faults are avoided by the use of oxalate of manganese, which is decomposed so readily that only a very slight heating with the oil is required to produce the desired effect. Generally 2—5 per cent. of oxalate is needed; rather more if the oil is to be kept at a very low temperature or is to dry rapidly. The mixture should be heated gently until the gases have escaped before being boiled.—A. R.

On the Preparation of Phosphorescent Sulphides of Calcium and Strontium. E. Becquerel. *Compt. Rend.* **107**, 892—894.

See under VII., page 117.

On the Chemical Constitution and Industrial Value of the Juice of Bassia Latifolia Roxb. E. Heckel and F. Schlagdenhauffen. *Compt. Rend.* **108**, 103—105.

This juice is a pale pink mass, hard at the ordinary temperature, but becoming soft when worked up. It loses nearly 60 per cent. of its weight of water at 105°. It was purified by agitation with hot water and dilute sulphuric acid, and then formed a soft sticky mass. When heated till all its water has been expelled it is brown, hard, and transparent, and after some days exposure to the air becomes covered with white patches, which dissolve in chloroform and carbon disulphide, but do not crystallise. Strong sulphuric acid colours it yellow and then brown, and a trace of ferric chloride develops in the mixture a fine red colour, becoming blue on standing, a reaction very similar to that yielded by cholesterol, but this substance is not present.

This gutta yields no picric acid when boiled with fuming nitric acid, and is not attacked by strong hydrochloric acid, aqueous potash, or fused potash. Its formula is $C_{25}H_{42}O$, and its ash is white, containing sodium chloride, and calcium phosphate and sulphate.

It could not be used as a substitute for ordinary gutta, but if mixed with an equal quantity of this latter it might be used for the vessels of galvanic batteries.—A. G. B.

PATENTS.

An Improved Paint or Coating. P. Molyneux, London. Eng. Pat. 6582, May 4, 1887. Amended November 13, 1888. 4d.

This amended specification describes a new paint for coating tanks in which mineral oil and turpentine are stored. It is composed of a solution of some resin insoluble in petroleum oil or turpentine, a little gum arabic and glycerin, together with some substance, such as litharge or other metallic oxide, capable of imparting body and permanence to the paint. The amendment consists in the withdrawal of the second claim relating to the mode of preparation of the paint. (This Journal, 1888, 392.)

—E. E. B.

Improvements in making Sulphide of Zinc. J. Wilson, Leith. Eng. Pat. 1546, February 2, 1888. 4d.

See under VII., page 119.

Improvements in the Production of Basic Lead Salts for Use as Pigments, and for other Purposes. F. M. Lyte, London. Eng. Pat. 2920, February 27, 1888. 6d.

BASIC sulphate or chloride or other basic salt of lead is converted into another basic compound of lead by treatment with a soluble salt, the acid of which is capable of combining with lead and forming the required compound. For example, basic lead sulphate may be converted into basic lead carbonate by treatment with a solution of sodium carbonate. The manufacture of basic sulphate of lead is described in previous patents, 10,298 of 1886, and 11,889 of 1886. (This Journal 1887, 601 and 732.)—E. E. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENT.

Means for removing Lime from Skins, Kips, or Hides, and for Swelling or Puffing the same. J. Hauff, Feuerbach, Germany. Eng. Pat. 14,889, October 16, 1888. 4d.

AN aqueous solution of "creosotic acid" is used. The "creosotic acid" is recovered from the liquor by adding an equivalent of muriatic acid.—J. M. H. M.

XV.—AGRICULTURE, MANURES, Etc.

Occurrence of Solid Hydrocarbons in the Vegetable Kingdom. H. Gutzeit, Ber. **21**, 2881—2882.

THE author has found crystalline hydrocarbons in the fruit of the *Heracleum giganteum hort.* melting at 61°—63° and 66°—71°, and also in *Heracleum Sphondylium L.*, and in *Pastinaca sativa L.* They were found to possess the general formula C_nH_{2n} . The presence of similar bodies has more recently been pointed out by Abbot and Trimble. (This Journal 1888, 758.)—J. B. C.

Manurial Experiments with Concentrated Ox Manure.

N.N. Oesterreich. landw. Wochenblatt, **14**, 26—27.

COMPARATIVE experiments, with manure obtained from oxen fed mainly on refuse liquors of a spirit distillery (distillers' wash) and with animal charcoal superphosphate, were made with wheat, on a cold but humic clay soil, having a permeable sub-soil. The superphosphate yielded on the whole a product of better quality, but the ox manure produced heavier and more profitable crops. The same manure applied to turnips gave a better result than an equal weight (700 kilos. per 2.75 hectare) of potassio-ammonium-superphosphates. Unmanured crops were grown for comparisons in each case.—D. A. L.

Experimental Cultivation of Potatoes. Reymann, von Wichelhaus, Gascard and von Donat. *Der Landwirt (Silesia)*, **24**, 92.

FOUR comparatively new varieties of potatoes, Aurehe, Hermann, Odin, and Kornblume, were cultivated in four districts, some older varieties being grown in each district for comparison. In Zowade they were grown without manure side by side with Late Rose; in Heidehaus on freshly danged loamy humic sandy soil with Richter's Imperator; in Norok on fields near the Oder with Imperator, Flourball, Champion, Yellow Zwiebel; in Chmielowitz with Zwiebel and Charlotte. All the experiments suffered from drought. The largest crops were obtained in Norok, Zwiebel yielding 133.66; Hermann, 116.66;

Imperator, 108·33; Flourball, 100; Champion and Aurelie each 91·66 centners per morgen respectively, all the others yielded smaller crops, in Zowade none were above 50, in Heidehaus none exceeded 57·5, in Chmielowitz they varied from 47·61 to 71·73 centners per morgen. Of the new varieties only Hermann and Aurelie came up to the old ones in yield. Hermann is the richest in starch, having on an average 22·8 per cent. (this characteristic has been noticed by previous experimenters), whereas the poorest in this respect were Zwiebel with 19·6, Richter's Imperator with 18·5, Late Rose with 17·6 per cent. In the crops of Aurelie, Hermann, Odlin, Kornblume, and Zwiebel the tubers were much smaller than the original seed potatoes.

The following results were obtained under similar conditions in the field:—

Variety.	Ctr. per Morgen.	Percentage of Starch.
Aurora	65'	19·4
Champion	72'	22·6
Imperator	70·5	19·7
Zwiebel	72'	19·4

—D. A. L.

Experiments with Breisgau (Baden) and Russian Hemp. F. G. Stebler. Oesterreich. landw. und forstw. Woch. 13, 331—332.

The author made comparative cultivations of Breisgau and Russian hemp grown on similar soil under similar treatment. The crops were compared as to number, weight, length, and quality of plants. The Breisgau plants were

found far superior, yielding more uniform crops, with three times as many long spikes on an average 0·5 metre longer than the Russian, whilst the weight of the crop was more than double that of the Russian. Moreover, the individual plants were nearly twice as heavy, and the yield of hemp nearly three times as great, as that from the Russian crop. The stems of the Breisgau plants were more slender, smoother, and less branched than the Russian, and consequently the quality of the hemp was better.—D. A. L.

Thomas-Slag as a Manure. P. Bredt. Der Landwirt (Silesia), 24, 423 and 430—431.

The author has compared the fertilising value of Thomas-slag containing 80 per cent. of finely pulverised material and 20 per cent. of phosphoric acid, with dissolved, 18 per cent., Baker-guano. Various crops were grown in 1886, the soil being a wet sandy loam. The result with sugar-beet and oats were as follows:—Two plots of sugar-beet both received 2 centners of Chili saltpetre per morgen, and in addition, one had 4 centners of Thomas-slag, and yielded 143 centners of roots; whilst the other had 2 centners of Baker-guano, and yielded 131 centners of roots; the percentage of sugar being the same in the beet from both. Three plots of oats were grown. Each received $\frac{1}{2}$ centner Chili saltpetre when the seed was sown, and another $\frac{1}{2}$ centner 14 days after the plants appeared. The other manuring and results were as follows, numbers being per morgen:—without phosphate, 10·35 centners of grain; with 1 centner of Baker-guano, 11·70; with 2 centners of Thomas-slag, 11·90. Thomas-slag in these cases proved more efficient and economical than Baker-guano.

In 1887 more experiments were tried with peas, oats, and potatoes on a strong deep loamy soil, and sugar-beet on a heavy loam and on a slightly sandy soil. The manuring and results are given in the annexed table, the quantities being per morgen.

Plot.	Manuring.	Yield of							
		Peas.		Potatoes.		Roots.			
		Seeds.	Straw and Chaff.	Tubers.	Starch.	On Heavy Loam.		On Loamy Sand.	
						Roots.	Quotient.	Roots.	Quotient.
1	No phosphates.....	Centners. 10·8	Centners. 12·6	Centners. 133	Per cent. 20·3	Centners. 150·4	83·2	Centners. 81·6	83·8
2	10 lbs. of phosphoric acid as superphosphate.....	10·3	12·5	100	19·2	167·6	83·1	112·6	86·0
3	20 lbs. do. as Thomas-slag...	9·9	13·6	86	19·4	153·95	81·7	101·65	86·5
4	No phosphate.....	10·8	12·1	99	20·5	142·45	83·2	98·0	86·2
5	20 lbs. of phosphoric acid as superphosphate.....	11·25	12·8	126	20·5	189·45	84·8	114·90	86·3
6	10 lbs. do. as Thomas-slag...	11·35	12·6	108	19·0	187·33	83·4	147·9	86·7
7	20 lbs. do. as slag..... 10 lbs. do. as superphosphate }	12·50	14·3	87·8	20·1	175·30	84·4	126·4	86·0
8	20 lbs. do. as superphosphate	13·10	15·7	108·8	20·3	204·20	85·1	126·4	87·0

The quantities of phosphatic manures were doubled in the sugar-beet experiments. The results speak for themselves. With sugar-beet, however, it will be noticed, the soluble phosphate did best on the heavy soil, the slag on the light wet soil.—D. A. L.

Value of the Phosphoric Acid in Thomas-Slag as compared with that in Soluble Phosphates and in Bone-Meal deprived of much of its Lime. E. Heiden. Bied. Centr. 17, 798—800.

Four plots sown with oats and vetches received each 5 lbs. of nitrogen as Chili saltpetre, and three of them 25 lbs. of phosphoric acid, in addition, in the form of superphosphate, Thomas-slag, and bone-meal respectively. Two sets of

similar experiments were made on smaller plots. The total yields in kilos. for each experiment were as follows:—

	Large Plots.	Small Plots.	
		1.	2.
Without phosphoric acid	1245·78	126·91	119·52
Thomas-slag	1015·14	161·96	142·71
Superphosphate	1379·41	173·36	141·24
Bone-meal	1169·42	131·14	147·94

—D. A. L.

Manurial Experiments with Thomas-Slag. F. Far-ky.
Bied. Centr. **17**, 800—803.

HEAVY land, with northern aspect, was dressed on April 27 with Thomas-slag containing 18·95 per cent. of phosphoric acid; 85·17 per cent. passed through a $\frac{1}{4}$ mm. sieve. In one case slag was mixed with peat-dust. Two crops of oats were now taken, the first sown April—May and harvested September 1886; the second sown in April and harvested in August 1887, with the following results in kilos. per 10 square meters:—

Manuring.	1886.		1887.	
	Grain.	Straw.	Grain.	Straw.
None	6·815	11·893	4·871	11·275
0·4 of slag.....	7·473	15·112	5·435	11·393
0·4 of slag + 0·25 of peat	6·873	11·855	6·268	13·793
0·6 of slag.....	7·543	15·583	5·609	12·538
0·8 of slag.....	7·774	15·749	5·809	12·437
1·0 of slag.....	7·983	16·135	5·864	11·352

These results show the immediate and subsequent benefit derived from the dressings with slag. The peat was injurious the first season but beneficial the second, when it had undergone some change. Both the yield and the proportion of grain to straw are increased by the larger dressings of slag. Experiments on a larger scale were made with potatoes, manuring either with superphosphate containing 17·02 per cent. of soluble phosphoric acid, or with Thomas-slag, with or without peat-dust; and with a mixed fodder crop consisting of vetches, oats, barley, a few peas and maize, manuring with slag. The manures were sown on May 4, the potatoes on May 6, the fodder crop May 27.

the latter was harvested in August, the former in October; the results were as follows, numbers being kilos. per *ar*:—

Manuring.	Potatoes.		Per Cent.
	Large.	Small.	
None	52·30	21·69	17·2
None	55·33	22·02	17·1
11·314 of slag	52·14	22·29	17·3
5·074 of slag + 2·537 of peat-dust	73·53	19·25	17·3
2·537 of superphosphate.....	67·22	16·18	17·2

Mixed Crop.

Manure.	Mean Yield.
None	210
5·0 of slag	263
8·0 of slag.....	349·5

Showing beneficial action of Thomas-slag in both cases and in spite of late sowing.—D. A. L.

Hop-growing Soils in the Neighbourhood of Saaz in Bohemia. J. C. Lerner. Dingl. Polyt. J. **270**, 374—375.

THE soil on which the celebrated Saaz hops are grown is a diluvium composed of loam, clay, marl, and various kinds of sand. The appended analyses were made on samples of the soil of the hop gardens belonging to A. Dreher, at Michelob, near Saaz, which has apparently been formed by the disintegration of basalt rocks containing potash, soda, and lime feldspars. The hops grown here exceed even those known as "Stuttgart" in excellence.

In all, 10 samples were examined.

A.—MECHANICAL ANALYSIS.

Number of Sample.	Stones.	Coarse Gravel.	Medium Gravel.	Fine Gravel.	Coarse Sand.	Fine Sand.	Dust.
1	..	0·05	0·06	0·08	1·12	30·36	58·55
2	0·06	0·31	0·31	13·04	7·23	29·21	49·76
3	0·07	0·21	0·11	5·14	2·03	33·80	58·61
4	..	..	..	0·24	3·14	53·25	43·07
5	..	..	..	0·14	6·32	30·90	59·61
6	..	0·07	0·03	0·18	0·97	27·93	70·82
7	0·05	0·07	0·53	14·00	50·98	11·11	33·23
8	..	..	..	..	1·27	63·85	51·90
9	..	0·11	0·09	2·95	17·81	40·03	59·01
10	..	..	..	4·33	10·93	26·94	57·90

The numbers represent parts per cent. on the air-dried soil.

B.—CHEMICAL ANALYSIS OF THE FINE EARTHY PORTION (AIR-DRIED).

Number of Sample.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Hygroscopic water	3.00	3.74	3.33	2.92	2.67	2.72	2.31	2.61	1.94	3.99
Combined water	3.23	3.19	3.05	3.22	1.75	2.17	1.53	1.73	1.83	2.46
Humus	1.27	1.01	1.25	1.27	1.54	6.82	0.97	0.72	1.22	1.89
Total	7.51	7.93	7.63	7.41	5.96	5.71	4.81	5.06	4.99	8.34
Loss on ignition	7.51	7.93	7.63	7.41	5.96	5.71	4.81	5.06	4.99	8.34
Mineral matter	92.49	92.07	92.37	92.59	94.04	94.29	95.19	94.94	95.01	91.66
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
* Calcium sulphate	0.06	0.04	0.04	0.05	0.04	0.05	0.05	0.04	0.04	0.06
Calcium carbonate	7.78	1.64	1.64	2.50	2.80	2.72	2.64	2.50	2.28	3.58
Magnesium carbonate	0.80	0.84	0.83	0.84	0.76	0.92	0.88	0.80	0.84	0.92
Total	9.58	2.48	2.47	3.39	3.56	3.64	3.52	3.30	3.12	4.50
Combined silica and quartz	63.30	66.30	66.10	63.50	68.50	63.30	69.30	64.60	69.00	64.80
Sesquioxides	15.50	17.10	17.80	19.30	19.80	20.50	17.10	18.80	17.10	17.30
Monoxides	11.56	14.08	13.18	13.85	8.83	12.64	10.18	12.14	8.94	13.34
Total silicates and quartz	90.36	97.48	97.08	96.65	97.13	96.44	96.58	95.54	95.34	95.44
Siliceous clay	78.00	85.40	84.40	85.40	85.10	85.60	85.60	84.40	85.31	79.40
Absorptive silicates	12.36	12.08	12.68	11.25	11.03	10.84	10.98	11.14	10.03	16.04
Absorption capacity	90.8	104.0	94.6	78.2	80.0	108.4	86.0	75.4	85.4	90.8

* Omitted from total.

† Obviously a misprint; probably should be 0.80, in which case the total would be 8.58.

From these tables the excellent quality of the soils is apparent. They show a considerable loss on ignition, a high percentage of sesquioxides, a notable proportion of bases existing as absorptive silicates, and a marked absorption capacity, indicating a state of advanced disintegration, rendering them admirably suited for the use to which they are put.—B. B.

PATENTS.

Improvements in Manures. F. I. R. Seaver, London.

Eng. Pat. 571, January 13, 1888. 6d.

AN improved manure for preventing phylloxera, black rot, &c., and destroying insects, worms, &c., consisting of a mixture of the carbonaceous residue with the oil resulting from the distillation of Kimmeridge or other shale, and chalk, clay, or sand, together with 10 to 15 per cent. of superphosphate, and 5 to 10 per cent. of nitrate of soda. Sulphate of ammonia may be substituted for the nitrate of soda.—J. M. H. M.

Process of Converting Insoluble Phosphoric Acid contained in Mineral and Petrified Phosphates into available Phosphoric Acid. C. Glaser and C. F. W. Dambmann, Baltimore, U.S.A. Eng. Pat. 13,462, September 18, 1888. 4d.

THE ground phosphate is treated with phosphoric acid containing 40 per cent. by volume of phosphoric anhydride. In practice, the phosphoric acid may be extracted from one portion of the mineral and added to another portion; 50–130 parts of phosphoric acid are required per 100 parts of mineral phosphate.—J. M. H. M.

XVI.—SUGAR, STARCH, GUM, Etc.

Notes in Connection with the Manufacture of Starch.
H. Schreib. Zeits. f. angew. Chem. 1888, 694–696.

I.—Estimation of the Starch in various kinds of Grain, and Valuation of the latter for the Manufacture of Starch.

THE mere determination of the total amount of starch in a sample of grain is of little value, as no distinction is made between the insoluble and soluble starch, although the latter is useless if the grain is to be used for making starch. Also, the amount of gluten seriously affects the quantity of starch obtainable from the grain, for which allowance must be made in valuing the sample. Each part of gluten in rice causes the loss of an equal quantity of starch in the course of manufacture; consequently, a sample of rice containing 78 per cent. of starch and 4 per cent. of gluten would be more valuable than a sample containing 80 per cent. of starch and 8 per cent. of gluten, as 74 per cent. of starch could be obtained from the former and only 72 per cent. from the latter (the yield being found by deducting the percentage of gluten from the total starch in the sample). In the case of wheat the gluten is a valuable by-product, but in rice it is so difficult to separate from the starch, and when separated can only be sold for feeding or manurial purposes, that the less gluten the rice contains the more valuable it is. Owing to the difficulty in making accurate direct determinations of the starch in grain, the author prefers, in making an analysis of "broken rice," to estimate the gluten, ash, and moisture, and determine the starch by difference, after making a fixed allowance for the other non-starchy constituents of the grain, that is, fat, sugar, gum, and cellulose. The whole analysis by this method can be

finished in four hours, or considerably less time than is required for a direct estimation of the starch by the "inversion" method, and in the author's opinion the indirect estimation of the starch is quite as accurate as the direct. For the direct estimation, Lintner's process is preferred. As both's method for estimating starch by means of baryta (*see* this Journal, 1887, 608, and 1888, 77) not being considered reliable for all kinds of grain, the gelatinisation of rice, for example, being extremely difficult to effect.

The nature of the proteins is also of considerable importance in valuing rice, as the larger the proportion of them which are soluble in alkalis, and are consequently dissolved in the preliminary maceration of the rice with caustic soda, the less will there be to remove subsequently by mechanical means.

II.—Examination of Starch.

A weighed quantity of the starch is boiled with a definite amount of water till it is gelatinised, and the hot paste is then poured into a porcelain basin just large enough to hold it. When cold, it must be noticed whether the paste is solid or sufficiently liquid to run out if the basin be tilted. Wheat starch almost invariably contains free acid, and rice and maize starch free alkali. Either impurity upon prolonged boiling with the starch converts part of it into dextrin, and renders the paste liquid. The paste must not be boiled for more than one minute, and it is of importance to do this in a porcelain basin, as a metal one gives rise to lumps of non-gelatinised starch.—E. E. B.

PATENTS.

Improvements in or relating to the Production of Ammonia and Oxalic Acid and Alkaline Salts from Molasses or Desaccharised Lyes without Carbonisation. E. Meyer, Berlin, Germany. Eng. Pat. 17,317, December 10, 1887. 6d.

WHEN the molasses or concentrated lyes of the desaceharised molasses are heated with a large excess of caustic potash or soda, the greater part of the organic matter is destroyed; the nitrogen escaping as ammonia and amine bases in the gaseous form, which are collected and treated in well-known ways, while in the molten mass a considerable quantity of oxalates is formed, which can also be recovered.

The apparatus consists of a cast-iron still with head and receiver, and in this is first placed and heated the caustic alkali, from 8—20 times greater in quantity than the molasses to be treated, and, to ensure a regular and controllable evolution of ammonia, the molasses are gradually added.

"The molten mass in the retort when finished is run off, and a part of it is treated in any well-known manner for the purpose of separating oxalic acid, potash, and other salts. The greater part of the mass, however, returns to the process after having been rendered caustic."—W. M.

Improvements in Apparatus for filtering Saccharine or other Liquids or Solutions, and Appliances for cleaning the said Apparatus. B. E. R. Newlands, London, and J. Allott, Nottingham. Eng. Pat. 1392, January 30, 1888. 8d.

THE filtering apparatus consists of a series of frames or supports over which a filtering medium, such as a cloth, is stretched so as to leave a space between two opposite sides of such a medium. Each frame so covered with the filtering medium is called a "filtering member," and a complete filtering apparatus consists of a series of the "members" ranged side by side in a vessel or container in such a manner that any one "member" can be easily removed without disturbing the others. The apparatus can be used in either of two different ways. By the first method the liquid to be filtered is filled into the interior of these "members," and the clear liquor passes through the filtering medium into the containing vessel. By the second method the process is reversed, and the impure liquid being run

into the containing vessel, the clear filtrate finds its way through the medium into the separate "members."

Assuming the latter process to be used, it is essential that, on removing one of the "members" from the vessel containing the unfiltered liquor, for the purpose of cleaning the filtering medium, some provision be made for preventing the impure liquor getting into the pipe which connects the interior of the "member" with the pure liquor cistern. This is accomplished in four or five different ways, for a full description of which reference must be made to the specification and the drawings given therewith. The filtering medium or cloth may also be supported by arranging, inside or outside, according to the direction of the flow of the liquor, wire gauze or grids.

Adjoining the containing vessel is a tank containing water and two revolving brushes for cleaning the filtering medium or cloth. A travelling pulley arrangement is provided, by which any of the "filtering members" can be removed from the filtering apparatus to the cleaning vessel, and *vice versa*.—A. J. K.

Improvements in Apparatus for evaporating Saccharine or other Solutions or Liquids. A. Chapman, Liverpool. Eng. Pat. 1752, February 6, 1888. 11d.

THE efficiency of apparatus used for the evaporation of saccharine or saline solutions, whether by simple, double, or multiple effect, depends in a large measure upon the existence of a good circulation of the liquor contained in the pans. The author claims to have effected this end by the application of special arrangements of tubes to ordinary vacuum pans. For details the specification and drawings must be consulted.—A. J. K.

Improvements in Apparatus for evaporating Saccharine or other Solutions or Liquids. A. Chapman. Eng. Pat. 2511, February 20, 1888. 8d.

RELATES to the same subject as the above, with the addition of a description of a special method of removing the condensed water from the drum of the vacuum pan.

—A. J. K.

Improvements relating to the Refining of Sugar and to the Treatment of Syrup obtained therefrom. F. Bander, Paris. Eng. Pat. 16,397, November 12, 1888. 6d.

"THIS invention relates to an improved process of refining sugar by producing ozone by the joint application of steam and electricity."

The raw sugar is placed in a centrifugal machine which is closed by a hermetically-fitting cover provided with terminals for holding the conducting wires from suitable source of electricity, and carrying the poles by which the current is introduced into the interior of the machine.

Steam is introduced into the machine, and after the sugar is sufficiently moist the electric current is turned on whereby a constant succession of sparks is produced giving rise to ozone, which bleaches the sugar. The syrup which results from the action of the steam on the sugar, and is separated by the centrifugal action, can be mixed with fresh raw sugar and subjected to the same treatment.—W. M.

Improvements in Lixiviating Batteries for Raw Sugar or Sugar Mass. C. Steffen, Vienna, Austria. Eng. Pat. 16,703, November 17, 1888. 8d.

THIS invention "relates to improvements in lixiviating batteries for raw sugar or raw sugar mass, in which the lixiviation or washing of the sugar mass is effected by means of an aqueous, alcoholic, or other solution of sugar in a systematic manner, *i.e.*, by saccharine solutions of varying concentration," as described in Eng. Pat. 7119 of 1887. (This Journal, 1888, 41.)

For details, the specification and drawings must be consulted.—W. M.

XVII.—BREWING, WINES, SPIRITS, Etc.

Preparation of Wines from Fruits and Berries. Nessler. Bied. Centr. 17, 848—850.

Good and ripe fruit should be used; worm-eaten or bad fruit gives the wine a flavour and yields wine either difficult to clear or which will subsequently become turbid. The fruit may be crushed, or ground in a mill and immediately pressed. Pears often contain too little acid, but frequently mucic matter and much tannin, and therefore wines prepared from them are generally more difficult to deal with and not so good as wines prepared from apples and pears together. (See this Journal, 1888, 857.) With good, juicy, ripe fruit the best wine is obtained without the addition of water; but with unripe and very sour apples or very hard pears, it is best to press, mix the residues with water, and after some hours press again and mix the liquors. For every hectolitre of water used 10—12 kilos. of sugar are added; in cold weather the sugar is dissolved in warm water so as to bring the temperature of the must to 15°—20°. To prepare an ordinary house-wine 200 kilos. of fruit are used to one hectolitre of water and the necessary amount of sugar.

When the chief fermentation is over and most of the yeast has settled, the wine should be left to undergo a second fermentation, which makes it fit for keeping; if this fermentation do not set in of itself, and the wine be not thick, 1—1½ kilos. of sugar must be added, which then ferments.

Wines which are brown or black, or which become black or turbid, can be improved by mixing with 5—10 per cent. of good fresh yeast or with a litre of sweet skim milk or with ¼ litre of isinglass per hectolitre.

All berries contain too little sugar, and, with the exception of blackberries, too much acid.

The following table shows the proportion of sugar and acid in different berries, and the quantity of sugar and water required to make wine of different strengths:—

Fruit.	10 Litres of Juice or 11 Kilos. of Fruit require							
	Amount of		Litres	Kilos. Sugar.				
	Sugar.	Acid.		Water.	Ordinary Wine.	Good Table Wine.	Strong Liqueur Wine.	Wine.
Currants...	6.4	2.1	30	5.0	6.6	9	13	
Gooseberries	7.0	1.4	18	3.2	4.3	6	8.8	
Blackberries	4.0	0.2	0	1.0	1.4	2	3	
Bilberries...	5.0	1.7	24	4.2	5.6	7.6	11	
Raspberries.	3.9	1.4	18	3.2	4.3	6	8.8	
Strawberries	6.3	0.9	8	2.0	2.6	3.7	5.5	

Berries should be used soon after gathering, and if kept at all, they should be crushed, mixed with sugar, and protected from air. For the preparation of wine they may either be crushed or diffused; the latter plan is very suitable for currants. If fermentation do not set in within two days, the liquor is repeatedly run off and poured back into the vessel so as to bring it in contact with the air, and where possible wine-yeast should be added. If fermentation stop too soon, the yeast should be mixed up and wine-yeast or freshly-fermenting grape wine added. Fermentation is frequently sluggish in berry juices, but can be stimulated by adding 0.5—1 kilo. of washed and cut-up dried currants or raisins and a litre of water for each 0.5 kilo. added per 10 litres of juice or 11 kilos. of fruit. When crushed or soaked fruit is kept, either before or after fermentation, air

must be excluded, otherwise acetic acid will be formed. When the bottles are well filled and well corked, the top is dried and dipped into hot paraffin.—D. A. L.

Composition of Crab-apple Wine. F. Farsky. Bied. Cent. 17, 850—852.

WINE was prepared from waste crab-apples; they weighed 61 kilos. per hectolitre, and on an average 16.8 grains. each. The kernels were removed and 39.8 kilos. of the pulped fruit were mixed with 31.2 litres of distilled water and left in a warm room with frequent stirring for five days. The mass was now pressed, yielding 43.08 kilos. of must and 27.92 kilos. of pulp; the latter treated with water gave 10 litres of poor juice. The must contained 6.17 per cent. of sugar and 0.74 per cent. of malic acid (calculated); 3.8 kilos. of sugar were added and the whole left to ferment for nine days at 16°—20°. The new wine was stored in a vat in a cellar at 4°—8.3 C.; it was subsequently drawn off into small casks, and finally into ½ and ¾ litre bottles. The bottles were laid down for ½ of a year, when the wine was pronounced excellent by connoisseurs. It was analysed with the following centesimal results (specific gravity, at 17.5 = 1.00796), water, CO₂ and ethereal substances 88.976; alcohol (by weight) 6.999; grape sugar 0.551; cane sugar 0.0511; malic acid 0.469; acetic acid 0.026; nitrogenous matter 2.752; ash 0.165; not determined 0.01. The ash contained SiO₂ 1.394; Cl 9.697; sulphuric acid 9.030; phosphoric acid 2.788; K₂O 34.667; Na₂O 28.424; CaO 9.758; MgO 2.788; Fe₂O₃ &c. 3.636. After 13 months it contained 0.168 per cent. of malic and 2.067 of acetic acid. The poor juice from the press residue yielded 9.2 litres of vinegar containing 2.18 per cent. of acetic acid.—D. A. L.

On the Bitter and Resinous Constituents of Hops. M. Hayduck. Wochenschr. f. Brauerei, 1888, 328—337.

THE BITTER RESINS of hops exert a considerable influence on the development of various moulds. In order to obtain them, hops were extracted with ether in the cold. The residue obtained on driving off the ether was dissolved in 90 per cent. alcohol, and the solution thus obtained carefully treated with a lead acetate solution. The yellow precipitate (which is soluble in an excess of the precipitant) was washed, suspended in alcohol, and the lead removed by means of hydrogen sulphide. A resin remained in solution which the author calls the α -resin. Two further resins (β and γ) were obtained from the original alcohol solution, from which the lead precipitate had been removed, by distilling off the alcohol, taking up the residue with ether, shaking up this solution with dilute sulphuric acid (to remove ash-constituents), driving off the ether and treating the residue with petroleum ether of a low boiling point. A soft (β -) resin went into solution and a solid (γ -) resin remained behind. The α -resin is viscous and of a red-brown colour; it is almost odourless but intensely bitter. It dissolves easily in ether, alcohol, and chloroform. It is slightly soluble in cold water, more so in boiling water. An alcoholic solution gives a yellow precipitate with lead acetate, and a greenish-yellow precipitate with copper sulphate. An aqueous solution gives a white precipitate with the former and a bluish-white precipitate with the latter reagent. On boiling the resin with water for some time, or heating it on the water-bath, it is split up into several products of decomposition. Alcoholic lead acetate does not precipitate the β -resin, and copper acetate gives an emerald-green solution with it; in other respects its properties are identical with those of the α -resin. On standing for some time, crystals are developed both in the α - and the β -resin; those in the α -resin form long prisms and appear to be Lerner's acid; while those in the β -resin form rhombic plates. A mixture of these two resins is probably the bitter principle found in hops by Isleib and Greshof. They probably represent modifications of the acid of the hop-bitter principle. A third substance in the hops is the ethereal oil which later on forms the γ -resin. The latter is a brittle dark-brown substance, which is not bitter and does not dissolve in petroleum ether, but dissolves easily in alcohol and in ether. It forms compounds with

alkalis which are decomposed by acids. In its properties it resembles the resin obtained by the oxidation of hop-oil. If the aqueous solution be extracted with ether, the γ -resin is obtained as a solid orange-coloured mass on driving off the ether. The proportion of the three resins found in the hops was α -resin 4.7 per cent., β -resin 8.0 per cent., γ -resin 5.1 per cent. The first two are the important ones for brewing purposes. On boiling hops with four successive lots of 50 parts of water, treating the extracts with dilute sulphuric acid for the purpose of decomposing the salts, shaking up with ether and evaporating the ether extracts, four quantities of resin are obtained. The first three extracts contain about 3 per cent., the last about 1.5 per cent. of resin. The resin in each case was found to consist of the α -, β -, and γ -resins, and a modification of the first two produced by boiling. After this treatment, the hops were found to still contain 52.9 per cent. of total resin. The same hops might possibly therefore be repeatedly used in brewing without the extracts losing any of their bitter or antiseptic properties. The resins found in the aqueous extracts were also found in beer. During fermentation a portion gets eliminated from the wort. The aqueous hop extract rather assists than retards the development of yeast, aceties, and *narivule*. The lactic acid *pediococcus* is only slightly affected whilst the development of the lactic acid bacilli is considerably retarded. These antiseptic properties are entirely due to the α - and β -resins.—F. W. T. K.

Occurrence of Boric Acid in Wines. G. Baumert.
Ber. 21, 3290—3292.

THE presence of boric acid in a large number of samples of Californian wines was detected by the author three years ago, and he has since found it to occur in all the Spanish, French and Italian wines he has examined. Special attention has been given to the examination of the wines of Saxony and Thuringia, and boric acid has been detected, not only in the wine, but also in the leaves, tendrils, stalks, and berries of the vine at different periods of growth; the ash of the wine contains 0.2—0.4 grm. of boric acid, which was determined by the turmeric paper test. An examination of the vines and wines from the neighbourhood of Freyburg yielded similar results—boric acid was found in every case. Hence there seems to be no doubt that boric acid is a normal constituent of wines, and that it is derived from the soil, as shown by its presence in all parts of the vine. This has been confirmed by Ripper (Weinbau u. Weinhandel, 1888, No. 36) who has detected boric acid in 1,000 samples of German and other wines; and also by Soltsien (Pharm. Zeit. 33, 312).—C. A. K.

PATENT.

Process for the Preparation of Materials containing Starch for direct Treatment in Brewing Processes, the production of Malt, and other Saccharifying Processes. C. D. Abel, London. From E. Kiderleu and J. W. van Leenhof, Rotterdam, Holland; A. Wernike, Halle; and A. Wilhelmi and A. Köhlmann, Frankfurt, Germany. Eng. Pat. 1528, February 1, 1888. 6d.

THE raw material (fruits, cereals, &c.) contains, besides starch, a series of bodies such as fats, pectin bodies, oils, foreign kinds of saccharine matter, and bodies which form fusel oils, and these bodies are first removed by a process of extraction. In carrying out this process the raw material is coarsely ground and subjected in an extraction apparatus to the action of the extracting medium, which may consist of hot pure alcohol, alcohol vapour, benzine, or an aqueous solution of sulphurous acid. The extracting medium, mixed with the substances extracted, is then run off into a contiguous vessel, from which the extracting material may be distilled off and condensed again for future use. There remains in the extraction vessel the residue of the raw material, consisting of the starch, the cellulose constituents, and such albuminous bodies as are insoluble in the extracting medium. This mixture, which still contains some of the extracting medium, is run off into the saccharifying vessel, the extracting medium distilled off and condensed, and the residue, after treatment with hot water, saccharified by malt in the usual way.—A. J. K.

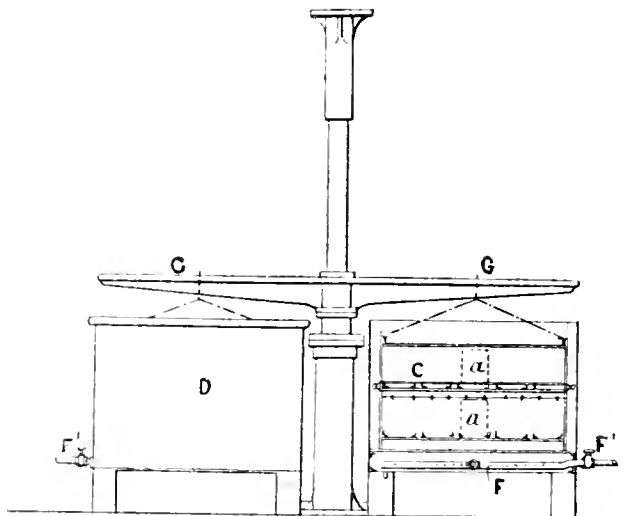
XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A)—CHEMISTRY OF FOOD.

PATENTS.

Improvements in or connected with Apparatus for Preserving Milk. W. C. Hallett, London. From K. G. Dahl, Drummen, Norway. Eng. Pat. 14,113, October 1, 1888. 6d.

THIS specification describes apparatus for carrying out the improved process for sterilising milk, described in Eng. Pat. 10,903, of 1886. (This Journal, 1887, 377.) C is a strongly braced angle-iron frame arranged to hold the sterilising vessels *u*. D is a tank in which the heating and cooling is effected by the steam pipe F'. G is a lifting arm fixed to a vertical hydraulic lifting ram by means of which the sterilising vessels are lowered into a receiver from the tanks.



(B)—SANITARY CHEMISTRY.

PATENT.

Improvements in the Purification of Sewage and Impure Waters. A. J. Capron, London. Eng. Pat. 1161, January 25, 1888. 8d.

THE sewage is passed continuously through a vessel containing a number of iron discs set on a horizontal revolving shaft; the space between each pair of discs is partially filled with sand or other abrasive material. The upper part of the periphery of each disc is in contact alternately with the opposite terminals of a galvanic battery, dynamo, or other source of electric current. Decomposition of the water sets free oxygen, which will "completely oxidise all the metallic iron taken up in solution." The abrasion of the sand keeps the surfaces of the discs clean.—C. C. H.

(C)—DISINFECTANTS, &c.

PATENTS.

Improvements in Means for Effecting the Evolution of Sulphurous Acid for Disinfecting and Deodorising. J. Hanlon, Wakefield. Eng. Pat. 1393, January 30, 1888. 4d.

A SULPHITE, such as "alkali waste in which the sulphur compounds have been oxidised into sulphite," or a bisulphite is mixed dry with a soluble acid sulphate, or bisulphate, e.g., those of soda or potash; such a mixture when used gives off sulphurous anhydride. A substance, such as Kieselguhr or fossil meal, may be saturated with sulphuric acid and used in place of the bisulphate.—C. C. H.

Improvements relating to the Preparation of Carbolic Acid and to the Formation thereof into Lozenges or the like. O. Rademann, Forbach, Germany. Eng. Pat. 1163, January 31, 1888. 4d.

WHEN carbolic acid is melted in a water-bath, cooled quickly, and stirred it is obtained as small crystals. These are mixed intimately with 10 per cent. of pure boracic acid, and the snow-like mass pressed into lozenges or cakes. By this means the acid is obtained in a form easily transported and handled without danger to the skin; moreover its melting point is considerably raised and as its solubility is very largely increased, an antiseptic solution of a definite strength can therefore be readily prepared.

—C. C. H.

Improved Manufacture or Preparation of Antiseptics. W. Black, Newcastle-on-Tyne, and W. L. Rennoldson, Jarrow-on-Tyne. Eng. Pat. 1696, February 4, 1888. 6d.

AN easily soluble salt, e.g., sulphate or chloride of sodium, or chloride or sulphate of aluminium, zinc, or iron, is recrystallised, and obtained in a finely granular condition. Upon the dry salt from 2 to 4 per cent. of perchloride of mercury solution is sprinkled and the mixture dried at from 60° to 70° F.—C. C. H.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Examination of Sulphonal. Kobbe. Pharm. Zeit. 1888, 739.

IN the manufacture of sulphonal some difficulty is experienced in preparing an odourless product. According to the author, it is easy to determine whether a preparation is odourless or not by boiling 1 grm. with about 10 cc. of water in a test tube, when any remaining odour is easily detected.—F. W. T. K.

On the Physiological and Therapeutic Importance of Creatine. Kobert. Chem. Zeit. 12, 1662.

THE physiological action of creatine is still far from settled. Some physiologists look upon it as a waste product and as valueless to the muscles; others again as an important muscle-strengthening agent. The writer adheres to the latter view. Experiments of his have led him to the conclusion that creatine exerts a very beneficial influence on muscular activity and that, accordingly, meat broths are not only pleasant appetisers but important muscle-strengtheners. Kobert has experimented with numerous other substances, but so far hypoxanthine and caffeine are the only ones which exert an influence similar to that of creatine. Lehmann has pointed out that the above action of creatine would explain the invigorating properties of Liebig's extract. J. Mays has further shown that solutions of creatine and creatinine excite an exhausted heart, and hypoxanthine and xanthine behave similarly, but on the other hand other meat constituents do not have such an effect. Creatine is a substituted guanidine, and Baumann and Gergens have shown that the latter is a specific though practically useless and dangerous muscle-irritant. Kobert further holds that creatine has important digestive properties, increasing the activity of the smooth muscles of the stomach and the intestines. For therapeutic purposes he therefore recommends 0.1 grm. of creatine taken 4 to 6 times daily; (1) for increasing the activity of the muscles in cases of weakness; (2) in cases of weak heart; (3) in chronic weakness of the digestive organs. The dry powder is placed on the tongue and washed down with water. Liebig's extract freed from salt crystals exerts a similar action, but the gelatins in it have an injurious influence in intestinal disorders.—F. W. T. K.

Conversion of Terpine into a Menthe. G. Boucharlat and J. Lafont. Compt. Rend. 107, 916—918.

WHEN terpine $C_{10}H_{16}$, 2 H_2O is heated to 100° for 15 hours with an aqueous solution of HI (saturated with this gas at 0°) the dihydriodide of terpine crystallises out, identical with the corresponding terebenthene derivative, $C_{10}H_{16}$, 2 HI. On raising the temperature the crystals melt, iodine is liberated, and the principal product formed is menthyl-dihydriodide $C_{10}H_{19}I$ or an isomeride of the same. The oily mixture, after removing excess of acid, is heated to 100° with alcoholic potassium acetate, and the filtrate treated with water. The oil which separates is distilled, the portion going over from 167°—170° being collected separately. The formula of the substance in this fraction is $C_{10}H_{18}$. It fixes the halogen acids slowly, which feature distinguishes it from the terpine $C_{10}H_{16}$. The solid hydrochloride $C_{10}H_{18}$, 2 HCl melts at about 50°. The mono-hydrochloride is also described. Alkalis act on it, reproducing the hydrocarbon $C_{10}H_{18}$. Its composition is the same as that of menthol hydrochloride, obtained by the action of HCl on menthol $C_{10}H_{20}O$, or on menthol camphor. The author concludes from the above that natural menthol must be regarded as belonging to the terpine series.—A. R.

A New Commercial Process for the Preparation of Cocaine. C. Liebermann and F. Giesel. Ber. 21, 3196—3202.

THE extract of coca leaves does not yield pure cocaine directly, but a mixture of a large number of alkaloids, from which the cocaine is separated. Liebermann has lately unfolded the nature of one of these by-products, to which he gave the name of isotropyl cocaine, because the benzoic acid of cocaine is replaced in it by isotropic acid (γ and δ). All these foreign alkaloids are easily split up by boiling with hydrochloric acid into ecgonine, and this fact is made use of for preparing ecgonine on the large scale. The amorphous by-products up to this time also valueless, are to be had in quantity. Ecgonine forms the starting point for the preparation of cocaine. Thus, ecgonine is converted into the benzoyl derivative, benzoyl ecgonine, and the latter is decomposed so as to yield cocaine by Einhorn's method (this Journal, 1888, 228). The cocaine thus prepared from

the hitherto troublesome by-products above referred to, shows all the chemical, physical, and medicinal properties of the "natural" cocaine.—S. H.

"*Imperialine*," a new Alkaloid. K. Fragner. Ber. **21**, 3284—3287.

Frittelaria or *Coronaria imperialis* (*Crown Imperial*), which was formerly employed for medicinal purposes, contains a poisonous alkaloid which the author names *Imperialine*. It is best obtained pure as follows:—The crushed bulbs are pulverised with lime, the mixture heated on the water-bath until perfectly dry, and then extracted with chloroform. The extract is shaken with dilute tartaric acid, the alkaloid precipitated from the acid solution with sodium carbonate, the precipitate washed and recrystallised from alcohol. The yield is 0.08—0.12 per cent.

Imperialine, $C_{35}H_{60}NO_4$, crystallises in colourless needles, is very readily soluble in chloroform, and moderately soluble in ether, benzene, amyl alcohol, light petroleum, and alcohol, but only very sparingly in water. Its solutions have a bitter taste, and the physiological action of this alkaloid is similar to that of *Scilla maritima*. When heated to 240° it turns yellow, becomes brown at 248°, and melts completely at 254°. Its specific rotatory power in chloroform solution is $\alpha_D = 35.40$.

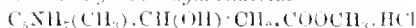
The hydrochloride, $C_{35}H_{60}NO_4 \cdot HCl$, is crystalline, and readily soluble in alcohol and water. The platinochloride, $(C_{35}H_{60}NO_4)_2 + 11PtCl_6$, and the aurichloride, $C_{35}H_{60}NO_4 + HAuCl_4$, do not crystallise very readily. The sulphate is very hygroscopic, and the oxalate crystallises only from very concentrated solutions. Solutions of the salts give precipitates with most of the usual reagents for alkaloids, and the free base gives the following characteristic reactions:—When treated with concentrated sulphuric acid it turns slightly yellow, but when previously mixed with sugar it gives a yellowish-green colouration which passes through pale brown, flesh-colour and cherry-red, and, after standing for a long time, finally becomes dark violet. It is coloured slightly green when treated with Froehde's reagent, and with Mandelin's reagent it gives an olive-green colouration which, passing through reddish-brown, turns dark brown. When mixed with sulphuric acid and then treated with potassium nitrate or chlorate it gives an orange colouration, but if previously warmed a dark reddish-yellow colour. It turns yellow when warmed with nitric acid; when treated with hydrochloric acid the solution, which is strongly fluorescent, becomes brownish-green on warming and finally changes to brownish-red.

—F. S. K.

Action of Acid Chlorides on Ecgonine Methyl Ether Hydrochloride. A. Einhorn and O. Klein. Ber. **21**, 3335—3338. (Compare pp. 131—133.)

COCAINE can be prepared by converting ecgonine into the methyl ether and treating the latter with benzoyl chloride.

Ecgonine methyl ether hydrochloride—

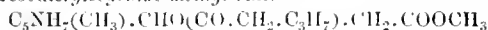


is obtained by passing anhydrous hydrochloric acid into a methyl alcoholic solution of ecgonine hydrochloride until the solution has become cold, and then heating the mixture for about an hour with inverted condenser. After evaporating, the salt can be isolated either by adding sodium carbonate, extracting with ether and converting the product into the hydrochloride, or by allowing the salt to crystallise from the concentrated alcoholic solution. It crystallises from dilute alcohol in prisms with 1 mol. of H_2O , and melts at 212° with decomposition.

Cocaine can be obtained by heating a mixture of equal weights of the preceding compound and benzoyl chloride on the water-bath until the whole becomes homogeneous, and the evolution of hydrochloric acid ceases. The hot melted mass is then poured into water, separated from the precipitated benzoic acid, and the cocaine precipitated with

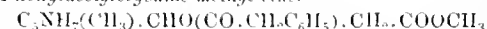
ammonia or alkaline carbonates, and recrystallised from alcohol. The cocaine thus prepared shows all the properties of the natural alkaloid.

Isovalerylecgonine methyl ether—



was obtained in the form of an oil by heating a mixture of equal weights of ecgonine methyl ether hydrochloride and isovaleryl chloride at 100° for about 15 minutes and precipitating the product with sodium carbonate. The hydrochloride, hydrobromide, and hydriodide are crystalline. The platinochloride, $(C_{15}H_{25}NO_4)_2 \cdot H_2PtCl_6$, crystallises in large plates.

Phenylacetylecgonine methyl ether—



obtained by treating phenylacetyl chloride with ecgonine-methyl-ether hydrochloride as described in the case of cocaine, is an oil. The hydrobromide, hydriodide, and platinochloride, $(C_{18}H_{23}NO_4)_2 \cdot H_2PtCl_6$, are crystalline.

Orthophthalglydi-ecgonine dimethyl ether, $C_{25}H_{36}N_2O_8$, prepared in a similar manner is a crystalline substance which has a similar physiological action to that of cocaine.

The platinochloride, $C_{25}H_{36}N_2O_8 \cdot H_2PtCl_6$, crystallises from water, and the hydriodide from alcohol in plates.—F. S. K.

Cinnamylecgonine. C. Liebermann. Ber. **21**, 3372—3376.

Cinnamylecgonine, $C_{19}H_{17}(C_9H_7O \cdot NO_2)$, can be prepared by heating ecgonine with cinnamic anhydride and water (see also pp. 131—133). After keeping the mixture overnight it is triturated with 6—8 times its weight of water, the cinnamic acid and unchanged anhydride separated and the remainder of the acid extracted with ether. When the aqueous solution is evaporated it solidifies to a mass of crystals and a second crop can be obtained by concentrating the mother-liquor. The yield is about 60 per cent. of the ecgonine employed. It melts at 216° with decomposition, and is readily soluble in alcohol, but is reprecipitated on adding ether. It is decomposed into ecgonine and cinnamic acid when boiled with hydrochloric acid, and when treated with cold, dilute potassium permanganate it is immediately oxidised, the smell of benzaldehyde being perceptible.

Cinnamylecgonine, $C_9H_{13}(CH_3)(C_9H_7O)NO_2$, is obtained when anhydrous hydrochloric acid is passed into a concentrated methyl alcoholic solution of cinnamylecgonine. The yield is about 50 per cent. It forms large colourless crystals, melts at 121°, and is almost insoluble in water, but readily soluble in most of the usual solvents. When boiled with hydrochloric acid it is readily and quantitatively decomposed into ecgonine and cinnamic acid. The hydrochloride is precipitated when a large volume of ether is added to a concentrated alcoholic solution containing a little hydrochloric acid; it separates in an oily condition but solidifies after some time. When treated with cold potassium permanganate it is immediately oxidised and the solution then smells of benzaldehyde. The platinochloride, $(C_{19}H_{23}NO_4)_2 \cdot H_2PtCl_6$, crystallises in microscopic needles melting at 217°.

The smell of benzaldehyde which is noticed in the oxidation of natural cocaine seems to indicate the presence of cinnamylecgonine.—F. S. K.

Ergosterin, a new Proximate Constituent of Ergot of Rye. C. Tanret. Compt. Rend. **108**, 98—100.

This substance is very similar to cholesterol; the rye containing ergot is exhausted several times with alcohol, the solution distilled, and the residue extracted with ether; when the ether is evaporated, an oily mass containing slender crystals is obtained. The crystals are picked out and recrystallised, first from slightly alkaline alcohol, to saponify adhering oil, and then from pure alcohol; the yield is about 0.02 per cent.

Ergosterin has the formula $C_{26}H_{40}O \cdot H_2O$; it crystallises in slender needles which lose their water of crystallisation at 110°; it melts at 154°, and boils, under 20 mm. pressure, at 185°; is soluble in 500 parts of cold and 32

parts of boiling alcohol, in 80 parts of cold and 38 parts of boiling ether, and in 45 parts of cold chloroform. Its specific gravity when it has been melted is 1.04; it oxidises slowly in air at the ordinary temperature, very rapidly at 100°, becoming coloured and odorous, but is not attacked by boiling concentrated alkali. It is a monatomic alcohol, and forms an acetate, $\text{CH}_3\text{COO}(\text{C}_{26}\text{H}_{50})$, which crystallises in nacreous anhydrous spangles, which are insoluble in water and difficultly soluble in cold alcohol; they melt with some decomposition at 169°. The author has also obtained the formate and butyrate.

Ergosterin may be distinguished from cholesterol by the fact that it dissolves entirely in sulphuric acid, and that chloroform, shaken with the solution, does not become coloured as it does in the case of cholesterol.—A. G. B.

PATENTS.

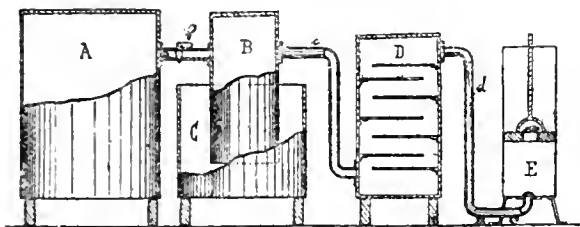
Improvements in the Treatment of Amorphous Alkaloids obtained in the Preparation of Cocaine. C. Liebermann and F. Giesel. Eng. Pat. 12,179, August 23, 1888. 6d.

THE amorphous alkaloids are decomposed by boiling with an excess of hydrochloric acid (sp. gr. 1.1 to 1.2) for 1–2 hours. The hydrochloride of eegonine in solution is filtered from the insoluble organic acids, the solution evaporated to dryness, and the free base obtained by treating with alkali. The eegonine thus obtained may be converted into benzoyl eegonine by treating with benzoyl chloride or benzoic anhydride, as follows:—

An aqueous solution of eegonine (1 mol.), saturated at boiling point, is treated with rather more than an equivalent quantity of benzoic anhydride (1 mol.). To complete the reaction, the mixture is maintained for $\frac{1}{2}$ –1 hour at the boiling point. The benzoic acid produced is removed with ether. The aqueous solution contains the benzoyleegonine, which crystallises on shaking or standing. (Compare pp. 131–133.)—J. B. C.

Improvements in Extracting Perfumes from Flowers, Fruits, and other Substances containing Etheral Oil or Aromatic Matters, and Apparatus therefor. W. P. Thompson, Liverpool. From G. D. Nellensteyn, Amsterdam, Holland. Eng. Pat. 15,299, October 24, 1888.

THE apparatus employed is shown in the accompanying figure.



A is a reservoir, of sufficient strength to resist external pressure and made of iron or any other suitable material, which can be opened and hermetically closed. This reservoir is connected with a receiver B by means of a pipe a, provided with a cock or valve b. The receiver B is placed in a cooling vessel C, containing a freezing mixture. The receiver B can also be opened and hermetically closed, and is connected to a chamber D by a pipe c. This chamber D is provided with several layers of vaselin, suet, or any other substance fit to absorb aromatic substances placed on the perforated or other shelves shown. The chamber D is connected by a pipe d to an air-pump E, or any other arrangement in order to produce a vacuum. The operation is as follows:—The reservoir A is filled with flowers, &c., and closed hermetically; the air is then pumped out from the reservoir A, the receiver B, and the chamber D. By the influence of the vacuum and the low temperature

in the receiver B, the volatile oils are therein condensed, either in the liquid or solid state, to be afterwards removed. By passing the air, when being pumped out, over vaseline or suet in chamber D any volatile matters which have not condensed in B are retained.—J. B. C.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

PATENTS.

Improvements in or relating to the Production of Pictures or Images on Materials or Fabrics having a Dark Ground by a Photographic process. W. P. Thompson, Liverpool. From J. W. C. C. Schirn, Breslau, Germany. Eng. Pat. 1026, January 23, 1888. 6d.

AN application of ordinary transfer methods to the production of light-coloured images on a darker ground, after the manner of Limoges enamels.—C. H. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENTS.

Improvements in Explosive Compounds. A. V. Newton, London. From A. Nobel, Paris, France. Eng. Pat. 1469, January 31, 1888. 6d.

THIS explosive mixture consists preferably of charcoal, nitrate of baryta, and pierate of ammonia or amorphous phosphorus. The two last ingredients are added in order to counteract the slow combustion inherent to nitrate of baryta powders.—C. N. H.

Improvements in the Manufacture of Safety Fuses. A. V. Newton, London. From A. Nobel, Paris, France. Eng. Pat. 1470, January 31, 1888. 6d.

INSTEAD of meal powder, which now forms the combustion core of safety-fuses, the inventor proposes to use a cellulosidal substance made in the following manner:—To 100 parts (by weight) of nitroglycerol, 15 to 20 parts of camphor are added, and the solution thus obtained is thickened, by dissolving in it 6 parts of nitrated pulped cotton. To the above are added 70 parts of chlorate of potash, 25 parts of ferricyanide of potassium, and 44 parts of nitrated soluble cotton. These, when thoroughly incorporated, produce a substance of the consistency of soft india-rubber and easily workable into thread.

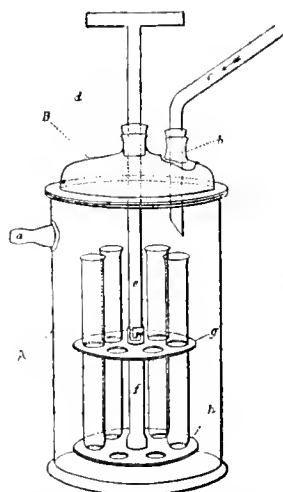
The advantages claimed are "absolute continuity, imperviousness to moisture," and absence of smoke when ignited.—C. N. H.

XXIII.—ANALYTICAL CHEMISTRY.

Apparatus for Fractional Distillation in a Partial Vacuum.
J. W. Brühl. Ber. 21, 3339-3342.

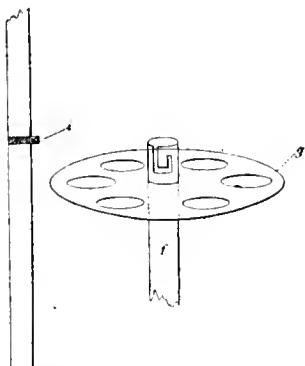
For fractional distillation in a partial vacuum the author recommends the following apparatus, a diagram and description of which are given below:—

Fig. 1.



A is a glass cylinder connected at *a* with the vacuum apparatus, and provided with a ground edge, on which rests the glass cover B. The tube *c*, which is connected with the distilling apparatus, passes through an india-rubber cork fitting tightly into the tubulure *b*. A glass rod, *c*, provided with a handle, passes through an india-rubber cork tightly fitted into the tubulure *d*, almost to the bottom of A, and at a short distance from the lower extremity is pierced with a hole, in which is pressed a pin *i* (Fig. 2). *f*, *g*, *h*, consist of a hollow stem *f*, to which the discs *g* and *h* are attached; it is made of ebony, and can be fastened on to *c* by means of a bayonet-shaped catch.

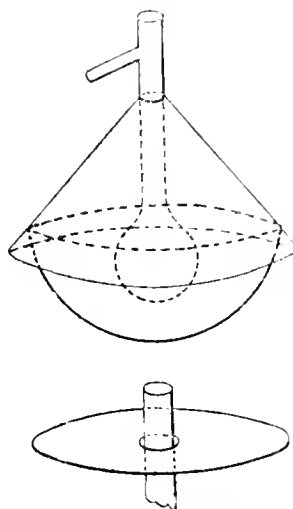
Fig. 2.



Test tubes having been placed in the holder *f*, *g*, *h*, the rod *c*, to which the cover B is attached, is fitted into the stem *f*: the two portions made fast by means of the catch are placed in A, and the apparatus made air-tight by pressing the greased edges of A and B together. The distilling vessel is then made air-tight, *a* is connected with the vacuum apparatus, and the distillation proceeded with; by turning the rod *c* the receiver can be changed at will. It is inadvisable to move the india-rubber stoppers after they have once been placed in position, but when the central one requires replacing, the pin in the glass rod can be easily removed.

The air-bath (Fig. 3), can be advantageously employed for all distillations.

Fig. 3.



The flask is suspended in a hemispherical metal basin so that it does not touch the bottom or sides, and is covered by an asbestos cone, which is provided with a radial slit and a circular opening to admit the neck of the flask. The temperature can be regulated and kept constant quite as easily as when a water, oil, or any other liquid-bath is employed. For high temperatures, the metal reflector shown in Fig. 3 is fixed on the Bunsen lamp.—F. S. K.

Hampe's Method of determining Cuprous Oxide in Metallic Copper. F. F. Dewey. Eng. and Min. Jour. 46, 460-461.

The above method—which consists in treating the sample with a cold solution of neutral nitrate of silver for three or four days, estimating the copper in the residue, and calculating from this the cuprous oxide on the assumption that two-thirds of it was transformed into an insoluble basic nitrate, and that the other third had gone into solution—was found to give unsatisfactory results with coppers containing excessive amounts of Cu_2O . The paper gives the results of a few experiments carried out to ascertain what really takes place.

A material was prepared from electrolytic copper having the following composition:—

	Per Cent.
Cu	83.317
Cu_2O	16.670
Fe	60.013
	<hr/> 100.000

The above figure for Cu_2O was calculated from the oxygen obtained by difference. Some of this metal was submitted to Hampe's treatment and the result multiplied by the Hampe constant, when 24.44 per cent. of Cu_2O was obtained, whereas if it be considered that the whole of the Cu_2O in the metal is converted into insoluble nitrate the resulting figure would be 16.29 per cent. of Cu_2O . Similar experiments were conducted on the same material diluted with pure copper and in which the percentages of Cu_2O were 13.33 and 9.75; when 12.455 and 9.10 respectively were the figures obtained, assuming as before that the whole of the Cu_2O becomes insoluble. The author gives an equation for the reaction which takes place, and concludes from these results, where the amounts of Cu_2O are rather high, that "when copper containing Cu_2O is treated with a neutral solution of AgNO_3 in excess in the cold, all the Cu_2O is converted into the insoluble basic nitrate."—A. W.

Table for Estimating amount of Nitric Acid from observed volume of Nitric Oxide. A. Baumann. Zeits. f. angew. Chem. 1888, 662-664.

The increasing use of gasometric processes for the estimation of nitric acid induced the author to compile a table to facilitate the calculation of results.

The table gives the value of $b \times 2.4134$
760 (1 + 0.00366 t)
where b = barometric pressure in mm.

t = temperature.

2.4134 = weight of N_2O_5 in milligrammes corresponding to 1 cc. of NO at the normal temperature and pressure.

Pressure.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	Pressure.
mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
700	2.144	2.137	2.129	2.122	2.115	2.107	2.100	2.093	2.085	2.078	2.071	2.064	2.057	2.050	2.043	2.037	700
702	2.150	2.143	2.135	2.128	2.121	2.113	2.106	2.099	2.091	2.084	2.077	2.070	2.063	2.056	2.049	2.042	702
704	2.156	2.149	2.141	2.134	2.127	2.119	2.112	2.105	2.097	2.090	2.083	2.076	2.069	2.062	2.055	2.048	704
706	2.163	2.155	2.148	2.140	2.133	2.125	2.118	2.111	2.103	2.096	2.089	2.082	2.075	2.068	2.061	2.054	706
708	2.169	2.161	2.154	2.146	2.139	2.131	2.124	2.117	2.110	2.102	2.095	2.088	2.081	2.074	2.067	2.060	708
710	2.175	2.167	2.160	2.152	2.145	2.137	2.130	2.123	2.115	2.108	2.101	2.094	2.087	2.080	2.073	2.066	710
712	2.181	2.174	2.166	2.158	2.151	2.143	2.136	2.129	2.121	2.114	2.107	2.100	2.093	2.085	2.078	2.072	712
714	2.187	2.180	2.172	2.164	2.157	2.149	2.142	2.135	2.127	2.120	2.113	2.105	2.098	2.091	2.084	2.077	714
716	2.193	2.186	2.178	2.170	2.163	2.155	2.148	2.141	2.133	2.126	2.119	2.111	2.104	2.097	2.090	2.083	716
718	2.200	2.192	2.184	2.177	2.169	2.161	2.154	2.147	2.139	2.132	2.125	2.117	2.110	2.103	2.096	2.089	718
720	2.206	2.198	2.190	2.183	2.175	2.167	2.160	2.152	2.145	2.138	2.131	2.123	2.116	2.109	2.102	2.095	720
722	2.212	2.204	2.196	2.189	2.181	2.173	2.166	2.158	2.151	2.144	2.136	2.129	2.122	2.115	2.108	2.101	722
724	2.218	2.210	2.202	2.195	2.187	2.179	2.172	2.164	2.157	2.150	2.142	2.135	2.128	2.121	2.113	2.106	724
726	2.224	2.216	2.208	2.201	2.193	2.185	2.178	2.170	2.163	2.155	2.148	2.141	2.134	2.126	2.119	2.112	726
728	2.230	2.222	2.215	2.207	2.199	2.191	2.184	2.176	2.169	2.161	2.154	2.147	2.140	2.132	2.125	2.118	728
730	2.236	2.229	2.221	2.213	2.205	2.197	2.190	2.182	2.175	2.167	2.160	2.153	2.145	2.138	2.131	2.124	730
732	2.242	2.235	2.227	2.219	2.211	2.203	2.196	2.188	2.181	2.173	2.166	2.159	2.151	2.144	2.137	2.130	732
734	2.248	2.241	2.233	2.225	2.217	2.210	2.202	2.194	2.187	2.179	2.172	2.165	2.157	2.150	2.143	2.135	734
736	2.255	2.247	2.239	2.231	2.223	2.216	2.208	2.200	2.193	2.185	2.178	2.170	2.163	2.156	2.149	2.141	736
738	2.261	2.253	2.245	2.237	2.229	2.222	2.214	2.206	2.199	2.191	2.184	2.176	2.169	2.162	2.155	2.147	738
740	2.267	2.259	2.251	2.243	2.235	2.228	2.220	2.212	2.205	2.197	2.190	2.182	2.175	2.167	2.160	2.153	740
742	2.273	2.265	2.257	2.249	2.241	2.234	2.226	2.218	2.211	2.203	2.196	2.188	2.181	2.173	2.166	2.159	742
744	2.279	2.271	2.263	2.255	2.247	2.240	2.232	2.224	2.217	2.209	2.202	2.194	2.187	2.179	2.172	2.164	744
746	2.285	2.277	2.269	2.261	2.253	2.246	2.238	2.230	2.222	2.215	2.207	2.200	2.192	2.185	2.178	2.170	746
748	2.292	2.284	2.275	2.267	2.259	2.252	2.244	2.236	2.228	2.221	2.213	2.206	2.198	2.191	2.184	2.176	748
750	2.298	2.290	2.281	2.273	2.265	2.258	2.250	2.242	2.234	2.227	2.219	2.212	2.204	2.197	2.189	2.182	750
752	2.304	2.296	2.288	2.279	2.272	2.264	2.256	2.248	2.240	2.233	2.225	2.218	2.210	2.203	2.195	2.188	752
754	2.310	2.302	2.294	2.286	2.278	2.270	2.262	2.254	2.246	2.239	2.231	2.223	2.216	2.209	2.201	2.194	754
756	2.316	2.308	2.300	2.292	2.284	2.276	2.268	2.260	2.252	2.245	2.237	2.229	2.222	2.214	2.207	2.200	756
758	2.322	2.314	2.306	2.298	2.290	2.282	2.274	2.266	2.258	2.250	2.243	2.235	2.228	2.220	2.213	2.205	758
760	2.328	2.320	2.312	2.304	2.296	2.288	2.280	2.272	2.264	2.256	2.249	2.241	2.234	2.226	2.219	2.211	760
762	2.334	2.326	2.318	2.310	2.302	2.294	2.286	2.278	2.270	2.262	2.255	2.247	2.240	2.232	2.224	2.217	762
764	2.340	2.332	2.324	2.316	2.308	2.300	2.292	2.284	2.276	2.268	2.261	2.253	2.245	2.238	2.230	2.223	764
766	2.347	2.338	2.330	2.322	2.314	2.306	2.298	2.290	2.282	2.274	2.267	2.259	2.251	2.244	2.236	2.229	766
768	2.353	2.344	2.336	2.328	2.320	2.312	2.304	2.296	2.288	2.280	2.273	2.265	2.257	2.250	2.242	2.234	768
770	2.359	2.351	2.342	2.334	2.326	2.318	2.310	2.302	2.294	2.286	2.279	2.271	2.263	2.255	2.248	2.240	770

If the gas be measured moist, the tension of the aqueous vapour, at the particular temperature, must be deducted from the barometric reading. Also, to allow for the expansion of the mercury in the barometer, deduct from the observed pressure, 1 mm. for temperatures of 10° to 12° , 2 mm. for 13° to 19° , 3 mm. for 20° to 25° C.

The number of cc. of nitric oxide obtained, multiplied by the coefficient obtained as above, gives the weight in milligrams of nitrogen pentoxide.—E. B.

Titration of small Quantities of Gases in Mixtures of Gases. P. Behrend and H. Kast. *Dingl. Polyt. J.* **270**, 423—435.

The technical methods employed for the estimation of small quantities of gases in mixtures do not allow of the determination of amounts less than 0.5 per cent., and even then it is necessary to employ a large quantity of the mixture, as, for instance, in Pettenkofer's method for the estimation of carbon dioxide, &c., using Hesse's apparatus, when $\frac{3}{4}$ to 1 litre is required. Bunte has recently proposed a method for the volumetric estimation of small amounts of gases in mixtures by means of his (Bunte's) burette, where the quantity of gas employed is only 100 cc., and by means of which 1 per cent. of a gas can be determined (*Dingl. Polyt. J.* **269**, 232). The method applies to the determination of sulphuretted hydrogen, ozone, ammonia and sulphur dioxide. The authors have examined the method as regards the first two of the above gases.

1. *Determination of sulphuretted hydrogen*—100 cc. of the gaseous mixture are measured off into a Bunte's gas-burette in the usual manner, the remainder of the water in the measuring tube run out to the lower mark of the tube, and then an iodine solution added gradually until the colour of the solution, which disappears rapidly at first, remains of a yellow tint. During the addition of the iodine solution the contents of the tube are well shaken from time to time; the iodine solution should contain 1.134 grms. of iodine per litre, when 1 cc. = 0.1 cc. sulphuretted hydrogen. Sulphur separates during the reaction according to the equation, $\text{H}_2\text{S} + \text{I}_2 = 2 \text{HI} + \text{S}$, and the turbidity formed aids in discerning the end reaction, or a few drops of sodium bicarbonate and thin starch paste may be added before introducing the iodine solution, whereby the end reaction (formation of the blue iodide of starch) is more easily observed. A small volume of the iodine solution, taken as 0.2 cc. in the authors' experiments, remains at the bottom end of the measuring tube, and does not come in contact with the gas; this volume of solution is subtracted from the amount used in each case. The method was employed for the determination of the sulphuretted hydrogen in a mixture of this gas with coal gas, the results being checked gravimetrically by passing a weighed volume of the gas through an acetic acid solution of lead acetate and again weighing it. The following results were obtained:—

Per Cent. of Sulphuretted Hydrogen.		Difference.
Gravimetrically.	Bunte's Method.	
1.34	1.33	0.01
1.29	1.19	0.10
1.29	1.22	0.07
0.67	0.62	0.05
0.58	0.58	0.00
Mean difference.		0.04

The above results by Bunte's method, which are corrected for temperature and pressure, are the mean, in each case, of several closely agreeing results. Equally accurate results were obtained with a mixture of sulphuretted hydrogen, coal gas, and air; the iodine-solution was, in this case, diluted to half the strength given above.

The authors have employed this method to determine the sulphuretted hydrogen in coal gas as the gas leaves the retorts, the samples being taken from the ascension pipes by means of a suitable pump. The appended table shows the percentage of sulphuretted hydrogen in the crude gas from I. Saar coal; II. Bohemian brown coal; III. Tyne Boghead Cannel, at short intervals during the distillation:—

Time of taking Sample.		Per Cent. of Sulphuretted Hydrogen in Crude Gas from:—		
Hour.	Minutes.	I.	II.	III.
1st	5	1.19	3.75	0.74
	15	0.98	..	..
	20	..	..	0.30
	25	..	3.23	..
	35	1.03	..	1.10
	45	..	3.00	..
	55	1.01	..	0.79
	65	0.73	2.02	..
2nd	70	..	..	0.85
	80	0.81	1.50	..
	85	..	..	0.41
	95	0.62	..	..
	100	..	..	0.58
	105	..	1.95	..
	110	0.80	..	..
	115	..	..	0.71
3rd	125	0.47	0.51	..
	130	..	..	0.68
	140	0.40	0.51	..
	145	..	..	0.44
	160	0.38	1.00	0.52
	170	..	0.72	..
	175	0.31	..	0.38
	185	..	0.60	..
4th	190	0.54	..	..
	195	..	..	0.46
	200	..	0.63	..
	205	0.38	..	0.46
	210	..	0.64	..
	220	0.21	0.43	0.10

These results show that the maximum percentage of sulphuretted hydrogen in the crude gas is, in the cases of Saar and Bohemian brown coal, immediately after charging; also that the latter contains almost three times as much as the former. The maximum amount of the gas from Tyne Boghead Cannel takes place about 35 minutes after charging.

It is remarked that a similar use may be made of Bunte's method for examining coal gas at different stages of its manufacture.

2. *Determination of Ozone*.—To determine ozone in ozonated oxygen, a measured volume of the gas is treated in a Bunte's burette with a solution of potassium iodide (about 7 cc. of a solution containing about 17 grms. of potassium iodide per 100 cc.) and then very dilute sulphuric acid added until the liquid reaches to the 10th graduation on the measuring tube. The contents of the tube are well shaken and the separated iodine titrated with $\frac{\text{N}}{20}$ or $\frac{\text{N}}{50}$ sodium thiosulphate, which is gradually added to the contents of the burette. From the amount of thiosulphate solution used the quantity of iodine separated, and therefore the percentage of ozone is found.

The authors are investigating similar methods of Bunte in regard to the determination of other gases.—C. A. K.

On the Accuracy of the Dry Assay for Silver. Dingl. Polyt. J. 270, 468—471.

A. GÖRZ (Berg- und Hüttenmännische Zeitung, 1888, 441), and H. ROSSLER (this Journal, 1888, 869) agree that for the assay of argentiferous materials the use of the scorifier is preferable to that of the crucible (unless special circumstances have to be considered, such as the presence of carbonaceous matter or the fact of the ore under treatment being a very poor one) as it gives results which are higher and nearer the truth.

In 100 grms. of crucible-slag, Görz found 2 and 4 mg. of silver in two different samples, and is of opinion that no sensible loss occurs in scorification, the chief amount of deficit being due to the subsequent cupellation. Nevertheless silver is present in scorifier slag, 100 grms. of it yielding 16.5 mg. of silver in the case of a rich ore, and 2.5 mg. in that of a poor one, corresponding to 0.25 and 1.04 per cent. respectively of the total silver present in the sample.

The loss of silver during cupellation is due both to absorption in the cupel and volatilisation, and increases, as would be expected, with the proportion of lead, and the temperature used.

In used cupels were found: in 100 grms. that had been used in the assay of a rich ore, 43 mg. of silver, corresponding to 0.5 per cent. of the total silver, and in the same quantity used for a poorer ore, 2 mg., equivalent to 1.5 per cent. of the whole.

Further, 580 mg. of silver were found in 100 grms. of the flue-dust of a gas-muffle.

The appended table shows the mean results of a large number of assays made on mixtures of known composition, and indicates what loss may be expected even when, as in this case, the utmost care is exercised, and the cupellation conducted at the lowest possible temperature.

Even here the loss appears smaller than is really the case, for the buttons of silver obtained by cupellation are never quite pure, but always contain some tenths of a per cent. of lead, and frequently copper and bismuth as well. It suffices to dissolve a few grms. in nitric acid and supersaturate with ammonia (a white precipitate of lead and bismuth hydrates, and a blue colour due to the copper being formed) in order to demonstrate this.—B. B.

Quantitative Analysis by Electrolysis. A. Classen and R. Schelle. Ber. 21, 2892—2899.

The author has employed for purposes of electrolysis two accumulators of the following dimensions. Each contains six negative and five positive lead plate electrodes 6 mm. thick. The total weight of electrodes is 15.5 kilos., the volume of 33 per cent. sulphuric acid 3.5 litres, and the total weight of an accumulator 35 kilos. The tension according to Siemens' torsion galvanometer is 2.05 volts., and they yield when coupled in series 40—50 cc. of electrolytic gas per minute. With these 4—8 analyses were simultaneously performed. The author gives a series of results, showing that with two fully charged accumulators 60—70 analyses may easily be performed.

Separation of Tin from Antimony.—In a former communication (this Journal, 1886, 334) the authors have given a method for this separation in presence of sodium sulphide, precipitating the antimony, adding ammonium sulphate, and then precipitating the tin. A modification, which gives better and more rapid results, is to convert the tin sulphide dissolved in sodium sulphide into the acid oxalate, and then to electrolyse the solution. This may be done in two ways, either by decomposing the sulphide with dilute sulphuric acid and oxidising the separated tin sulphide with ammoniacal

Substance.	Quantity of Silver present.	Silver taken.	Lead taken.	Proportion of Lead.	Percentage of Silver lost.	
Argentiferous copper	150 g. in 100 k.	15 mg. with 10 g. copper	200 g.	12,000 : 1	8.3	Cupelled.
" "	2,000 " 100 "	200 " 10 "	100 "	800 "	4.5	
Argentiferous lead	150 " 100 "	150 mg.	100 "	600 "	2.5	
" "	300 " 100 "	150 "	50 "	300 "	2.2	
" "	700 " 100 "	150 "	20 "	120 "	2.0	
Rich argentiferous lead	1,500 " 100 "	150 "	10 "	60 "	1.6	Scorified and cupelled.
" " "	3,000 " 100 "	150 "	5 "	30 "	0.9	
" " "	15,000 " 100 "	150 "	1 "	6 "	0.1	
Lead ore.....	50 " 100 "	2.5 mg. in 5 g. 20 times	40 "	16,000 "	3.5	
"	100 " 100 "	5 " 5 " 10 "	40 "	8,000 "	2.8	
"	500 " 100 "	25 " 5 " 1 "	40 "	1,600 "	2.3	Run down in a crucible and cupelled.
Silver ores, slags, silver sulphide, &c., ..	1,600 " 100 "	10 mg. in 2.5 g.	40 "	1,000 "	2.3	
" " " " ..	4,000 " 100 "	100 " 2.5 "	40 "	400 "	1.9	
" " " " ..	10,000 " 100 "	250 " 2.5 "	40 "	160 "	1.6	
" " " " ..	20,000 " 100 "	500 " 2.5 "	40 "	80 "	1.3	
" " " " ..	60,000 " 100 "	1,500 " 2.5 "	40 "	27 "	0.8	
Lead ore.....	50 " 100 "	12.5 " 25 "	25 "	2,000 "	5.3	
"	100 " 100 "	25 " 25 "	25 "	1,000 "	1.0	
"	500 " 100 "	125 " 25 "	25 "	200 "	3.1	
Slag	700 " 100 "	175 " 25 "	25 "	150 "	3.5	
"	2,000 " 100 "	500 " 25 "	25 "	50 "	2.7	

hydrogen peroxide to tin oxide, or by adding directly hydrogen peroxide until the solution is colourless, and then sulphuric acid to precipitate the stannic oxide; the separated oxide being then dissolved in oxalic acid. The authors find

that in presence of excess of oxalic acid, copper oxalate may be more rapidly electrolysed than the nitrate, and that a firmly adherent film of metal is obtained.—J. B. C.

Estimation of Nitrates in Natural Water. S. C. Hooker.
Ber. 21, 3302.

MANY years ago Graebe and Glaser discovered the fact that the addition of oxidising bodies in small quantities to a solution of carbazol in concentrated sulphuric acid produced a dark green solution. The author based a method for the estimation of minute quantities of nitrates on this reaction. He proceeds thus: A measured quantity of the water to be tested, 2 cc. or less, is mixed with 4 cc. of concentrated sulphuric acid, and after cooling a small quantity of sulphuric acid, containing some carbazol, is added. The intensity of the green colour produced is compared with that obtained under similar conditions with a known amount of potassium nitrate. The reaction is very delicate, and still applicable, if the water only contain two parts of nitric acid per million. Certain precautions must be taken in the presence of chlorides and nitrites, which will be published at some future date.—S. H.

Method for rapidly Analysing Water for Industrial Purposes, with a view to its Purification by Chemical Means.
L. Vignon. Bull. Soc. Chim. 50, 598—604.

IN most cases it is advisable to purify water, previous to using it for industrial purposes, when there is a solid residue of 0.3 grms. or more per litre of the water. The author's method consists in saturating the acid carbonates contained in the water with lime, and then precipitating all the lime and magnesia salts still in solution with sodium carbonate. Phenol-phthalein is used as an indicator, and decinormal clear lime-water is required. The titration is conducted in two narrow glass-stoppered cylinders of about 100 cc. capacity. Into one, 50 cc. of distilled water and 10 drops of an alcoholic solution of phenol-phthalein are introduced; this is then coloured by 0.2—0.5 cc. of the normal lime solution, and kept as standard. The other cylinder is filled with 50 cc. of the water under examination, 10 drops of phenol-phthalein solution, and 5 cc. of a 10 per cent. neutral calcium chloride solution. The normal lime-water is then added, until, on agitating, the solution remains coloured. The standard is now diluted until its volume corresponds to the volume of liquid in the other cylinder, and a little lime-water added to one or the other solution until the colour in both is identical. The difference in the quantity of lime-water used for the standard and for the water under examination gives the quantity of lime which has combined with the free carbonic acid in the water.

In order to determine the quantity of soda required to precipitate the lime in the water, 100 cc. of the latter are mixed in a graduated 250 cc. cylinder with the quantity of lime-water necessary to combine with any free carbonic acid, 5 cc. of phenol-phthalein solution then added, and the mixture, after shaking, allowed to settle. Exactly one-half of this solution is placed in one of the cylinders previously used for the colorimetric determination and the amount of soda solution (containing 1 gm. of Na_2CO_3 per litre) ascertained which is necessary to produce a recoloration. This must be equal in intensity to the standard made by adding to distilled water the same amount of phenol-phthalein contained in the former solution and coloured by a small quantity of the soda solution.

From the above data the quantity of lime and soda which it is necessary to add to the water may be readily deduced.

Water containing notable quantities of magnesium sulphate or chloride cannot safely be tested by this method.

—A. R.

Determination of the Metals of the Iron Group by Means of Hydrogen Peroxide. A. Carnot. Compt Rend. 107, 948—949 and 997—1000.

THE action of hydrogen peroxide on the different metals of the iron group is either that of an oxidising or reducing agent. The best known reaction is that with chromates, where dilute solutions of both when mixed yield a blue colour. This latter is very fugitive, remaining a few minutes if the solution be nearly neutral, and only a few seconds if it contain more than 1 per cent. of free H_2SO_4 or HCl . The colouration is due to the formation of a body with the

formula $\text{CrO}_3 \cdot \text{H}_2\text{O}_2$. With a sufficient quantity of H_2O_2 the chromate is finally reduced to Cr_2O_3 . On this fact the author bases a volumetric determination of chromic acid or hydrogen peroxide. The former is more readily carried out. The solution of the chromate must have a slightly acid reaction. It is titrated with a very dilute solution of H_2O_2 (the commercial product mixed with 5—20 times its volume of water); the latter being added until a drop ceases to produce a blue spot in the chromate solution. The strength of the H_2O_2 solution may be ascertained by titrating in a similar manner a solution containing a known weight of bichromate. The chromate solution should not contain more than 0.5 per cent. of chromic acid, to prevent the colouration being too dark. The dilute hydrogen peroxide solution keeps very well.

The reverse takes place when hydrogen peroxide acts on chromium salts in alkaline solution, the chromium salts being converted into chromates. A dilute solution of chromium chloride is heated to boiling, a few cc. of the H_2O_2 solution and an excess of ammonia added, and the mixture boiled again until quite yellow. Any undissolved oxide must be redissolved in acid and treated again in the same manner. The oxidation finished, the chromate may be determined again by reduction with H_2O_2 , or otherwise. This method may be used with obvious advantage for separating chromium from those metals which are precipitated by ammonia or ammonium carbonate. The process is also very useful when it is a question of separating chromates from chromium salts or, in the analysis of chrome iron ore, from alkaline aluminates.

Manganese is acted upon by H_2O_2 similarly to chromium; in acid solution reduction takes place; in alkaline solution oxidation. When a manganous salt is mixed with dilute H_2O_2 and boiled with ammonia, all the manganese is deposited as dioxide, but generally it has to be redissolved several times, &c., to free it from any other metals.

Iron salts are oxidised by H_2O_2 in acid solutions, unlike the two preceding metals. The transformation is immediate, even in the cold, and H_2O_2 is more effectual in this case than any other oxidising agent.

No analytical data are given, testifying to the accuracy of the methods described.—A. R.

Some similar Reactions of Carbazol and Pyrrol.

S. C. Hooker. Ber. 21, 3299—3301.

1. CARBAZOL, like pyrrol, gives the red colouration with a pine-wood shaving. The colourations are best produced by soaking the shaving in a hot alcoholic solution of carbazol, and then exposing it to hydrochloric acid fumes.

2. Treated with isatin and sulphuric acid (conc.), an intense blue colouration is produced. This reaction is very characteristic in the case of carbazol, and may serve as a test. An indigo-coloured precipitate, which rapidly becomes lighter coloured, is formed on adding water to the acid solution.

3. If an acetic acid solution of carbazol and benzoquinone be treated with a little sulphuric acid previously mixed with twice its volume of acetic acid, a deep carmine red solution is produced, from which water precipitates a red to red-violet substance, soluble in ether, chloroform, and alcohol. A neutral aqueous solution of pyrrol behaves similarly when treated with benzoquinone. (V. Meyer and O. Stadler. Ber. 17, 1035. This Journal, 1884, 439.) The author considers the action of benzoquinone to be that of an oxidising agent only, and similar colours precipitated by water are produced by the addition of any oxidising agents to a sulphuric acid solution of carbazol or pyrrol.

4. Picric acid combines with pyrrol to form an unstable compound, which melts at about 71° . The compound of carbazol and picric acid is a characteristic and stable body melting at 186° .—C. A. K.

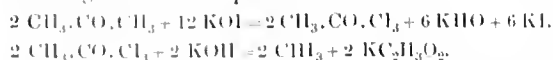
Volumetric Estimation of Acetone in Methyl Alcohol.

J. Messinger. Ber. 21, 3366—3372.

METHYL alcohol which is employed in the manufacture of aniline dyes should contain only a very small quantity of

acetone, and it is therefore important to have some quick and accurate method by which the quantity of acetone can be ascertained.

When acetone is treated with iodine and potash the following reactions take place :—



If a known quantity of iodine be added to an alkaline solution of the methyl alcohol, for every two molecules of acetone present six molecules of iodine (I_2) will enter into combination and form iodoform. If the solution be then acidified the excess of iodine present as potassium iodide and iodate, will be liberated and can be estimated by titrating with sodium thiosulphate.

The analysis is carried out as follows:—20 cc. or, if the sample contains a considerable quantity of acetone, 30 cc. of potash, and 1–2 cc. of the methyl alcohol are shaken together in a stoppered 250 cc. flask, and a known quantity (20–30 cc.) of a $\frac{1}{2}$ -normal iodine solution added. The mixture is shaken until it becomes clear, just acidified with hydrochloric acid, and excess of decinormal sodium thiosulphate solution run in. Starch is then added and the excess of sodium thio-sulphate titrated with the $\frac{1}{2}$ -normal iodine solution.

The potash solution employed is made by dissolving 56 grms. of KOH in one litre of water; the hydrochloric acid is of sp. gr. 1.025, and the volume added should be the same as that of the potash.

If r be the volume (in cc.) of the iodine solution required to combine with the acetone, and u the volume (in cc.) of the methyl alcohol taken, then the quantity of acetone, by weight, in 100 cc. of the sample is equal to

$$r \times 0.1933448$$

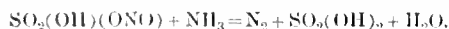
"

A large number of test analyses are given showing the results obtained with prepared solutions of chemically pure methyl alcohol containing from 0.2 to 2 per cent. of acetone and also with aqueous solutions of acetone and samples of commercial methyl alcohol. The results in all cases are very satisfactory.—F. S. K.

Kjeldahl's Method for the Determination of Nitrogen.

G. Lunge. Zeits. f. angew. Chem. 1888, 661–662.

The method proposed by Meldola and Moritz (this Journal 1888, 63–64) for purifying sulphuric acid intended for use in the determination of nitrogen by Kjeldahl's method, is adversely criticised. In the paper referred to, it is assumed that the nitrogenous impurities exist in the form of ammonium sulphate. But it is not always so. It is well known that the most usual impurity in purified sulphuric acid is nitrosylsulphonic acid, and ammonium sulphate is added to prevent injury occurring to the platinum stills during the concentration of such acid. Ammonium sulphate is present in the rectified acid only when a larger quantity has been added than is required in the equation—



But frequently the rectified acid contains nitrous acid. Again, the assumption of Meldola and Moritz that the excess of nitrous acid is driven off by heating, is incorrect. When a nitrite is added to sulphuric acid, nitrosylsulphuric acid is formed, and Lunge has shown (Dingl. Polyt. J. **233**, 155 and 237; Ber. **12**, 1058) that this is a very stable compound. Even after prolonged boiling of a solution of this body in concentrated sulphuric acid, no decomposition takes place, but usually a small quantity of it distils over with the sulphuric acid. This fact has been again verified by a series of experiments, of which the following is an example. Nitrite of soda was dissolved in pure sulphuric acid; a portion tested with permanganate gave the proportion of 0.1928 gm. of HNO_3 in 200 cc. 200 cc. were then taken and boiled for four hours; 80 cc. distilled over. The nitrous acid was estimated and the total quantity added found again :—

	Grm.	HNO_3
In the residue	0.1842	
In the distillate.....	0.0096	"
	0.1938	"

Meldola and Moritz's method of purification can, therefore, only be applied when the quantity of ammonia present has been determined, and the nitrite must not be added in excess, and, in such a case, a correction is more easily made, and the purification entirely dispensed with.—E. B.

On the Estimation of Nitrogen and Phosphoric Acid in Organic Bodies. O. Lunge. Chem. Zeit. **12**, 1587–1588.

In the following method Lunge has made the attempt to employ the solution prepared according to Kjeldahl's method for the estimation of nitrogen, and phosphoric acid as well. He thus aims at simplifying the analysis of such bodies as bone ash. 10 grms. of the substance are transferred to a flask (300–350 cc. capacity), 50 cc. of concentrated sulphuric acid, and 0.5–1 gm. of copper sulphate added. At first the mixture must be heated very carefully, and it should only be raised gradually to the boiling-point, when carbonisation is complete. After two hours' (in exceptional cases, 2½–3 hours) vigorous ebullition, the reaction should be complete, and after the precipitate has subsided, the supernatant liquid should be of a pure, light green tint. When cold the whole is rinsed into a 500 cc. flask, which has been previously half-filled with water. The mixture is then cooled and made up to half a litre.

During ebullition, the flask should occasionally be shaken about in order to wash down the small carbonised particles which adhere to the sides. The dilute solution is filtered and 50 cc. of the filtrate (corresponding to one gm. of the original substance) taken for the phosphoric acid estimation. For this purpose 100 cc. of "Märker's citrate solution" and 25 cc. of magnesia mixture are added, and the whole stirred up till precipitation sets in. The precipitate can be filtered off after a quarter of an hour. "Märker's citrate solution" is prepared as follows: 1,500 grms. of citric acid are dissolved in 3 litres of water and 5 litres of 24 per cent. ammonia, and 7 litres of water added. For the nitrogen estimation, 50 cc. of the filtrate are diluted with water, an excess of soda-lye and a few small pieces of zinc added and the ammonia distilled off. The results obtained by this method are excellent. Very good results were also obtained when 0.5 gm. of mercury was used instead of the copper sulphate; and the destruction of the organic matter took place much more rapidly, being completed in 1 to 1½ hours. The author, however, prefers not to employ mercury, as mercury amido-compounds might be precipitated with the phosphoric acid, and though these compounds would no doubt volatilise when the precipitate is ignited, the escape of the poisonous mercury fumes might have unpleasant consequences. The precipitates obtained both by the mercury and the copper method were perfectly white.—F. W. T. K.

The Testing of Fats. Meeting of the Austrian Society for the Advancement of Chemical Industry. Chem. Zeit. **12**, 1641.

In discussing tests for fats L. Ausserwinhler lays special stress on the determination of the saponification-, acetyl-, and iodine values as means for distinguishing and recognising fats.

E. Lauber has found the physical properties of pure olive oil to vary according to the nature of the ground on which the olives have been grown, the time of their harvest, the method of pressing them, the storing of the oil and the action of light on it. The results obtained with pure olive oils by the elaidin test vary according to the above circumstances.

Nettl agrees with Lauber; F. Storck, on the other hand, holds that with sufficient experience of the physical properties of pure olive oils and of their behaviour when

subjected to the claudin test, the nitric and sulphuric acid tests, and the silver test, these are sufficient to determine the purity of a sample.

W. Gintl points out that olive oil which has been exposed to direct sunlight for about 14 days no longer gives the claudin reaction. Italian olive oil is denaturalised on the frontier with rosemary oil. Colour tests are therefore unsuitable for such oil. Gintl and L. Storek are in favour of the more modern quantitative methods, as these allow of a more objective judgment and are less liable to error.

—F. W. T. K.

Estimation of the Starch in various kinds of Grain, and Valuation of these for the Manufacture of Starch, &c.
H. Schreib. Zeits. f. angew. Chem. 1888, 694—696.

(See under XVI., page 127.)

New Books.

THE FUNDAMENTAL PRINCIPLES OF CHEMISTRY. Practically taught by a New Method. By ROBERT GALLOWAY, M.R.I.A., F.C.S. London: Longmans, Green, & Co. New York: 15, East 16th Street. 1888.

THE author in his Preface finds fault with the ordinary chemical text-books that are in use in schools, and for teaching junior students generally. "Many of these books," says he, "are little more than mere compilations of unclassified facts; hence the reason is not cultivated, and consequently the science is not attained, for unless the first is reached the second is not gained." The text, covering 346 pages and embellished with 71 wood engravings, is divided into chapters, in which the matter is treated progressively, according to the following steps. Chap. I. Matter.—The Physical Properties of Bodies. II. Molecular Attraction.—Heat and Temperature. III. Gravitation.—The Physical Properties of Gases. IV. Ebullition.—Elastic Force of Vapours. V. Density. Specific Gravity. VI. Sublimation.—Solution.—Precipitation. VII. Adhesion.—Capillary Action. VIII. Elements and Compounds.—Chemical Affinity. IX. The Different Classes of Compound Substances. X. General Laws of Chemical Combination. XI. Nomenclature and Notation.—Basic Substances. XII. Acids and Acid Anhydrides. XIII. Salts.—Their Formation and Properties. XIV. The Mode of Expressing Chemical Changes. XV. Combination of Similar Atoms.—Determination of Atomic Weights. A set of exercises with answers is also given. The book is of 8vo. size, bound in cloth.

WATER ANALYSIS. A Practical Treatise on the Examination of Potable Water. By J. ALFRED WANKLYN, M.R.C.S. London: Trubner & Co., Ludgate Hill. Seventh edition. 1889.

As the Preface states, the seventh and present edition of this book contains a large part of the last edition, which reappears without alteration; but the beginning of Part II. is altered by there being two new chapters added, viz., a chapter on Specific Gravity (taking the place of an old chapter on the same subject), and an additional chapter on Carbonic Acid. It is also announced that for the first time, "a real connexion between the specific gravity and the contents of a drinking-water has been experimentally demonstrated." Part III. has been enlarged, and includes a section on the classification of natural waters. There is a section also dealing with the solution of lead by certain kinds of drinking water. The bulk of the book is slightly increased, as may be judged from the foregoing. It is bound in black cloth, is of 8vo. size, and the price is 5s.

Trade Report.

(From the Board of Trade Journal and other sources.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

RUSSIA.—FINLAND.

Tariff Changes.

Note.—Kilogramme = 2·204 lbs. 100 penni = 9½d.

The duty on Chilean saltpetre has been reduced from 90 penni to 20 penni per 100 kilograms.

JAPAN.

Abolition of Export Duties on certain Articles.

An Imperial ordinance has been promulgated abolishing, from the 1st January 1889, the export duty on drugs and certain other articles, and stating that in the event of a re-imposition of the duty, a notice of six months will be given. The following is a list of the articles, as contained in the translation in question:—

Drugs (camphor excepted), prepared medicines, dye-stuffs, colours, glue, isinglass, candles, Japanese ink and similar articles, ink pads, washing-powder, soap, tooth-powder, and blacking, medical and scientific instruments, perfumery, articles for the toilet, asbestos, deposits of thermal springs, cement, flowers and gum of plants and trees, powdered railnuts, spirits, vinegar, oils, and prepared spices.

NEW CUSTOMS TARIFF OF QUEENSLAND.

The following is a statement of the rates of Customs duty now levied under the new tariff, assented to on the 25th October last:—

Classification of Articles.	Rates of Duty now levied.
	£ s. d.
Gunpowder.....	Reputed lb. 0 0 1
Tallow, stearine, and lard	" 0 0 1½
Blue, candles, and glue	" 0 0 2
Mustard, spices, and acetic acid.....	Lb. 0 0 3
Leather (except otherwise enumerated)	" 0 0 4
Bicarbonate of soda and resin.....	Cwt. 0 1 0
Caustic soda	" 0 1 6
Soda crystals	" 0 2 0
Acid, sulphuric	Cwt. 0 2 6
Paints (wet and dry) and lead (white and red) ..	" 0 3 6
Saltpetre	" 0 4 0
Soap.....	" 0 10 0
Cement.....	Barrel 0 2 0
Vegetable oils (in bulk).....	Gallon 0 1 0
Mineral oils and turpentine.....	" 0 0 6
Opium	Lb. 1 0 0
Sugar (refined)	Cwt. 0 6 8
Glucose	" 0 10 0
Perfumed spirits	Liq. gall. 1 0 0
Methylated "	" 0 5 0
Sulphur, nitrate of soda.....	5% ad val.
All other goods	15% ad val.

The following articles are exempt from duty:—

Dye; all explosives, save gunpowder; manure; muntz metal; paper; quicksilver; safety matches; salt; and soda ash.

SWITZERLAND.

Classification of Articles in Customs Tariff.

"Hydroleine" (soda, calcined, mixed with a little soap).—Category 18. Duty, 2 francs per quintal.
 "Poliment" (mixture of alumina, soluble glass, and ground graphite).—Category 30. Duty, 60 cents per quintal.
 "Antipyrine."—Category 60. Duty, 7 francs per quintal.

UNITED STATES.

Customs Decisions.

So-called "hashish," which is not the crude drug known to commerce by that name, but is a preparation of Indian hemp, used medicinally, is dutiable at the rate of 25 per cent. *ad valorem*, under T. I., 93; and so-called "Butyr-cacao," an expressed oil, is dutiable at the same rate, under T. I., 92.

Asbestos, manufactured or unmanufactured, cannot be classified under the provision in the free list, T. I., 754, for "paper stock," inasmuch as the substance is otherwise specially provided for, as follows: when manufactured, under Schedule A. (T. I., 39), and when unmanufactured, under the free list, T. I., 538.

A substance, consisting of a mixture of caustic soda and lime, is held to be dutiable at the rate of 25 per cent. *ad valorem*, under the provision in Schedule A. (T. I., 92), for chemical salts not provided for by name; and certain powdered copper, which is not the "regulus" or black or coarse copper of commerce, but consists of metallic copper reduced, probably by chemical agencies, is held to be dutiable at the rate of 45 per cent. *ad valorem*, under the provision in Schedule C. (T. I., 216), for manufactures of copper.

SOUTH AMERICAN ANIMI RESIN.

It is announced that the Government of the Republic of Colombia, in order to stimulate the production and importation of animi resin from that country, has decided to grant an export bounty of 8 per cent. *ad valorem* on all shipments of the resin. The trade is at present concentrated in the hands of a native firm in the department of Bolivar, where it is found in large quantities deposited in the earth as a product of the *Hydnocarpus Courbaril* and other trees. —*Chemist and Druggist*.

MISCELLANEOUS TRADE NOTICES.

PHOSPHATE OF LIME IN RUSSIA.

The *Engrais* states that there exist in Russia important beds of phosphate of lime, occupying almost the whole area of an immense triangle, the base of which would pass from Odessa to Orenburg. The number of strata, one above the other, varies from three to seven, but for the most part the deposit is a mere vein. The beds are at one place near the surface, in another they are several hundred metres below the ground. The phosphate often takes the form of nodules of very diverse size and colour, but it is also found in slabs, or even in massive blocks. The principal bed in Russia, that of Koursk, forms an immense basin, extending for a length of more than 150 kilometres.

MANUFACTURE OF GLASS IN ITALY.

The *Volks-wirtschaftliche Wochenschrift* for the 3rd January last announces that a company has been formed to establish a manufactory of window and table glass at Milan. The German newspaper adds that the importance of this fact will not escape the notice of exporters in other countries. Hitherto, Italy has almost entirely depended upon foreigners for glasswares, but it is intended to start the new company on such a scale as, if possible, to exclude foreign glass altogether from the Italian market. The technical management of the factory is to be placed in the hands of a Belgian expert. It appears that a capital of a million francs has already been subscribed. An Italian firm in Mannheim is interested in the enterprise.

LOCALITIES IN WHICH MANGANESE OCCURS IN THE UNITED STATES.

While there has been a constant and persistent search for new deposits of manganese during the past year, no new development of any importance has been reported outside of the localities that have been described in the previous volumes of "Mineral Resources." Indeed, some localities regarded as quite promising at the time the report for 1886 was made up have proved to be of little value, and the chief production is still confined to the localities that have been noted as manganese producers for many years. The extensions of the iron-ore regions in the Lake Superior district, in which it was hoped deposits of manganese ores might be found, have so far produced only insignificant quantities of an ore with more than 44 per cent. of metallic manganese, the chief product being a manganoferous iron ore containing from 4 to 10 per cent. There are somewhat encouraging prospects of the discovery of manganese

ore in North Carolina and also in Western Arkansas. Yet it is still true that Crimora (Virginia), Cartersville (Georgia), and Batesville (Arkansas), furnish practically all the manganese ores mined in the United States. —*J. D. Weeks*.

THE MANUFACTURE OF SPIEGELEISEN.

During the past few months the North Chicago Rolling-mill Company have been making spiegeleisen at one of their furnaces. They have been turning out about 600 tons a week. The ores used come from Batesville, Ark., and it is thought that the company will soon be able to obtain it in sufficient quantities to supply them with all the spiegeleisen they will require at their entire works. Heretofore, this metal has been imported from England and Germany, and the company have bought annually as much as 20,000 or 25,000 tons. That which has just been made at the North Chicago furnace is what is known as 50 per cent. manganese metal. A small quantity of spiegeleisen has been made heretofore in some of the Western furnaces, but it was of an experimental character. This is believed to be the first case where this metal has been manufactured in paying quantities in the Western States.

—*The Ironmonger*.

THE SMYRNA CHEMICAL INDUSTRY.

A correspondent calls attention in a foreign contemporary to the possibility of working up an export trade from Asia Minor in the many medicinal drugs which are indigenous in the country, but are at present exported to a comparatively small extent only. Herbs suitable for liquor-manufacture are especially abundant in the country. One of the liquorice-juice works in Asia Minor, owned by a Swiss, and said to have been very well appointed, has ceased working. —*Chemist and Druggist*.

BOGUS REPRESENTATIVES IN ROMANIA.

The existence throughout Roumania, but especially in Bucharest, of an exceptionally numerous fraternity of long firms and bogus agents has hitherto rendered business with that Danube State extremely risky. Some improvement is likely to be effected in this respect by a law which compels all agents of foreign manufacturers and traders to deposit with the Bucharest Chamber of Commerce a declaration by their principals, legalised before a Roumanian notary public, to the effect that the agent named therein is the sole representative of his principals for the whole or part of the country, that he has the right to act in all commercial matters on their behalf, to represent them in courts of justice, and to collect accounts in their name. After the deposition of this deed with the Chamber of Commerce, the agent receives from that body a licence permitting him to act as the representative of his principals. The law came into operation on January 1. —*Chemist and Druggist*.

THE DECIMAL ASSOCIATION.

An association has been formed under this title for the purpose of promoting the adoption in this country of a decimal system for currency and for weights and measures. The association does not take upon itself to recommend the adoption of any particular unit of currency, but it will press for the adoption by the Government of a decimal system of coinage. It is thought that the Government is favourably disposed to the object of the association, which is well supported by members of both Houses of Parliament and other influential persons. The association's offices are at Botolph House, Eastcheap, E.C., and members' subscriptions range from 10s. per annum upwards. During the last session a memorial signed by one hundred and fourteen members of the House of Commons, most of them connected with manufacturing and trading interests, was presented to the Chancellor of the Exchequer to urge upon him the importance of the adoption of a decimal system of coinage and weights and measures. —*Chemist and Druggist*.

REPORT ON MANURE MANUFACTURE. DR. W. COHN.

Chem. Indust. Oct. 1888, 429—431.

The introduction of powdered Thomas-slag has had a considerable effect on all manfactories which produced phosphatic manures, and many of them have now erected plant for grinding the slag. If the demand for the above article continues as active as it has been, and of this there appears to be a good prospect, the extra outlay in plant will not be misplaced. Crude slag and considerable quantities of powdered slag are imported from England, but these usually contain a smaller percentage of phosphorus pentoxide than the slags obtained in Germany. Cohn offers no opinion as to whether the Thomas-slag exported from England represents a surplus left after all possible demand for home supply has been satisfied, or whether the conservative feeling in England hinders the employment of Thomas-slag in favour of super-phosphates and bone-flour. He points out, however, that the moist climate of Britain should be very favourable towards the employment of Thomas-slag, if the latter really possesses all the advantages which several German experimental stations claim for it. For the purpose of grinding the slag, specially constructed ball-mills have come into use during the last few years which are said to be a great improvement.

Bone-flour is now being imported into Germany not only from Austria, France, Russia, and America, but also from India; and Russian shipments are now coming in fairly large quantity from Odessa as well as from the Baltic ports.

Amongst artificial manures may be included preparations which by being added to stable manure preserve its constituents from dissipation, and themselves supply valuable manurial constituents.

Finely-powdered manure gypsum has long been used for this purpose, and during the last few years potash salts have also been used, although the latter are liable to produce inflammation of the hoofs of the cattle if they are not carefully strewn about the stable.

Calcium sulphite has been introduced for the same purpose, but is no better than gypsum, and may be worse on account of retarding the oxidation of the manure.

Superphosphate of lime is another substance which has been employed for the preservation of manures. It is the mud retained in the filter-presses of certain phosphate factories which work with phosphates of lime containing only a small percentage of phosphoric acid. It consists of gypsum and acid calcium phosphate. This substance appears to be a good one for the purpose. No doubt a mixture of gypsum and superphosphate would do as well. In the latter case the farmer would have greater ease in regulating the quantity of phosphoric acid he wishes to have in his manure. Eventually his choice will probably be regulated by the ease with which he can obtain the superphosphate gypsum or the separate constituents.

The mixture of superphosphate and Chili saltpetre, which is principally used in spring, has been objected to on the ground that the latter is easily decomposed when thus mixed, and that loss of nitrogen is thus entailed. Experiment has, however, shown that this is only the case when badly prepared superphosphate is used containing much free sulphuric acid.

The employment of the new manure, potassium phosphate (30 per cent. of potash, 40 per cent. of phosphoric acid), is said to have yielded very good results. The unsatisfactory results often obtained with potash salts is due, according to Adolf Mayer, to the high percentage of chlorides and sulphates in them. Still the consumption of potash salts has increased, for though the employment of the potash manures manufactured in the Stassfurt factories has decreased, the use of kainite and carnallite has increased considerably. These latter salts are principally used, mixed with Thomas-phosphate powder. It is more especially the use of carnallite which has increased, for although this contains only three-quarters of the quantity of potash present in kainite, it is half as cheap again.

The production and consumption, too, of ammonium sulphate is increasing. The experiments ordered by the Minister of Rural Economy are not yet complete, but so far as they have gone they show that in the case of ammonium sulphate more than in that of any other manuring agent, the action depends on the physical and chemical nature of the soil.

Manuring substances have as a rule become cheaper, and their consumption has increased. The benefits to be derived by their use seem to be becoming more and more recognised.—F. W. T. K.

SULPHUR PRODUCTION IN SARDINIA.

Chem. Zeit. 12, 1659.

The yield of the sulphur mines in Northern Italy was only 21,663 tons in 1887, as against 23,274 tons in 1886.

The decrease is partly due to the diminished yield of the Boratella pits, which have been partly worked out, and to the collapse of the Cesena Sulphur Company, Limited, which has pretty well exhausted the basin of the Romagna. The company has spent large sums in the search for new places of production, and in the attempt to work further those commenced by its predecessors, but without avail; and after a few years the company saw itself confined to the pits at Boratella. The production of the company of the Romagna shows a slight increase. The Monteverchie shaft, which belongs to this company, is not yet complete.

Permanent progress is noticeable in the provinces of Pesaro and Urbino. The new shaft in the mine of San Lorenzo in Zolinelli, has increased the daily yield of the latter to 200 tons of ore. The loss of work in the Boratella mines has caused many of the workmen to turn again to the old Casalbano mines, which they work in small gangs. The yield has so far only been moderate.

The treatment of the crude sulphur has undergone little modification. A new refinery with three ovens and 34 refining kilns has been erected at Porto Corsini, near Ravenna. It turns out 6,000 tons a year. In 1887 the various refineries have produced 24,000 tons of ground sulphur, an increase of 3,516 tons over last year. The exact quantity of finely-ground sulphur produced is not known, but it probably represents $\frac{1}{3}$ of the total refined sulphur. The Albani Pit Company produces special preparations, and to meet the increased demand, especially for their acid sulphur, has induced them to enlarge their new mill at Fano. During the last wine season the Pesaro manufactory turned out 9,500 tons of acid sulphur containing 0.22 per cent. of sulphuric acid, and 1,105 tons sulphur containing between 1 and 8 per cent. of copper sulphate.

The presence of the above quantity of sulphuric acid has been found the most suitable in the treatment of the vine disease. This acid is not added, as is done in some parts of Italy, but is a natural adjunct of the preparation. Artificial acidification does not yet appear to have been introduced in the factories.

Though almost the whole production was disposed of during the wine season, prices have been kept low by Sicilian competition.

The average price per centner for the year has been:—

	Fr.
Crude sulphur.....	8.75
Refined in loaves.....	10.40
Sulphur in sticks.....	13.00
Coarsely powdered.....	13.10
Sublimed.....	14.50
Acidified powdered.....	17.65
Powdered and containing copper...	21.50
Flowers of sulphur, washed.....	35.00

The following are the statistics for 1887:—

Province.	Number of Pits in Work.	Quantity of Crude Sulphur.	Total Value.	Number of Workmen.		
				Grown up.	Under 15 Years.	Total.
Anicene.....	1	Tons, 34	Fr. 2,680	96	..	96
Porti.....	10	13,026	1,095,006	1,231	7	1,238
Pesaro and Urbino.....	5	8,603	668,269	1,304	48	1,352
Totals.....	16	21,663	1,765,955	2,631	55	2,686

—F. W. T. K.

THE SALT DEPOSITS OF NEW-YORK.

In our issue of November 10th, 1888, we mentioned that the persevering efforts of Mr. W. B. Cogswell, of the Solvay Process Company, had resulted in the discovery of a bed of rock-salt about 17 miles south of Syracuse, and that other wells were being sunk to reach the salt at other points where it comes nearer the surface of the ground. We now have an interesting report by Dr. T. E. Englehardt on behalf of the State, detailing the results obtained by the sinking of 63 deep wells in the central and western counties of the State. Few of these were sunk with the expectation or the object of finding salt, most of the work being done in prospecting for oil or gas, but in only seven of them was there a failure to meet with rock-salt or brine.

In the case of the Solvay Company's well, the bed of salt was reached by the drill after passing through 40 feet of Marcellus shale, at a depth of 678 feet, 150 feet of carboniferous limestone, 50 feet of "water lime," and 300 feet of Helderberg rock, making a total depth of 1,218 feet, and here it has a thickness of 47 feet.

This was considered satisfactory and at a workable depth, but the thickness of this bed, we learn from Dr. Englehardt's report, was far below that previously discovered some two or three years ago in sinking for gas at Ithaca, about a mile from the grounds of Cornell University, where the drill encountered the first layer of salt at a depth of 2,244 feet, and in the succeeding 470 feet the aggregate of salt layers amounted to 248 feet, the thickest being 54 feet, and being only separated by a layer of shale, 6 feet thick, from one of salt above of 24 feet, and by another layer of shale below, 12 feet thick, from 17 feet of salt, making a total thickness of 95 feet of salt in one part of the stratum, with 18 feet of shale interposed.

The great depth at which the salt is met with in most instances deprives it of the value it would otherwise have, the least distance from the surface being 710 feet; but it is expected that this, and even the 1,200-foot well of the Solvay Company, can be profitably utilised in the same manner, and under conditions similar to the rock-salt beds in the Durham salt district in England, where, by pumping fresh water into the wells, a strong brine is procured which can be evaporated on the spot, or piped, as would be the case in this instance, to the Solvay Works, near Syracuse.

All but 10 of the wells mentioned in the report have been sunk to below the level of the sea, the depths below sea level being from 259 to 1,818 feet.

The exact return from the 63 wells reported upon is as follows: Brine was met with in 14, two of which are useless for salt-making in consequence of the bitterness imparted by other mineral salts; rock-salt met with in 42, varying in thickness from $3\frac{1}{2}$ to 248 feet, and as we have already mentioned, neither salt nor brine in seven cases, although in some of these last cases the sinking was persevered with as far as 2,000 feet. The average thickness of salt may be taken to range between 40 and 80 feet, and with the exception of the one instance in which there is only $3\frac{1}{2}$ feet, there is none with less than 12 feet.—*Engineering and Mining Journal*.

A VALUABLE BLUE REDISCOVERED.

Professor Fouqué, of the College de France, at the last meeting of the Academy of Sciences (February 18) read an important memoir on the blue pigment used by the ancient Romans for wall decorations. It is a magnificent colour, as bright to-day as when first applied, and is found in the fresco paintings of Pompeii and other monuments dating from the Roman period. Its production is one of the lost arts, as there is no record of the pigment being used after the invasion of the Barbarians. Modern chemists have more than once tried to ascertain the nature of the compound, but beyond the point that it contains copper nothing definite was discovered. M. Fouqué thinks the lack of success is owing to the fact that the ancients followed no exact rules or proportions. Having secured comparatively copious specimens of the coreuleum—such is the old name of the pigment—he has succeeded not only in analysing it, but also in finding a process for making it regularly in quantities. The compound is, according to M. Fouqué, a quadruple silicate of copper and lime, which may be prepared with silica, oxide of copper, and lime, with or without any fluxes. The ancients simply made it with sand, calcined or roasted copper, and lime, but kept to no regular proportions. He worked differently, and managed to obtain an exact chemical combination, which is neither

a glass nor an enamel, but a crystalline substance of the composition already mentioned. The crystals are perfectly definite, and strongly dichroic appearing deep sky-blue when viewed from the surface, and pale rose edgewise. The only difficulty in the preparation is the heating. A bright red heat is necessary to effect the combination, but on heating too much the blue colour is lost and an aventurine green glass is obtained, a circumstance which must have rendered the process a delicate one in old times. Nowadays, however, with the means at our disposal, the difficulty is trifling, and kilns, of the corallum could easily be made in the College de France laboratory. It is a very stable pigment, so far as chemicals are concerned, as it stands, unaffected, boiling with sulphuric acid or potash lye, as well as quicklime and hydrogen sulphide. That it will be air and water proof is abundantly shown by the old fresco paintings. M. Fouque considers, therefore, it would be a great boon to the arts to produce the blue commercially, and promised his assistance to any French manufacturer who will undertake the fabrication. While examining the fine specimens of the rediscovered blue presented by M. Fouque, M. Berthelot, who is well versed in ancient chemical lore, remarked the corallum in question was no doubt the Alexandria blue, known in Egypt about the beginning of the Christian era, and taken to Pozzuoli, whence its use spread all through Italy. He agreed with M. Fouque that the pigment was unknown to the Assyrians and ancient Egyptians, and is no doubt a most valuable one.—*Chemist and Druggist*, 25th February 1889.

OFFICIAL REPORTS.

THE WORKING OF THE MERCHANDISE MARKS ACT.

See Board of Trade Journal for February, p. 204.

THE PHOSPHATE MINING INDUSTRY OF SOUTH CAROLINA.

The annual report of the Agricultural Department gives some interesting figures with regard to the phosphate mining in South Carolina, which in its way is nearly as curious as the amber mining, or rather fishing, in the Baltic, as a large proportion of the phosphate rock is obtained by dredging in the rivers of the State. The river companies, as they are called, and private firms which secure their product by dredging, pay a royalty of 1 dol. a ton to the State for the privilege of extracting phosphate rock below water, and in this way the State receives a considerable revenue, the amount paid in the year ending August 31st, 1888, being 186,993 dols.

This rock, recovered from the beds of the rivers and marshes, is the hardest and best quality of phosphate, and fetches the highest price in the market, and up to the present time has been almost exclusively shipped and sold in Europe. In the past year, out of a total production of 190,274 gross tons, only 29,381 tons were used in the United States, the balance being shipped abroad. The higher freights ruling since the middle of the past year has had an unfavourable influence upon this branch of the industry, the production showing a falling off of more than 20,000 tons, and the shipments in June, July, August, and September of 1888 being only 40,326 tons, against 83,106 in the corresponding period in 1887.

This drawback to the industry cannot, apparently, be remedied by any great economies in the production, and the price cannot be advanced in Europe with any benefit, as, with a slight improvement in that direction, Belgian, Spanish, and other phosphates come into competition with the American supply and shut out the demand, so that the only relief to be looked for is a reduction of freights. The preference of the American manufacturers of fertilisers for the land rock does not seem to be based so much on the price as the hardness of the river rock, which they claim costs 75 cents to 1 dol. more in grinding. During the year 1888 the production of land rock was 259,330 long tons, of which only 3,650 tons were shipped abroad, while 60,000 tons were used in South Carolina, and the balance of 195,680 tons was manufactured in other parts of the country.

The land miners work in combination as to prices and periods of contracts, with very few and insignificant exceptions, and in this way are enabled to maintain a profitable return for their labour; but we are under the impression that, if the objection of the American manufacturers to the hard rock could be overcome, some of the more important of the river companies, which are most favourably situated for production, would be ready to sell phosphate at prices below that of the land rock combination. From the Geological Survey report we learn that the production for the year 1887 was 480,558 long tons, showing an increase of over 50,000 over the previous year, but from the more recent figures that we have given for the year 1888 the production of the past year is not likely to exceed that of 1886. The report of the Geological Survey criticises the method of using phosphate rock, and points out that, owing to the expensive treatment it receives, although a ton of Carolina phosphate costs only 6 dols., the price of the manufactured product is about 30 dols. a ton at the factory. That much of this costly treatment might be saved, and the fertiliser sold at a much lower price, is probable, and we hope will be brought about.—*Engineering and Mining Journal*.

STATISTICS.

LEADING IMPORTS IN JANUARY.

Amongst the principal imports during January were the following, which are compared with those during the same month of 1888, and also with those of December 1888:—

Article.		Month of January 1889.	Month of January 1888.	Month of December 1888.
Brimstone	Cwt.	29,666	29,226	31,313
Caoutchouc.....	"	22,579	21,415	23,473
Copper, ore	Tons	18,358	5,464	12,113
" regulus, &c. .	"	6,918	9,872	11,886
" unwrought ..	"	3,917	3,898	2,986
Glass, all sorts.	Cwt.	152,047	141,522	182,560
Gutta-percha	"	2,399	1,725	1,108
Iron, ore.....	Tons	323,945	344,134	264,552
" bar	"	5,380	5,125	10,761
" girders, beams, and pillars...	"	6,251	4,632	5,200
" manufactures, unenumerated	Cwt.	254,181	186,590	324,874
Steel, unwrought	Tons	608	506	1,949
Lead, pig and sheet ..	"	12,997	11,586	8,443
Petroleum, all	Gall.	6,227,762	9,181,390	11,010,431
Pyrites, iron, copper, and sulphur	Tons	89,264	60,542	49,592
Quicksilver.....	Lbs.	543,925	857,964	503,986
Salt-petre	Cwt.	37,833	32,702	39,014
Tallow and stearine..	"	96,682	103,696	83,119
Tar.....	Brls.	2,321	689	5,926
Teeth, elephants', &c.	Cwt.	1,481	1,464	1,011
Tin, all sorts.....	"	58,917	52,539	66,493
Zinc, crude cakes	Tons	4,369	5,060	6,258
" manufactured ..	Cwt.	39,406	26,123	38,089

—*Ironmonger*.

THE TRADE OF PERSIAN GULF PORTS.

The following articles pertaining to the drug trade were imported into and exported from the two Persian Gulf ports, Bushire and Banderabass, in 1887:—

	Bushire.	Banderabass.
IMPORTS.	Dollars.	Dollars.
Drugs and medicines	37,000	4,445
Dyeing materials	2,200	..
Glass and glassware	37,000	..
Indigo	200,000	111,060
Spices	55,504	37,000
EXPORTS.		
Drugs	14,815	22,000
Dyeing materials	22,000	111,060
Gums	22,000	15,000
Opium	1,777,000	880,000
Seeds (cumin, &c.)	20,000	18,000
Rose water	44,500	..

—*Chemist and Druggist*.

PROGRESS OF THE BASIC OR THOMAS-GILCHRIST PROCESS DURING THE TWELVE MONTHS ENDING 31ST DECEMBER 1888.

The total make of steel and ingot iron from phosphoric pig during this period amounts to 1,953,234 tons, being an increase over the make for the previous 12 months of about 218,753 tons, and making the total production of basic steel to this date 8,570,000 tons.

It will be noticed that of the above-mentioned make of 1,953,234 tons, no fewer than 1,495,032 tons were ingot iron containing under 0.17 per cent. of carbon.

The makes of the various countries for the 12 months ending 31st October 1887, and 31st December 1888, respectively, are as follows:—

	1887.		1888.	
	Total.	With under 0.17 Per Cent. Carbon.	Total.	With under 0.17 Per Cent. Carbon.
England.....	Tons. 364,526	233,358	Tons. 493,594	276,476
Germany, Luxemburg, and Austria.....	1,102,496	826,609	1,276,070	1,026,033
France.....	176,500	123,049	222,533	158,223
Belgium and other countries.....	60,959	39,716	46,237	32,300
Totals.....	1,704,481	1,222,732	1,953,234	1,495,032

With this 1,953,234 tons of basic steel were produced some 600,000 tons of slag (containing about 36 per cent. of phosphate of lime), most of which was used as a fertiliser.

RUSSIA.

Customs Receipts from Chemicals, &c.

Value expressed in thousands of gold roubles.

	Chemicals, Colours, &c.	Olive Oil.	Coal and Coke.
1885	1,662	1,445	2,386
1886	1,833	1,486	2,008
1887	1,847	1,542	1,523

GERMANY.

Trade Returns.

Imports and exports from January 1st to November 30th, 1888, compared with corresponding period of 1887.

	Imports.		Exports.	
	1888.	1887.	1888.	1887.
Coke.....	100 Kilos. 2,468,676	100 Kilos. 2,114,940	100 Kilos. 8,272,333	100 Kilos. 6,610,813
Coal.....	28,885,595	24,420,612	85,238,855	79,710,818
Copper.....	74,867	116,327	58,319	41,828
Lead.....	68,799	65,545	218,112	353,593
Zinc.....	59,772	41,929	530,459	582,760
Dyewoods.....	610,570	561,035	91,595	84,875
Chili Saltpetre..	2,454,424	1,826,818	69,305	41,627
Salt.....	248,571	244,058	1,128,214	1,280,953

BOARD OF TRADE RETURNS.

Imports.

	Compared with January 1888.		
	Total.	Increase.	Decrease.
Animals living.....	£ 469,736	£ 45,774	£ ..
Articles of food and drink (duty free).....	11,263,681	880,716	..
Articles of food and drink (dutiable).....	2,435,901	275,796	..
Metals.....	2,157,316	93,765	..
Chemicals.....	942,914	..	35,980
Raw materials for textile manufacturers.....	11,110,512	612,539	..
Raw materials for other industries.....	2,760,078	631,260	..
Manufactured articles.....	4,675,107	498,720	..
Miscellaneous articles.....	2,271,429	220,194	..
	38,025,774	3,258,766	35,980
		35,980	
Net increase.....		3,222,786	

Exports.

	Compared with January 1888.		
	Total.	Increase.	Decrease.
Articles of food and drink...	£ 770,316	£ 50,332	£ ..
Raw materials.....	1,281,108	362,853	..
Cotton manufactures.....	5,239,959	127,964	..
Linen manufactures.....	593,338	49,013	..
Woollen and worsted manufactures.....	2,194,963	199,308	..
Metals and ironwork.....	3,056,923	85,238	..
Machinery and millwork....	1,112,981	276,090	..
Articles of personal use.....	1,083,689	214,336	..
All other articles.....	5,136,064	530,536	..
	20,479,341	1,895,670	..

RAILWAY AND CANAL TRAFFIC ACT, 1888.

THE NEW RAILWAY CLASSIFICATION AND REVISED RATES AND CHARGES.

(From the "Ironmonger," Feb. 16th, 1889.)

On Saturday, February 9th, being the last day under the Railway and Canal Traffic Act, 1888, the whole of the railway companies deposited with the Board of Trade their proposed new classification, together with their revised schedules of rates and charges. For the sake of comparison and general convenience we have dealt with the chief companies in the following manner, which will enable those who are interested to gather the information they require in a ready and certain manner.

PROPOSED MAXIMUM RATES AND CHARGES.
PART I.—GOODS AND MINERALS IN RESPECT OF MERCHANDISE IN CLASS A.

Name of Railway Company.	Proposed Maximum Rates for Conveyance.				Proposed Station Terminal at each End.		Proposed Service Terminal at each End.	
	For the first 10 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the remainder of the Distance.	At large Towns, as defined.	At any other Station.	At large Towns, as defined.	At any other Station.
	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>
London and North-Western (<i>see special Table</i>)	..	..	..	..	..	..	..	..
Great Western	1½	1½	0½	0½	0 8	..	0 6	..
Great Northern	1½	1½	0½	0½	0 8	0 6	..	..
London and South-Western	2	1½	..	1	0 8	0 6	..	..
London, Brighton, and South Coast	2	1½	..	1	0 8	0 6	..	..
South-Eastern	2	1½	..	1	0 8	0 6	..	..
Furness Railway	2½	1½	0½	0½	..	0 6	..	..
Lancashire and Yorkshire (<i>see special Table</i>)	..	..	..	..	..	..	..	..
Manchester, Sheffield, and Lincolnshire	1½	1½	0½	0½	0 8	0 6	..	..
North British	2½	1½	1	0½	0 8	0 6	..	..
North-Eastern	2	1	..	0½	0 6	0 6	..	..
Midland	1½	1½	½	½	0 8	0 6	..	..
c Glasgow and South-Western	2½	1½	1	0½	0 8	0 6	..	..
Great Eastern	1½	1	0½	0½	0 8	0 6	..	..
London, Chatham, and Dover	2	1½	..	1	0 8	0 6	..	..
d Caledonian	2½	1½	1	0½	0 8	0 6	..	..

c and *d*. The second column is for the "next 10 miles," &c.
These are special rates over portions of the above lines for which the original paper must be consulted.

GOODS AND MINERALS IN CLASS B.

Name of Railway Company.	Proposed Maximum Rates for Conveyance.				Proposed Station Terminal at each End.		Proposed Service Terminal at each End.	
	For the first 10 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the remainder of the Distance.	At large Towns, as defined.	At any other Station.	At large Towns, as defined.	At any other Station.
	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>
* London and North-Western	2	1½	1½	1	1 0	0 9	..	..
Great Western	2	1½	1	0½	0 8	0 6	..	..
Great Northern	2	1½	1	0½	0 8	0 6	..	..
London and South-Western	2	1½	..	1½	0 8	0 6	..	..
London, Brighton, and South Coast	2	1½	..	1½	0 8	0 6	..	..
a South-Eastern	2	1½	..	1½	0 8	0 6	..	..
Furness Railway	2½	1½	1	0½	0 9	0 9	..	..
Manchester, Sheffield, and Lincolnshire	2	1½	1½	0½	1 0	0 9	..	..
c Glasgow and South-Western	2½	1½	1	0½	1 0	0 9	..	..
North British	2½	1½	1	0½	1 0	0 9	..	..
North-Eastern	2	1½	..	1	0 9	0 9	..	..
Midland	2	1½	1	0½	1 0	0 9	..	..
Great Eastern	2	1½	1	0½	1 0	0 9	..	..
London, Chatham, and Dover	2	1½	..	1½	1 0	0 9	..	..
d Caledonian	2½	1½	1	0½	1 0	0 9	..	..

* In the case of this company the first column refers to the "first 20 miles," &c.
a, Canterbury and Whitstable Railway, 3d. per ton per mile, with the same terminals as South-Eastern Railway, also 1d. 6d. for Junction, &c. and *d*. The second column is for the "next 10 miles."

GOODS AND MINERALS IN CLASS C.

Name of Railway Company.	Proposed Maximum Rates for Conveyance.				Proposed Maximum Station Terminal at each End.		Proposed Maximum Service Terminal at each End.	
	For the first 10 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the remainder of the Distance.	At large Towns, as defined.	At any other Station.	At large Towns, as defined.	At any other Station.
	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>
*London and North-Western.....	2½	2	1½	1½	1 3	1 0	0 9	0 6
Great Western.....	2½	2	1½	1	1 3	1 0	0 9	0 6
Great Northern.....	2½	2	1½	1	1 3	1 0	0 9	0 6
London and South-Western.....	2½	2	..	1½	1 3	1 0	0 9	0 6
London, Brighton, and South Coast.....	2½	2	..	1½	1 3	1 0	0 9	0 6
<i>a</i> South-Eastern.....	2½	2	..	1½	1 3	1 0	0 9	0 6
Furness Railway.....	3	2	1½	1	1 0	1 0	0 6	0 6
<i>b</i> Lancashire and Yorkshire.....	2½	2	..	1	1 3	1 0	0 9	0 6
Manchester, Sheffield, and Lincolnshire.....	2½	2	1½	1	1 3	1 0	0 9	0 6
North British.....	3	2½	2	1½	1 3	1 0	0 9	0 6
North-Eastern.....	2½	1½	..	1½	1 0	1 0	0 6	0 6
Midland.....	2½	2	1½	1	1 3	1 0	0 9	0 6
<i>c</i> Glasgow and South-Western.....	3	2½	2	1½	1 3	1 0	0 9	0 6
Great Eastern.....	2½	2	1½	1	1 3	1 0	0 9	0 6
London, Chatham, and Dover.....	2½	2	..	1½	1 3	1 0	0 9	0 6
<i>d</i> Caledonian.....	3	2½	2	1½	1 3	1 0	0 9	0 6

* The first column in the case of this company is for the "first 20 miles," &c. *b.* The first column is for the "first 20 miles," &c.
a. Canterbury and Whitstable Railway, 3½*d.* per ton per mile, with South-Eastern Railway terminals; also Blackfriars Junction (560 yards long), 2½*d.* per ton and terminals.
c. and *d.* The second column is for the "next 10 miles," &c.

GOODS AND MINERALS IN CLASS I.

Name of Railway Company.	Maximum Rates for Conveyance.				Maximum Station Terminal at each End.		Maximum Service Terminal at each End.	
	For the first 10 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the remainder of the Distance.	At large Towns, as defined.	At any other Station.	At large Towns, as defined.	At any other Station.
	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>
*London and North-Western.....	3	2½	2	1½	2 0	1 6	1 6	1 0
Great Western.....	3	2½	2	1½	2 0	1 6	1 6	1 0
Great Northern.....	3	2½	1½	1½	2 0	1 6	1 6	1 9
London and South-Western.....	3	2½	..	2½	2 0	1 6	1 6	1 0
London, Brighton, and South Coast.....	3	2½	..	2½	2 0	1 6	1 6	1 0
<i>a</i> South-Eastern.....	3	2½	..	2½	2 0	1 6	1 6	1 0
Furness Railway.....	3½	2½	1½	1½	1 6	1 6	1 0	1 0
<i>b</i> Lancashire and Yorkshire.....	3	2½	..	2	2 0	1 6	1 6	1 0
Manchester, Sheffield, and Lincolnshire.....	3	2½	2	1½	2 0	1 6	1 6	1 0
North British.....	3½	3	2½	2	2 0	1 6	1 6	1 0
North-Eastern.....	3	2½	..	1½	1 6	1 6	1 0	1 0
<i>c</i> Glasgow and South-Western.....	3½	3	2½	2	2 0	1 6	1 6	1 0
Midland.....	3	2½	1½	1½	2 0	1 6	1 6	1 0
Great Eastern.....	3	2½	1½	1½	2 0	1 6	1 6	1 0
London, Chatham, and Dover.....	3	2½	..	2½	2 0	1 6	1 6	1 0
<i>d</i> Caledonian.....	3½	3	2½	2	2 0	1 6	1 6	1 0

* The first column is for the "first 20 miles," &c. *b.* The first column is for the "first 20 miles," &c.
a. Canterbury and Whitstable Railway, 1½*d.* per ton per mile and South-Eastern Railway terminals; also Blackfriars Junction, 3½*d.* per ton per mile, with South-Eastern Railway terminals.
c. and *d.* The second column is for the "next 10 miles," &c.

GOODS AND MINERALS IN CLASS 2.

Name of Railway Company.	Maximum Rates for Conveyance.				Maximum Station Terminal at each End.		Maximum Service Terminal at each End.	
	For the first 10 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the remainder of the Distance.	At large Towns, as defined.	At any other Station.	At large Towns, as defined.	At any other Station.
	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>
*London and North-Western	3½	2½	2½	2	2 0	1 6	1 9	1 3
Great Western	3½	3	2½	2	2 0	1 6	1 9	1 3
Great Northern	3½	2½	2	1½	2 0	1 6	1 9	1 3
London and South-Western	3½	3	..	2½	2 0	1 6	1 9	1 3
London, Brighton, and South Coast	3½	3	..	2½	2 0	1 6	1 9	1 3
aSouth-Eastern	3½	3	..	2½	2 0	1 6	1 9	1 3
Furness Railway	3½	2½	1½	1½	1 6	1 6	1 3	1 3
bLancashire and Yorkshire	3½	2½	..	2½	2 0	1 6	1 9	1 3
Manchester, Sheffield, and Lincolnshire	3½	2½	2½	1½	2 0	1 6	1 9	1 3
North British	3½	3½	2½	2½	2 0	1 6	1 9	1 3
North-Eastern	3½	2½	..	1½	1 6	1 6	1 3	1 3
cGlasgow and South-Western	3½	3½	2½	2½	2 0	1 6	1 9	1 3
Midland	3½	2½	2	1½	2 0	1 6	1 9	1 3
Great Eastern	3½	2½	2	1½	2 0	1 6	1 9	1 3
London, Chatham, and Dover	3½	3	..	2½	2 0	1 6	1 9	1 3
dCaledonian	3½	3½	2½	2½	2 0	1 6	1 9	1 3

* The first column is for the "first 20 miles," &c.

b. The first column is for the "first 20 miles," &c.

a. Canterbury and Whitstable Railway, 5½d. per ton per mile, with South-Eastern Railway terminals; also Blackfriars Junction, 3½d. per ton with terminals.

c and d. The second column is for the "next 10 miles," &c.

GOODS AND MINERALS IN CLASS 3.

Name of Railway Company.	Maximum Charges for Conveyance.				Maximum Station Terminal at each End.		Maximum Service Terminal at each End.	
	For the first 10 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the remainder of the Distance.	At large Towns, as defined.	At any other Station.	At large Towns, as defined.	At any other Station.
	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton per Mile. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>
*London and North-Western	3½	3½	3	2½	2 0	1 6	2 0	1 6
Great Western	4	3½	3	2½	2 0	1 6	2 0	1 6
Great Northern	3½	2½	2½	1½	2 0	1 6	2 0	1 6
London and South-Western	4	3½	..	3½	2 0	1 6	2 0	1 6
London, Brighton, and South Coast	4	3½	..	3½	2 0	1 6	2 0	1 6
aSouth-Eastern	4	3½	..	3½	2 0	1 6	2 0	1 6
Furness Railway	3½	2½	2	1½	1 6	1 6	1 6	1 6
bLancashire and Yorkshire	3½	3½	..	3	2 0	1 6	2 0	1 6
Manchester, Sheffield, and Lincolnshire	3½	3	2½	2	2 0	1 6	2 0	1 6
North British	3½	3½	2½	2½	2 0	1 6	2 0	1 6
North-Eastern	3½	3	..	2½	1 6	1 6	1 6	1 6
cGlasgow and South-Western	3½	3½	2½	2½	2 0	1 6	2 0	1 6
Midland	3½	2½	2½	1½	2 0	1 6	2 0	1 6
Great Eastern	3½	2½	2½	1½	2 0	1 6	2 0	1 6
London, Chatham, and Dover	4	3½	..	3½	2 0	1 6	2 0	1 6
dCaledonian	3½	3½	2½	2½	2 0	1 6	2 0	1 6

* and b. The first column is for the "first 20 miles," &c.

c and d. The second column is for the "next 10 miles," &c.

a. Canterbury and Whitstable Railway, 6½d. per ton per mile; Blackfriars Junction, 1½d. per ton, in both cases with above terminals.

GOODS AND MINERALS IN CLASS 4.

Name of Railway Company.	Maximum Rates for Conveyance.				Maximum Station Terminals at each End.		Maximum Service Terminals at each End.	
	For the first 10 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the remainder of the Distance.	At large Towns, as defined.	At any other Station.	At large Towns, as defined.	At any other Station.
	Per Ton per Mile. <i>d.</i>	Per Ton per Mile. <i>d.</i>	Per Ton per Mile. <i>d.</i>	Per Ton per Mile. <i>d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>
*London and North-Western.....	4	3½	3½	3	2 0	1 6	2 9	2 0
Great Western.....	4½	4	3	3	2 0	1 6	2 9	2 0
Great Northern.....	4	3½	3	2	2 0	1 6	2 9	2 0
London and South-Western.....	4½	4½	..	4	2 0	1 6	2 9	2 0
London, Brighton, and South Coast.....	4½	4½	..	4	2 0	1 6	2 9	2 0
aSouth-Eastern.....	4½	4½	..	4	2 0	1 6	2 9	2 0
Furness Railway.....	4½	3½	3	2	1 6	1 6	2 0	2 0
bLancashire and Yorkshire.....	4	3½	..	3½	2 0	1 6	2 9	2 0
Manchester, Sheffield, and Lincolnshire.....	4	3½	3½	2½	2 0	1 6	2 9	2 0
North British.....	4	3½	3½	3	2 0	1 6	2 9	2 0
North-Eastern.....	4	3½	..	3	1 6	1 6	2 0	2 0
cGlasgow and South-Western.....	4	3½	3½	3	2 0	1 6	2 9	2 0
Midland.....	4	3½	3	2	2 0	1 6	2 9	2 0
Great Eastern.....	4	3½	3	2	2 0	1 6	2 9	2 0
London, Chatham, and Dover.....	4½	4½	..	4	2 0	1 6	2 9	2 0
dCaledonian.....	4	3½	3½	3	2 0	1 6	2 9	2 0

* and b. The first column is for the "first 20 miles," &c.

c and d. The second column is for the "next 10 miles," &c.

a. Canterbury and Whitstable Railway, 4½d. per ton per mile; Blackfriars Junction, 1½d. per ton, in both cases with above terminals.

GOODS AND MINERALS IN CLASS 5.

Name of Railway Company.	Proposed Maximum Rates for Conveyance.				Proposed Maximum Station Terminal at each End.		Proposed Maximum Service Terminal at each End.	
	For the first 10 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the next 20 Miles or any part of such Distance.	For the remainder of the Distance.	At large Towns, as defined.	At any other Station.	At large Towns, as defined.	At any other Station.
	Per Ton per Mile. <i>d.</i>	Per Ton per Mile. <i>d.</i>	Per Ton per Mile. <i>d.</i>	Per Ton per Mile. <i>d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>	Per Ton. <i>s. d.</i>
*London and North-Western.....	5	4½	4	3½	2 0	1 6	3 6	2 6
Great Western.....	5	4½	4	3½	2 0	1 6	3 6	2 6
Great Northern.....	5	4	3½	3	2 0	1 6	3 6	2 6
London and South-Western.....	5	5	..	4½	2 0	1 6	3 6	2 6
London, Brighton, and South Coast.....	5	5	..	4½	2 0	1 6	3 6	2 6
aSouth-Eastern.....	5	5	..	4½	2 0	1 6	3 6	2 6
Furness Railway.....	5	4	3½	2½	1 6	1 6	2 6	2 6
bLancashire and Yorkshire.....	4½	4½	..	4	2 0	1 6	3 6	2 6
Manchester, Sheffield, and Lincolnshire.....	4½	3½	3½	3	2 0	1 6	3 6	2 6
North British.....	4½	4	3½	3½	2 0	1 6	3 6	2 6
North-Eastern.....	4½	3½	..	3½	1 6	1 6	2 6	2 6
cGlasgow and South-Western.....	4½	4	3½	3½	2 0	1 6	3 6	2 6
Midland.....	5	4	3½	3	2 0	1 6	3 6	2 6
Great Eastern.....	5	4	3½	3	2 0	1 6	3 6	2 6
London, Chatham, and Dover.....	5	5	..	4½	2 0	1 6	3 6	2 6
dCaledonian.....	4½	4	3½	3½	2 0	1 6	3 6	2 6

* and b. The first column is for the "first 20 miles," &c.

c and d. The second column is for the "next 10 miles," &c.

a. Canterbury and Whitstable Railway, 7½d. per ton per mile; Blackfriars Junction 5d. per ton, with above terminals.

EXCEPTIONAL CLASS.

For articles of unusual length, bulk, or weight, or of exceptional bulk in proportion to weight; for articles requiring an exceptional truck, or more than one truck, or a special train; for locomotive engines and tenders, and railway vehicles running on their own wheels; for any wild beast, or any large animal not otherwise provided for; or for dangerous goods the companies take power to charge such reasonable sum as they may think fit in each case. Some of the companies fix charges ranging up to 10*d.* per ton per mile, with terminals extra.

SMALL PARCELS.

For small parcels not exceeding 560 lbs. in weight:—The *London and North-Western* propose, if such parcels are conveyed by merchandise train, to charge double the maximum rates for conveyance, and double the terminal charges authorised in respect of merchandise comprised in the 5th class of the classification, with a minimum charge as for 28 lbs. If conveyed by passenger train, 2*d.* per lb., with a minimum charge of 3*d.* per parcel. These charges are also proposed by the *Manchester, Sheffield, and Lincolnshire*. The *Great Northern* propose "such reasonable sum as the company may think fit," a proposal also adopted by the *London and South-Western* and all other companies, except as otherwise mentioned here. The *Cambrian Railways* adopt quite an intricate tariff in respect of these parcels. The *Lancashire and Yorkshire* propose the following rates:—

Maximum Rates for Conveyance.		Maximum Terminal Charges.		
In Weight.	For any Distance.	Station Parcel at each End.	Terminal Parcel at each End.	Service Parcel at each End.
Any parcel—	<i>s.</i> <i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>
Not exceeding 7 lbs.	0 6	0½	0½	0½
Over 7 lbs. and not exceeding 14 lbs.	1 0			
" 14 " " " 28 "	2 0			
" 28 " " " 56 "	3 0	1	1	1
" 56 " " " 112 "	4 0	1½	1½	1½
And for every additional 112 lbs. or fraction thereof up to 560 lbs.	0 9	1½	1½	1½

For the charges of the *Cambrian and North Staffordshire* railways and of portions of other lines, the original paper must be consulted, which may be obtained, price 1*s.*, from the publishers of the *Ironmonger*, 42, Cannon Street, E.C.

THE REVISED CLASSIFICATION.

The following is the revised classification adopted by the railway companies, so far as it relates to the chemical industries.

CLASS "A" TRAFFIC.

Applicable to Consignments of Four Tons and upwards.

Cannel.	Culm.	Slack.
Cinders (coal).	Iron ore.	Slag or scoria (blast furnace).
Coal.	Ironstone.	
Coke.		

CLASS "B" TRAFFIC.

Applicable to Consignments of Four Tons and upwards.

Antimony ore waste; barytes, raw, in bulk; bog ore (or oxide of iron) for gas purifying; bricks, clay, common and fire; cement, in blocks or slabs; cement stone; chalk lime; clay in bulk, except otherwise herein provided; coal fuel, patent; coprolites and rock phosphate, unground; gambister; gas carbon; gas lime or gas-purifying refuse from gasworks; gypsum stone in lumps, unground; iron ore refuse for gas purifying; iron pyrites; lime, in bulk; limestone in bulk; red and purple ore; zinc ore.

CLASS "C" TRAFFIC.

Applicable to Consignments of Two Tons and upwards.

Antimony ore; arsenic; asphaltum; barytes, ground, in casks or bags; bricks, clay, glazed or enamelled; cement, except otherwise herein provided; chromate ore; clay, in bags or casks; copper ore; emery stone; ferro manganese; lead ore; manganese ore; mineral white; chloride of manganese; chloride of potassium; ochre; oxide of iron; pyrites, except otherwise herein provided; retorts, retort lids and mouthpieces, iron, or steel; skimmings (flux, lead, tin, or

zinc); slate, ground (for cement); spiegeleisen; sulphate of ammonia; sulphate of iron; sulphur, crude or unmanufactured; terra cotta blocks and bricks; umber; vegetable tar; whitening and whitening; zinc ashes; zinc carbonate (calamine); merchandise comprised in Classes "A" and "B" of the classification, if sent in quantities of less than four tons and not less than two tons.

CLASS 1 TRAFFIC.

Acetate of lead or sugar of lead; arseniate of soda; ashes, pot and pearl; bichrome and bichromate of potash, in casks; bottles, glass, black or green, common, packed; caustic potash; charcoal; chloride of zinc; copper precipitate; copper regulus; copperas; earth nuts or ground nuts; galvanised iron; lead ashes; litharge; nitrate of lead; paraffin, scale, and wax; plumbago ore; pumice stone; putty; resins (not oily); red lead; retorts (clay); resin; rotten-stone; saltpetre; silicate of soda; soap; solder; sulphate of copper; sulphur, except otherwise herein provided; tallow; tin ore; tin plates; washing powder and paste; weights, iron; white lead; zinc white or oxide of zinc; merchandise comprised in Classes "A," "B," and "C," if sent in quantities of less than two tons.

CLASS 2 TRAFFIC.

Antimony regulus; asbestos; black lead; blacking; borax; brass; bronze (phosphor) castings and ingots, rough; candles; cobalt ore; coir rope; colours, in casks or iron drums, or in tins packed in cases; copper; cotton and woollen waste; crucibles (clay); electric accumulators; electric insulators; emery; emery dust; filters, cast iron; iron liquor, or chloride of iron; ivory black; ivory waste or dust; nickel ore; nitrate of copper, in casks; nitrate of iron; oils, not dangerous, in casks or iron drums, except otherwise herein provided; paints, in casks or iron drums, or in tins packed in cases; plumbago; polishing paste; sal-ammoniac; silicate cotton or slag wool; size, except otherwise herein provided; tinfoil; tin liquor.

CLASS 3 TRAFFIC.

Anthracene, crude; beeswax; carbon candles, for electric lighting; carbonate of ammonia, in cases; chemicals (not dangerous, corrosive, or explosive), in casks, iron drums, bales, or bags; cinabar ore; colours, in cans, hampers, boxes, or iron bottles; delta metal; drysalteries, in casks; Dutch metal and leaf; electric batteries; filters, earthenware; glass, crown; glass, flint, except otherwise herein provided; glass, plate, rough; glue; gutta-percha, raw; lampblack; leather, except otherwise herein provided; nickel; paints, in cans, hampers, boxes, or iron bottles; pans, chemical and dye, iron or steel; silver ore; varnish; vegetable ivory; weights, brass.

CLASS 4 TRAFFIC.

Bronze powder; cobalt; drysalteries, except otherwise herein provided; earthenware, except otherwise herein provided; gold size; gutta-percha goods; india-rubber goods; oils, not dangerous, in cans, jars, and in bottles, in casks or boxes, except otherwise herein provided; stills, copper; vats; verdigris.

CLASS 5 TRAFFIC.

Aluminium; anthracene, except otherwise herein provided; bismuth; colours, in jars; crucibles, except otherwise herein provided; empty cases, casks, crates, hampers, and other empties, except otherwise herein provided; glass, plate, silvered; glass, stained; magnesium metal; nitrate of copper, in jars or stone bottles, covered with wicker basketwork; paints in jars; quicksilver; silver precipitate; sponges; thermometers; ultramarine; and, subject to the provisions of the Railway and Canal Traffic Act, 1888, all articles, matters, and things not herein-before classified, and not being of an explosive or dangerous character.

In addition to the revised classification each railway company has filed a revised schedule of maximum rates and charges, with a formal statement of the general conditions which are proposed to govern the traffic over its system. As these general conditions are not identical in every instance, and as they are of much importance, we have compared them with each other, and give the results of that comparison below. In doing so we take the *London and North-Western* as the standard, and note the variations from it of the other principal companies under, or in connexion with each clause or section. Where no variations are specially mentioned it may be taken for granted that all the chief companies are in substantial agreement with the *London and North-Western* schedule.

GENERAL CONDITIONS.

Each company defines what is meant by the words "the company," mentions the lines which are leased by it; defines the term "merchandise" to mean goods, cattle, live stock, and animals of all description; defines the term "trader" to mean any person sending, receiving, or desiring to send merchandise by the railway; and defines the word "terminal station" to mean a place at which the company have provided accommodation for receiving or delivering merchandise from or to traders, but does not include a junction between the railway and a siding not belonging to the company.

The term "large towns" mentioned by each company in respect of terminal charges is specified in each case, with "any other places on the railway which may from time to time be added thereto by authority of Parliament."

The "large towns" mentioned by the principal companies are:—
London and North-Western.—London, Liverpool (including Bootle), Manchester (including Salford), and Birmingham.

Great Western.—London, Liverpool, Manchester, and Birmingham.

South-Eastern.—London and places near it which are within "an urban district" under the Cheap Trains Act, 1883.

London, Brighton, and South Coast.—London and its "urban districts."

Great Northern.—London.

North British.—Dundee, Edinburgh, Glasgow, and Leith.

Lancashire and Yorkshire.—Liverpool, Bootle, Manchester, and Salford.

Manchester, Sheffield, and Lincolnshire.—Manchester, Ashton-under-Lyne, Oldham, Barnsley, Sheffield, Rotherham, Hull, and Grimsby.

London and South-Western.—London and its "urban districts."

Midland.—London, Liverpool, Manchester, and Birmingham.

Great Eastern.—London.

Caledonian.—Aberdeen, Dundee, Edinburgh, Glasgow, Greenock, Leith, and Paisley.

London, Chatham, and Dover.—London and its "urban districts."

Cambrian.—None.

Furness.—None. Terminals apply to "any station."

North-Eastern.—None. Terminals are simply "station terminals."

Glasgow and South-Western.—Glasgow, Paisley, and Greenock.

North Staffordshire.—None.

The maximum rates and charges proposed to be authorised are divided as follows:—

1. Maximum rates for conveyance.

2. Maximum station terminals.

3. Maximum service terminals.

To these the other companies add:—

4. Special charges.

(1.) *Maximum rates for conveyance* include:—

(a.) The charge for conveying merchandise by merchandise train along the railway.

(b.) The provision of trucks, except for merchandise comprised in Class A of the classification; the following articles in Class B:—Clay, in bulk; gas lime or gas-purifying refuse, from gasworks; lime, in bulk; nightsoil; salt, in bulk; sand, in bulk; and the following articles in Class C:—Creosote (coal tar), coal tar or gas tar, and gas water.

The other companies put this in a different way, but the meaning of all is that trucks are provided for all traffic except for the goods named.

(2.) *Maximum station terminals* include the charge for accommodation (exclusive of coal drops) at terminal stations provided by the company for dealing with merchandise as carriers thereof, before and after conveyance, together with the following services and expenses, namely:—Share of general charges and office expenses, attributable to such services as are rendered by the company to all descriptions of merchandise alike in performing the duties incidental to the business of a carrier: shunting and marshalling of trucks; and the provision of engines, horses, machinery, plant, and stores used in the services referred to in this sub-section.

(3.) *Maximum service terminals* include the charges for the following services rendered by the company in dealing with merchandise as carriers thereof, before or after conveyance, namely:—The labour of servants of the company in loading or unloading, covering or uncovering merchandise, the provision of machinery, plant, sheds, or stores used in such services, and also the share of general charges and office expenses specially attributable to the classes of merchandise in respect of which service terminals are authorised.

(4.) *Special charges*.—The company may charge such reasonable amounts as, in case of difference, shall be determined by the Railway Commissioners in respect of the following matters:—

(a.) Accommodation provided by the company at or in connexion with sidings not belonging to the company, and the delivery or reception of traffic to and from such sidings.

(b.) The collection or delivery of merchandise.

(c.) The use of trucks, or the use or occupation of any accommodation included in the station terminal, beyond such period before or after conveyance as shall be reasonably necessary for enabling the company to deal with merchandise as carriers thereof, and the services rendered in connexion with such use or occupation.

(d.) The loading or unloading, covering or uncovering merchandise included in Class A or Class B of the classification.

For further special charges by individual companies, the original paper must be consulted.

PROVISIONS AND REGULATIONS.

1. For any distance not exceeding six miles the company may charge the rates authorised for six miles.

2. For any quantity in one truck received from or delivered on or at a siding not belonging to the company, may be charged as for a reasonable minimum load.

3. A fraction of a quarter of a ton shall be deemed a quarter of a ton, and larger fractions of a ton shall be charged for according to the number of quarter-tons in them.

4. Miles are treated similarly to the above.

5. For fractions of a penny the company may demand a penny.

6. Imperial avoirdupois weight shall be used.

7. Articles sent in quantities, although in separate parcels, such as bags of sugar and the like, shall not be deemed small parcels.

Individual companies mention further provisions and regulations beyond those above mentioned, which are virtually identical in all the schedules, but the original paper must be consulted for details of these.

THE NEW RAILWAY RATES.

Form of Notice of Objection.

The Board of Trade has fixed the following as the official form of objection to the classification and proposed new rates and charges of the railway companies. The notice must be written upon foolscap paper.

RAILWAY AND CANAL TRAFFIC ACT, 1888.

TO THE BOARD OF TRADE:—

I, the undersigned [*fill in Christian and surname of objector*], hereby give notice that I object to the parts of the proposed classification of merchandise traffic and schedule of rates and charges of the _____ company set forth in the first column of the schedule to this notice, on the ground set forth in the second column of this notice, and that my address, to which all notices and communications may be sent, is [*here state address of objector in full*].

Dated the _____ day of _____ Signed _____

SCHEDULE.

Reference to Proposed Classification and Schedule.	Grounds of Objection.
--	-----------------------

Every notice of objection must be signed by the person making the objection, or where the objection is by a company or body or association of persons, by some person or persons on behalf of the company, body, or association, and must state a postal address to and at which notices may be served or communications addressed to the objector or objectors. The envelope or cover enclosing each notice of objection must be marked outside "Railway and Canal Traffic Act, 1888."

A copy of every notice of objection must at the same time be sent to the secretary of the company affected thereby, by prepaid letter, addressed to the company at its principal office.

UNITED STATES MINERAL STATISTICS FOR 1888.

(From the Engineering and Mining Journal.)

THE MINERAL INDUSTRIES IN 1888.

The year just closed has been a very eventful as well as a very prosperous one to the mineral industries. The value of the mineral products, which in 1887 amounted, as shown on another page, to the enormous total of \$4,284,225,000, was still further increased in nearly every item in 1888, when it undoubtedly exceeded \$50,000,000,000, or more than the aggregate value of the mineral products of all European countries.

PRODUCTION.

Coal, anthracite. (Tons of 2,240 lbs.)	40,000,000
„ bituminous „ „	80,000,000
Iron ore. (Tons of 2,240 lbs.)	11,400,000
Pig-iron „ „	6,900,000
Steel rails „ „	1,350,000
Copper. Lbs.	236,000,000
Lead. (Tons of 2,000 lbs.)	189,000
Zinc „ „	57,000
Silver. Troy ozs.	43,000,000
Coining value, 1'29 dols. per oz.	55,470,000
Gold. Troy ozs.	1,650,000
Coining value, 20'67 dols. per oz.	34,105,500

UNITED STATES IMPORTS AND EXPORTS OF COPPER.

From official data we get the exports of copper for 11 months from all parts of the United States, and we have added the exports for December from the Port of New York. We have carefully estimated the copper in ore, matte, &c., exported, and thus estimate the total exports as about 78,000,000 pounds. The imports were mostly in ore, which produced, as already stated, 5,000,000 pounds of copper.

IMPORTS.

Years.	Bars, Ingots, and Pigs.		Old, fit only for Remanufacture.		Fine Copper contained in Ores.		Regulus and Black Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.	Dollars.	Pounds.	Dollars.	Pounds.	Dollars.	Pounds.	Dollars.
1867	1,635,553	287,831	569,732	81,339	..	936,271	..	..
1872	2,638,389	578,965	1,144,142	178,536	584,878	69,017	4,247	1,083
1877	230	30	219,443	28,608	76,637	9,756	1,874	269
1882	6,200	836	508,401	59,629	1,473,169	147,416	224,052	30,013
1886	159	24	41,025	2,647	4,123,842	413,276	186,887	14,962
1887	415	49	37,786	2,198	4,119,412	299,095	29,004	1,448
1888	74,090	5,625	..	..	5,492,900	426,099	..	..

EXPORTS.

Fiscal Years ending June 30.	Ore, Cwts. of 112 lbs.		Pigs, Bars, Sheets, and Old.		Value of Manufactured.	Total Value.
	Quantity.	Value.	Quantity.	Value.		
	Cwts.	Dollars.	Pounds.	Dollars.	Dollars.	Dollars.
1867	87,731	317,791	*1,637,867	393,048	171,062	791,901
1872	35,564	101,752	267,868	64,844	121,139	287,735
1877	21,432	109,451	13,461,553	2,718,213	195,730	3,023,394
1882	25,936	89,515	3,319,531	565,295	93,616	748,456
1886	544,020	3,968,879	24,262,303	2,493,898	108,971	5,671,748
1887	367,289	1,693,879	19,735,696	1,947,990	85,623	3,727,492
1888	754,420	6,500,000	31,425,754	4,871,617	120,314	11,492,921

* Evidently errors in quantities.

PRODUCTION OF ZINC IN THE UNITED STATES IN 1888.

The production of spelter in the year 1888 amounted to 57,000 short tons, of which 10,400 tons was produced in the Eastern and Southern States, about 22,500 in Illinois, and the balance in Kansas and Missouri. This has been a moderate increase over last year, and the mines are reported in good condition and likely to increase the output in 1889.

THE WORLD'S PRODUCTION OF ZINC, IN LONG TONS.

Years.	United States.	Belgium.	Silesia.	Great Britain.	France and Spain.	Poland.	Austria.	Total.
1880	20,749	98,830	64,450	*22,000	15,000	*4,000	*2,520	227,558
1881	30,000	110,989	66,497	24,419	*18,353	*4,000	4,270	258,533
1882	*30,118	119,193	68,811	25,581	18,975	4,400	5,094	271,302
1883	32,021	123,891	70,405	28,661	14,671	3,733	4,672	278,964
1884	34,414	130,522	76,116	29,259	15,341	4,164	4,479	294,286
1885	36,339	129,754	79,623	23,969	14,847	5,019	3,890	292,571
1886	38,972	129,929	81,639	26,739	15,305	4,115	3,760	292,662
1887	41,947	130,995	81,375	19,319	16,028	3,589	3,566	299,810

* Estimated.

UNITED STATES IMPORTS AND EXPORTS OF ZINC.

Fiscal Year ending June 30.	Imports.					Exports.				
	Blocks or Pigs.		Sheets.		Total Value Imports.	Ore or Oxide.		Plates, Sheets, Pigs.		Total Value Exports.
	Pounds.	Value.	Pounds.	Value.		Cwt.	Value.	Pounds.	Value.	
1867	5,752,611	Dollars. 256,366	5,142,417	Dollars. 311,767	Dollars. 568,068	3,676	Dollars. 32,044	312,227	Dollars. 39,587	Dollars. 62,628
1872	11,802,247	522,524	10,704,944	503,885	1,175,077	3,686	20,880	62,949	5,726	26,606
1877	1,266,894	63,259	1,341,333	81,815	147,564	6,428	34,468	1,443,922	115,122	150,708
1882	18,468,391	736,964	4,413,042	207,032	948,936	10,904	13,736	1,489,552	124,638	138,374
1886	3,616,462	115,813	1,037,951	38,359	164,822	8,749	24,951	770,558	64,410	102,110
1887	7,432,490	240,535	757,245	26,668	275,319	1,209	44,152	363,199	25,403	88,109

PRODUCTION OF LEAD IN THE UNITED STATES.

Year.	Arizona and California.	Colorado.	Idaho and Montana.	Missouri, Kansas, Illinois, and Wisconsin.	Nevada.	Utah.	Other States.	Total Production.
1873	..	56	..	22,381	..	15,000	5,103	42,540
1878	..	6,369	..	26,770	31,063	21,000	5,858	91,060
1883	3,200	70,557	11,000	21,600	6,000	29,000	2,600	143,957
1886	..	59,600	17,000	22,000	3,400	24,000	14,229	135,629
1887	1,000	63,000	27,000	28,000	3,100	22,000	16,300	160,700
1888	..	65,000	39,000	33,000	..	22,000	30,000	189,000

UNITED STATES IMPORTS AND EXPORTS OF LEAD.

Fiscal Years ending June 30.	Imports.							Total Imports.	Total Exports.
	Pigs and Bars.		Sheets, Pipe, and Shot.		Old and Scrap.		Not specified.		
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.			
		Dollars.		Dollars.		Dollars.	Dollars.	Dollars.	Dollars.
1867	65,322,923	2,812,668	185,825	9,560	1,256,233	53,292	6,247	2,881,677	32,859
1872	73,089,657	2,929,623	12,518	859	4,257,778	171,324	21,616	3,123,422	48,132
1877	14,583,845	671,482	..	..	249,645	8,383	2,303	682,168	49,835
1882	6,079,304	202,603	..	..	220,762	5,949	3,048	211,500	178,779
1886	11,005,083	294,856	24,087	1,623	17,943	666	1,698	298,243	114,098
1887	11,148,211	333,256	19,260	950	35,081	1,452	360	345,171	144,154
1888	..	..	..	..	..	..	..	636,449	121,822

IRON STATISTICS.

We compile the following estimates of production for 1888 from the bulletin of the American Iron and Steel Association, the best authority on the subject:—

	1888.	1887.
Production of pig-iron	Gross Tons. 6,000,000	Gross Tons. 5,417,118
„ Bessemer rails	1,350,000	2,101,904
„ Lake Superior iron ores	5,000,000	4,738,203
Imports of iron ores	600,000	1,194,301
„ iron and steel	950,000	1,783,251

UNITED STATES NITRATE STATISTICS.

The shipments to Europe, including the large quantity loading December 1st, would be 670,000 tons, against 610,000 tons last year. There will be more than this difference in the spring supply, because engagements are made for steamer shipments in January. The increased supply has given the bears on the other side an opportunity, but it is a question how long they will have the markets. Beside the growing general use of nitrate as a fertiliser of the highest rank, the advancing value of beet sugar justifies the belief that a larger acreage of beet culture will be found this year, and perhaps to an extent that may give the market another squeeze.

The shipments to the States were 472,500 bags, against 555,000 bags in 1887, 522,750 in 1886, 270,325 in 1885, and 437,234 in 1884. The quantity to arrive for Atlantic ports is 224,000 bags, against 239,000 in 1888, 238,500 in 1887. The total visible supply is 310,000 bags, against 301,940 in 1888, 311,236 in 1887. The quantity to arrive in Europe is 2,527,000, making the visible supply there 3,112,000 bags, against 2,927,500 bags in 1888, and 2,070,000 in 1887. The deliveries at San Francisco during last year were 60,000 bags, making total deliveries in this country 515,000 bags, against 534,347

in 1887, 151,761 in 1886. In Europe the deliveries were 4,712,000 bags, making total for the world 5,227,000, against 4,161,347 in 1887, 3,522,260 in 1886, 3,278,986 in 1885, and 3,971,071 in 1884.

UNITED STATES.

—	1888.	1887.	1886.	1885.	1884.	1883.
Imports	498,562	483,862	398,293	270,323	437,244	360,610
Deliveries.....	453,632	470,060	412,818	394,186	388,384	367,175
Stocks, Dec. 31..	86,000	62,910	72,766	87,291	121,151	72,304
Average price ...	2½	2·07	2·23	2·20	2½	2½

EUROPE.

—	1888.	1887.	1886.	1885.
Imports.....	4,807,000	3,410,000	2,550,000	2,985,000
Stocks, Dec. 31..	585,000	490,000	720,000	1,237,500
Deliveries.....	4,712,000	3,630,000	3,067,500	2,917,500
Average price ...	9s. 9d.	10s. 3d.	10s. 3d.	9s. 6d.

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

1888.

18,289. J. Neilson and J. Whitclaw, Glasgow. Improvements in gas and air reversing valves for regenerative and other furnaces, &c. December 14.

18,312. W. Booth, Manchester. Improvements in furnaces. December 15.

18,383. W. R. Watson and R. A. Robertson, Glasgow. Apparatus for evaporating, concentrating, and distilling liquids. December 17.

1889.

1078. H. Green and A. Green, Manchester. Purifying water, and removing crustation from steam boilers. January 21.

1202. A. H. Hobson, London. Apparatus for use in making extract from, and otherwise treating, partially soluble substances by means of steam pressure and heat. January 22.

1345. B. Nicholson and T. Palmer, London. Cylinders or rotating vessels for use in tanning or otherwise treating hides or skins, washing, emulsifying, churning, or like operations; applicable also for the treatment of materials in vacuo or under fluid pressure or the like. January 24.

1424. C. F. H. Hayes, Stratford. Apparatus for compressing air, gases, or other fluid, and for force pump purposes generally. January 25.

1462. E. Ducretet, London. Filtering apparatus. January 26.

1847. E. Harrison, London. Means and apparatus for softening and purifying water, and for the removal and prevention of incrustation in steam and other boilers. February 1.

2036. W. Sayer, London. Apparatus for forcing, exhausting, or pumping air, gases, liquids, and the like. Complete Specification. February 5.

2259. J. Simpson and S. Reid, London. Apparatus for economising coal and for the better combustion of smoke in furnaces. February 8.

2528. W. Hicks, London. Improved centrifugal separator for removing solids and other matter from liquids. February 13.

2603. W. Beaumont, London. Improvements in centrifugal pumps. February 14.

2677. W. F. Gorham and M. Watson, Newcastle-on-Tyne. Improvement in arrangement of mills for grinding cement, phosphates, and other substances. February 15.

2691. C. Hill, London. Improvements in the grates of furnaces employed in connexion with brewers' cuipers, salt pans, boilers, &c. February 15.

2736. J. Wood, Bradford. Method and apparatus for consuming smoke. February 16.

COMPLETE SPECIFICATIONS ACCEPTED.*

1888.

2548. F. Windhausen. Refrigerating apparatus, applicable to machines for compressing air and gases. February 20.

2549. F. Windhausen. Refrigerating apparatus, applicable to machines for compressing air and gases. February 20.

3044. O. Bran. Centrifugal machines. January 30.

3123. T. Burtenshaw. *See* Class II.

4139. J. J. Hicks. Apparatus for ascertaining the specific gravity of liquids. January 30.

4766. S. H. Johnson and C. C. Hutchinson. Filter presses. February 6.

5246. J. H. Breze. Apparatus for condensing, cooling, and heating fluids; and machinery for the construction thereof. February 13.

5426. J. S. Sawrey and H. Collet. Apparatus for separating liquids from solid matters in suspension. January 30.

5527. R. Le Las and A. Robin. Apparatus for supplying furnace fires with moistened air. February 20.

16,761. R. Reichling. Apparatus for condensing steam and for heating and purifying feed water. February 6.

17,012. R. Hasenclever. Apparatus for subjecting pulverulent or granular materials to the action of gases. January 16.

18,925. D. McColey Weston. Centrifugal machines. January 16.

18,939. N. L. Hilton. Improved agitators. February 6.

18,860. H. J. Allison.—From The Casamajor Filter Co. Apparatus for cleansing filtering media. February 20.

1889.

785. H. H. Lake.—From J. M. Duncan. Apparatus for evaporating brine, &c. February 20.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

1888.

18,451. E. Brook and J. J. Brook, London. Regenerative kilns. December 18.

18,665. J. F. Cohen, London. Improvements in the manufacture of artificial fuel. December 18.

1889.

1210. J. Williams, London. A reverberating cupola furnace, and gas, tar, and crude petroleum-making apparatus. January 23.

1271. H. Simon, London. Improvements in coke ovens. January 23.

1326. J. Greenfield.—From C. A. d'Assumpcao and E. S. Dias, Portugal. Improvements in the treatment of coal and small coke or breeze in the manufacture of gas and coke. January 24.

1444. L'Agence Maritime Anglaise, Limited.—From C. Audony, France. Apparatus for manufacturing artificial fuel blocks. January 25.

1508. L. H. Green, London. Improvements in or applicable to gas retorts and ovens. Complete Specification. January 28.

1637. J. Ewing, Stoneycroft, Liverpool. Combustion and economy of fuel, and bar preservation. January 30.

1806. C. H. Mowll, London. An improved composition of artificial or block fuel. February 1.

1846. W. Borzett, London. Improvements in the application of heat produced from liquid hydrocarbon and water burners to the production of light and electricity, and in apparatus for this purpose. February 1.

1955. W. Wells, Leith. An improved form of burner for converting oils or spirits into vapour or gas to obtain light or heat. February 4.

2093. J. F. M. Pollock, Leeds. Improvements in machinery for the manufacture of blocks of compressed coal dust and pitch or other agglomerate; also of clay, cement, and similar substances. February 6.

2246. G. H. Lloyd, A. L. Lloyd, H. Bewlay, and W. S. Sutherland, Liverpool. Improvements in producing water gas, and in apparatus therefor. February 8.

2351. J. Hillier and G. H. Rayner.—For Messrs. Rayner and Cassell, London. An improved fuel, which burns without smoke or smell. February 9.
2378. M. Murphy and T. J. Cluff, Dublin. Making gas from paraffin oil on an improved method, and utilising same for heating purposes and propelling power. February 11.
2508. H. S. Maxin, London. Improvements in and relating to apparatus for carburetted gas. February 12.
2561. J. Pring, Newport. Improvements in machinery or plant for the manufacture of patent fuel. February 13.
2659. J. C. Chandler, London. Improvements in apparatus for washing and scrubbing gas. February 14.
2664. J. O. Spong, London. Novel means and apparatus to facilitate the enrichment and purity of flame of coal gas. February 14.
2796. H. Darby, London. Improvements in apparatus for generating and burning gases from hydrocarbon oil and water. February 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

1195. J. T. Williams. Treating small anthracite coal to render it available for use as fuel.
3179. E. Bowen. Treating the by-products of gas and tin-plate manufactures. January 16.
3423. T. Birtenshaw. "Tar-burners," and the furnaces to which they are applied for heating gas retorts, &c. January 30.
3495. A. McDougall. Apparatus for manufacture of gas. January 16.
3538. G. Seagrave and P. A. Olivier. Apparatus for the carburization of gas or air. January 16.
3566. R. Dempster and J. Dempster. Apparatus for feeding retorts with coal, &c. January 23.
3880. E. B. Ellice-Clark and L. Clark. Apparatus for obtaining oxygen and nitrogen from air. January 16.
3917. R. Auton. Making blocks of compressed fuel. January 23.
3950. R. Auton. Making blocks of compressed fuel. January 30.
3992. L. T. Wright. Means for indicating the extent to which gasholders are charged. January 23.
4158. R. B. Avery. Apparatus for generating and burning gaseous fuel. January 23.
4162. J. H. Glew. Compound of materials for production of firelighters. January 23.
4885. J. H. R. Dinsmore. Manufacture of gas from coal. February 6.
5259. J. V. Capeck. Electrical heating. February 13.
6220. W. A. McIntosh-Valon and Brin's Oxygen Co., Limited. Purification of carburetted hydrogen or coal gas. February 13.
- 17,562. De Witte Stearns. Apparatus for production of gas from liquid hydrocarbon, and devices for utilisation of gaseous fuel. January 16.
- 18,027. W. T. Bate. Apparatus for manufacture of gas. February 6.
- 18,105. T. Shaw. Apparatus for testing and detecting the presence of gases or gaseous mixtures. February 13.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

1889.

2096. R. F. Craig, Glasgow. Improvements in and connected with retorts and apparatus for decomposing and distilling products from wood, shale, or other material. February 6.
2569. J. H. du Vivier, London. Improvements in apparatus for the production of pyroligneous acid. February 13.

COMPLETE SPECIFICATION ACCEPTED.

1888.

566. R. Dempster and J. Dempster. See Class II.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

1888.

- 18,425. S. Pitt.—From L. Casella, Germany. Manufacture of bluish-black colouring matters. December 17.
- 18,524. B. Wilcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of succinic acid, rhodamine, or rhodamine succinate. December 18.

1889.

1257. O. Overbeck, London. Improvements in the manufacture of colouring matter. January 23.
1303. R. Lucas, London. Improvements in the manufacture of phthalic acid. January 24.
1518. O. Imray.—From The Society of Chemical Industry, Switzerland. Manufacture of monoacetylmetaamidophenol. January 28.
1523. J. G. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. Improvements in the manufacture of alpha-naphtholdisulphonic acids, and for the obtaining therefrom of materials suitable for dyeing and printing. January 28.
1735. A. Banz.—From Messrs. Dahl and Co., Prussia. Improvements in dye-stuffs or colouring matters. January 31.
1771. B. Wilcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of para-amidophenol and the formyl combinations thereof. January 31.
1803. J. Frost, Halifax. Improvements in the method of and means for concentrating or evaporating and distilling solutions for the production of dyes and other bodies. February 1.
1844. A. G. Green, London. Improvements in the manufacture of primuline. February 1.
1992. C. Dreyfus, London. Improvements in the production of colouring matters for dyeing. February 4.
2360. E. Brasier and J. H. Knowles, London. The production of a new colouring matter, extract, or dye and tannin solution obtained in the process of treating certain fibrous materials. February 3.
2499. O. N. Witt, London. The production of new azo-dyes applicable for dyeing and printing. February 12.
2635. R. Gnehm, London. A new colouring matter for dyeing and printing purposes, and its method of manufacture. February 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

1533. H. H. Leigh.—From R. G. Williams. Manufacture of colouring matters. January 16.
4217. W. P. Thompson.—From The Actien Gesellschaft für Chemische Industrie, Rheinau. Manufacture of colouring substances by the reaction of aromatic hydrazin sulphonic acids on retenehiou. January 23.
4476. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Manufacture of blue colouring matters. February 6.
4625. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Berlin. A new alpha-naphtholdisulphonic acid. January 30.
5404. H. H. Leigh.—From R. G. Williams. Colouring matters. January 16.
5852. S. Pitt.—From L. Casella and Co. New blue colouring matters. February 20.
5910. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Berlin. Azo-colouring matters. February 6.
6143. H. H. Leigh.—From R. G. Williams. Colouring matters. January 16.
6899. L. Limpach. Separating isomeric xylylides from commercial xylyline in a pure state, for production of colouring matters. February 20.
- 15,654. H. H. Leigh.—From R. G. Williams. Azo-colouring matters. February 20.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

1889.

2256. I. Frankenburg, Manchester. Improvements in the manufacture of waterproof fabrics. February 8.
2570. J. H. du Vivier, London. A new composition termed "artificial silk" for the production of the threads or filaments and films, and for coating threads, fabrics, or objects, and apparatus employed in the manufacture of said composition. February 13.
2571. J. H. du Vivier, London. Improvements in apparatus for the manufacture of textile threads from viscous or semi-fluid matters. February 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

2391. D. W. Pessey. Making sewing threads from lubricated or coated yarns. January 23.

4786. J. Petrie and F. W. Petrie. Apparatus for cleansing wool and other fibrous materials. February 6.

12,682. J. Mactear. Treating vegetable fibrous material for obtaining fibre therefrom. February 13.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

1888.

18,252. J. Clegg, Liverpool. Improvements in cleansing, scouring, bleaching, mordanting, and dyeing cotton yarn in the bundle form in which it is sold, and apparatus therefor. December 14.

18,348. S. D. Stead, London. Improvements in and machinery for washing, scouring, and bleaching of fibrous materials. December 15.

18,517. H. F. Lippett, London. Hollow perforated tubes for dyeing, bleaching, or otherwise treating yarn in cops. Complete Specification. December 18.

1889.

1172. W. Mather, London. Improvements in apparatus for treating textile materials with liquids, gases, or vapours. Complete Specification. January 22.

1313. E. M. H. Andreoli. See Class XI.

2690. T. Wolstenholme, London. An improved machine for dyeing yarns. Complete Specification. February 5.

2525. H. Erdmann, Halle, Germany. A cold process of dyeing hair and feathers by means of paraphenyldiamine or similar bases. February 13.

2668. J. Walker and H. Carver, Manchester. Improvements in printing what are known as "sanitary" or "washable" paper-hangings. February 15.

2743. F. A. Blair, Glasgow. Improvements in and connected with vats or apparatus for dyeing, washing, bleaching, scouring, or mordanting fibrous materials. February 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

1357. T. Winter. Immersion rollers used in dyeing, bleaching, sizing, &c. January 16.

2322. W. P. Thompson.—From A. Douleiron and E. van Meerbeeck. Apparatus for cleansing, dyeing, or steeping fabrics. February 6.

3490. W. Mycock. Dyeing apparatus. January 30.

17,271. F. E. Anderson and S. Hodgeson. Method and apparatus for dyeing, scouring, and washing wool, &c. January 16.

18,717. E. O. Fankhauser. Mordant for dyeing purposes. February 20.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

1888.

18,320. S. B. Bowen, Liverpool. Improvements in or relating to the concentration of sulphuric acid, and in apparatus therefor. December 15.

18,573. E. Solvay, London. Improvements in the purification of gases. December 19, but antedated (under sec. 103, Pat. Act, 1883) June 5, 1888, being date of application in Belgium.

18,574. E. Solvay, London. Improvements in the manufacture of chlorine and chloride of lime, and in apparatus therefor. December 19, but antedated (under sec. 103 of Pat. Act, 1883) June 5, 1888, being date of application in Belgium.

1889.

1110. F. Maxwell-Lyte, London. Improvements in the production of chlorine, of hydrochloric acid, and of certain subsidiary products. January 21.

1189. E. Ange, London. Improvements in the manufacture of salts of alumina. Complete Specification. January 22.

1376. E. W. Parnell, Liverpool. Improvements in the manufacture of calcium sulphhydrate solution from calcium sulphide or Leblanc waste. January 25.

1769. P. McLaren, Glasgow. An improved process of and means for manufacturing brown sugar of lead. January 31.

1885. C. Roth, London. Improvements in the manufacture of nitrate of ammonia, and sulphates, chlorides, and carbonates of potassium and sodium. February 2.

1916. H. Y. Castner. See Class X.

1989. H. Y. Castner. See Class X.

2160. L. Mond, Liverpool. Improvements in apparatus for volatilising ammonium chloride. February 6.

2161. F. Gilleteaux, London. Improved process for decomposing hydrochlorate of ammonia. February 6.

2310. T. Parker and E. Robinson, Manchester. Improvements in and relating to the production of chlorine, and to the manufacture of sulphate of soda. February 9.

2383. T. Parker and E. Robinson, Manchester. Improvements in the manufacture of cyanogen compounds from sulpho-cyanides. February 11.

2575. L. Mond, Liverpool. Improvements in volatilising ammonium chloride, and in obtaining ammonia, chlorine, and hydrochloric acid therefrom; also in obtaining chlorine from hydrochloric acid. February 13.

2608. J. McBryde and A. Kay, Liverpool. Improvements in the manufacture of chlorates. February 11.

2656. F. W. Dapre, London. An improved process of manufacturing potassium carbonate. February 14.

2786. E. K. Muspratt and G. Eschelman, London. Improvements in the manufacture of chlorates, and of magnesium hydrate for use therein. February 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

2831. E. W. Parnell and J. Simpson. Treating sulphide of calcium for obtaining sulphide of ammonium and sulphuretted hydrogen. January 23.

3118. J. S. Rigby. See Class IX.

3128. H. Green. Apparatus for treating ammoniacal liquor. February 6.

3678. A. M. Clark.—From J. B. Daguin. Manufacturing soda by means of ammonia, and producing carbonate of soda, caustic soda, and hydrochloric acid or chlorine. January 23.

3699. A. M. Clark.—From J. B. Daguin. Facilitating the oxidation of sulphurous acid for the manufacture of sulphuric acid, and of hydrochloric acid and chlorine. January 30.

4648. E. W. Parnell and J. Simpson. Producing sulphur from sulphuretted hydrogen. February 13.

4699. W. D. Bohm. Apparatus for the expulsion of chlorine or other noxious gases from solutions. February 20.

6175. E. W. Parnell and J. Simpson. Production of sulphur from sulphuretted hydrogen. February 13.

11,920. C. A. Faure. See Class X. February 20.

17,945. G. C. Dymond. From C. E. D. Winssinger. Manufacturing bicalcareous phosphate, called precipitated phosphate. January 30.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

1888.

18,303. W. Ambler, London. Improvements in or applicable to the manufacture of cylindrical and tubular articles of plastic clay and other plastic material. December 14.

18,457. W. A. Sheppard, London. An improved machine for the purpose of washing and refining fuller's earth, china clay, and other similar substances. December 18.

18,577. W. H. Turner, London. Improvements in or relating to painting or printing upon earthenware. December 19.

18,622. J. Bessley, Coventry. Improvements in glassware, earthenware, and the like. December 20.

18,661. W. W. Macvay and R. Sykes.—From H. M. Ashley, United States. Improvements in the manufacture of bottles and other hollow ware in glass, and in apparatus to be used therein. December 20.

1889.

1079. G. Vernon, Birmingham. An improved method of illuminating or ornamenting pottery ware and glass. January 21.

1198. A. Ramsden, London. Improvements in the method of and machinery for making earthenware pipes. January 22.

1377. A. Larthe, Dresden-Langton. Applying the style of enamels, hitherto applied to copper, to porcelains, earthenware, and crystal glass. January 25.

1822. W. H. Turner, London. Improvements in the manufacture of articles of pottery. February 1.
 2337. G. Emberson, London. Improvements in producing ornamental effects on glass or like transparent material. February 9.
 2641. T. Davidson, London. Improvements in the manufacture of articles of pressed glass. February 14.
 2776. J. Thorne, London. Improvements in the manufacture of coloured lenses for signal and other lamps. February 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

1550. J. P. Guy. Machine for making hollow earthenware. January 30.
 2318. J. B. Adams. Manufacture of bottles and other glassware, and apparatus therefor. February 13.
 3583. J. Holroyd and A. Wilson. Gas-fired kilns for burning pottery, &c. January 23.
 3743. G. M. Garrard. Roofing and wall or hanging tiles, and dies and presses for moulding such tiles. February 13.
 4204. A. Taylor and N. Brooke. Method and apparatus for moulding and pressing earthenware and fireclay baths, sinks, basins, closets, &c. February 13.
 4777. T. Button and J. Binner. Machine for chipping glass marbles or stoppers for glass bottles. January 23.
 5214. W. D. Gooch, F. H. Varley, and F. B. Lidstone. Manufacture of porous artificial stone for use as indestructible wicks, filter, partitions, &c. February 13.
 5253. F. Beer. Plastic composition for moulding. February 6.
 6039. W. Ambler, J. Rhodes, and S. Rhodes. Manufacture of glass bottles. January 16.
 15511. M. Winter. Manufacture of brilliant crystal coloured flowers. February 6.
 16737. T. Soufflet-Leban. A new mosaic tile. February 13.
 18101. P. A. Newton.—From J. Henning and F. Wrede. Manufacturing bottles or other hollow bodies of glass, and apparatus therefor. January 23.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

1888.

18182. G. S. Hüek and H. R. Schuck, London. Improvements in artificial stone. December 18.
 18491. W. Joy, London. Improvements in apparatus for use in the preparation of slurry for the manufacture of cement, and in mixing slurry with fuel. December 18.

1889.

1082. J. Robinson, London. A quick-drying adhesive cement for the better fixing of enamelled copper letters, designs, or devices, or other letters or designs, to glass, metal, wood, or stone. January 21.
 1262. A. McLean, London. An improved mode of and means for manufacturing blocks of artificial stone. January 23.
 1765. L. Brentini, London. Improvements in roofing tiles. Complete Specification. January 31.
 1952. J. C. Merryweather, London. Improvements in paving. February 4.
 2093. J. F. M. Pollock. See Class II.
 2121. G. A. Wright, London. An improved block, tile, or slab for building and other purposes. February 6.
 2289. J. Homan, London. Improvements in fireproof structures, and in bricks for the same. February 8.
 2403. J. H. Hughes, London. Improvements in the manufacture of a fireproof material which can be used for decorative, building, artistic, sanitary, and other purposes. February 11.
 2632. J. Sazden, London. Improvements in artificial building materials. Complete Specification. February 14.
 2718. A. C. Ponton, B. L. Mosely, and C. Chambers, London. Improvements relating to the preparation of siliceous materials used in the manufacture of artificial stone. February 15.
 2780. A. C. Ponton, B. L. Mosely, and C. Chambers. Improvements in artificial stone. February 16.
 2781. A. C. Ponton, B. L. Mosely, and C. Chambers. Improvements in and relating to the manufacture of artificial stone. February 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

1515. C. A. Eissner. Machines for cutting clay, for making bricks and tiles, &c. January 30.
 2632. J. Robertson and J. A. Patrick. Manufacture of Portland or similar cement. January 23.
 3118. J. S. Rigby. Manufacture of cement, and utilisation of the lime-mud residue of the ammonia-soda process therefor. February 20.
 18708. E. Edwards.—From F. Meyer. Waterproof roofing material. February 13.
 18596. F. Hunsinger. Improved roofing tile. January 30.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

1888.

- 17611A. B. J. B. Mills.—From T. A. Edison, United States. Improvements in the method of and apparatus for effecting the separation of metals from their ores by mechanical means.—Originally included in No. 17,614 of December 3.
 17611B. B. J. B. Mills.—From T. A. Edison, United States. Improvements in the method of and apparatus for extracting gold from its ore by amalgamation.—Originally included in No. 17,614 of December 3.
 18290. A. H. H. Bratt, Plumstead. The production of steel or metal ingots for gun and other forgings with freedom from blow-holes or cavities, and with equal distribution of metalloids through their masses. December 14.
 18263. J. L. M. Alkings and F. Mazalon, London. Improvements in or relating to the suppression or neutralising of the effects of deleterious gases in pits and underground workings. December 14.
 18400. T. Turner, Birmingham. The treatment of dross from the tin orterne plate manufacture. December 17.
 18440. C. A. Burghardt, Manchester. Improvements in the production of pure zinc. December 18.
 18477. G. C. Dymond.—From W. H. Appleton, United States. Improvements in machines for rolling seamless tubing, columns, and other hollow articles from hollow ingots. Complete Specification. December 18.
 18492. T. H. Roberts, London. An improvement or improvements in treating the tap cinder produced in puddling iron. December 18.
 18493. R. A. Hadfield, London. Improvements in cutting hollow steel and other steel shells, and in appliances therefor. December 18.
 18506. R. A. Hadfield. Improvements in the manufacture of hollow steel and other steel shells. December 18.
 18529. J. Mactear, London. Improvements in the production of sodium, potassium, aluminium, and alloys of aluminium. December 18.
 18551. J. Wilson, Berwick-on-Tweed. Treating the waste liquor of copper works. December 19.
 18632. T. Summers, London. Improvements in cleaning tin,terne, or other metal plates, and apparatus therefor. December 20.

1889.

1062. W. Corbett, W. W. Manfield, and J. Marsh, Manchester. Improvements in and relating to the manufacture of iron and steel. January 21.
 1099. J. Richardson, London. Improvements in the manufacture of iron and steel. January 21.
 1230. W. E. Pedley and T. G. Barlow, Massicks, Old Brompton. Improvements in cooling and breaking up slag. January 23.
 1380. J. Müller, Manchester. Miners' safety lamps. January 25.
 1406. W. S. Simpson, London. A novel process or means for the production of wrought metal articles direct from semi-fluid metal, and furnaces and moulds for the purpose. January 25.
 1418. G. Kruss, London. A process for decomposing technical nickel and its salts, and galvanically coating objects with pure nickel. Complete Specification. January 25.
 1531. D. Whitehouse, London. Improvements in the manufacture of tin andterne plates, and in machinery therefor. January 28.
 1590. W. E. Koch, London. Improvements in apparatus for casting steel pipes. Complete Specification. January 29.
 1602. M. Johnson, W. E. Field, and J. S. Beeman, London. Certain improvements in the amalgams and method of applying the same used in amalgamation of gold and silver, called or intended to be called "Johnson, Field, and Beeman's patent amalgamating process." Complete Specification. January 29.
 1622. J. Young, Glasgow. Improvements in obtaining gold and silver from ores and other compounds. January 30.

1629. W. H. Duncan, Coalbrookdale. Improvements in extracting, washing, and separating gold, silver, diamonds, copper, and other metals from the earthy matter in which they are found. January 30.

1762. Sir Lowthian Bell, London. Improvements in the manufacture of steel by the open-hearth process. January 31.

1916. H. Y. Castner, London. A process for the production of pure double chlorides of aluminium. February 2.

1957. J. Ward, Glasgow. Improvements in and relating to the manufacture of compound plates of steel and iron. February 4.

1989. H. Y. Castner, London. A process for the production of pure double chlorides of aluminium. February 4.

2031. S. McGilley Godfrey and J. B. Allen, London. Impregnating metals and making metal alloys. Complete Specification. February 5.

2078. H. M. Redemann and R. J. Tilford, London. Improvements in and relating to a new and useful process for treating crude or low grade steel to produce a refined or high grade steel. Complete Specification. February 5.

2080. H. M. Redemann and R. J. Tilford. Improvements in and relating to a new and useful process for treating crude or low grade steel to produce a refined or high grade steel. Complete Specification. February 5.

2070. H. M. Redemann and R. J. Tilford. Improvements in and relating to a new and useful process for treating crude or low grade steel to produce a refined or high grade steel. February 5.

2174. J. Hill, London. Improvements in the manufacture of steel ordnance. February 7.

2279. A. J. Boulton.—From O. Hofmann and P. Linke, Germany. Metal alloy for moulders' tools. Complete Specification. February 8.

2372. A. G. D. Craushay, London. Improvements in the manufacture of chain made of steel, iron, or other metals. February 9.

2350. T. Bell, London. An improved method of lining barrels or other vessels to resist acids for use in extracting metals by chlorination or similar process from their ores. February 9.

2369. L. Roberts, J. Jones, and the Moor Steel and Iron Company, Limited, Stockton-on-Tees. An improved method of and apparatus for delivering and charging pig iron and "scrap," or other heavy material, into steel and open-hearth furnaces. February 11.

2377. A. C. A. Holzappel, London. Improved machine for flanging and shaping steel, iron, and other metal plates for ship-building and other purposes. February 11.

2359. A. Heine, London. Improvements in kilns for the calcination of copper ore and regulus from 25 to 45 per cent. of copper. February 11.

2456. W. Hawdon, London. Improvements in apparatus for removing molten slag or scoria from furnaces. February 12.

2483. R. Welford, Harrow. Improvements in obtaining gold, silver, and copper from ores and other compounds. February 12.

2538. W. J. Dobbs, T. Dobbs, and J. Dobbs, Wolverhampton. Improvements in the method of ensing or coating iron or other metallic tubes with brass or other sheet metal. February 13.

2704. E. J. Ball, London. Improvements relating to the manufacture of iron and steel. February 15.

2722. E. L'Homme, London. Improvements in certain metallic alloys. February 15, but antedated (under Patent Act, 1883, sec. 103) July 19, 1888, being date of application in Belgium.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

652. F. Herbert, J. E. Jordao, and C. G. Jordan. Cast-iron, steel, and other spigot and flange pipes. January 23.

814. P. Jensen.—From F. W. Martin. Process and apparatus for the manufacture of plates, sheets, &c. of copper, yellow-metal, naval brass, &c. January 23.

885. J. Otter, Crane for lifting and turning over large ingots during forging. January 30.

2182. J. Sinclair and J. P. Smith. Metallic compounds or alloys. February 20.

2778. F. Trickett and J. Noad. Extraction of gold, silver, and platinum from auriferous and argentiferous materials. January 30.

3179. E. Bowen. See Class II. January 16.

3369. A. Watt. Treatment of zinc ores. February 13.

3410. J. F. Hall. Manufacture and treatment of iron or steel. January 16.

3548. L. Q. Brin. Method and apparatus for making aluminium bronze. January 23.

3549. L. Q. Brin. Process and apparatus for obtaining alloys of aluminium, particularly aluminium bronze. January 30.

3741. C. Appleby.—From Rankin, Brayton, and Co. Ore-concentrating machinery. February 13.

3963. W. Holland, jun. Method and appliances for heating, hardening, and tempering metallic wire. January 16.

3965. T. R. Jordan. Extraction of metals from their ores by amalgamation, and apparatus therefor. January 16.

4014. C. Shannon. Manufacture of armour plates. February 13.

4086. J. C. Ball. Metallic alloys or compounds. January 23.

4281. J. Beasley and A. J. Wood. Lining or fettling for iron and steel furnaces. February 6.

4430. G. J. Atkins. Treatment of metallic ores, and apparatus therefor. January 30.

4842. G. A. Jarvis. Manufacture of sodium or potassium. February 6.

5116. J. Willis and Co. Anti-corrosive steam propeller blades and castings for marine, mining, and other purposes. February 20.

5665. W. Evans. Blast furnaces. February 20.

11,020. C. A. Faure. Producing aluminium chloride. February 20.

11,339. H. Ostermann and A. Prip. A new metallic alloy. January 16.

12,683. D. Hutton. Calcining pyrites and other gold-bearing ores. January 16.

13,117. J. Kleinpeter. Compound castings for armour plates or chilled castings and inset iron armour-plates. January 16.

13,234. L. A. Groth.—From O. Leprevost-Bourgerel and E. Pierron. Extracting tin from tin scrap. February 20.

14,833. A. E. Sarti. Copper amalgamating plates. January 30.

16,671. F. W. Koller and A. Breden. Process and apparatus for zincing metal articles. February 13.

17,068. H. H. Lake.—From O. B. Peck. Separating metals, &c. from molten slag. January 23.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

1888.

18,194. J. L. Roberts and H. L. Brevoort, London. Improvements in galvanic batteries and in the arts. Complete Specification. December 18.

18,589. J. L. Hulser, London. Improvements relating to secondary batteries. December 19.

1889.

1056. T. Pense, Liverpool. Improved electrical storage battery. January 21.

1313. E. M. H. Andreoli, London. Improvements in bleaching paper pulp and vegetable fibres by electrolysis. Complete Specification. January 24.

1401. J. T. Dyer, P. Fish, and R. C. Fish, London. Improved mode of generating electricity by dynamo-electric machines. Complete Specification. January 25.

1418. G. Kruss. See Class X.

1420. F. King, London. Improvements in secondary batteries. January 25.

1535. J. A. Timmis, London. Improvements in the construction and working of dynamos. January 28.

1571. T. B. Saunders, Bradford. Improvements in or appertaining to the process of galvanising iron and steel. January 29.

1673. G. Philippart, London. Improvements in the construction of secondary batteries. January 30.

1683. C. A. Caspersen, London. Method of determining the temper of iron and steel. January 30.

1861. W. J. S. Barber-Starkey, Manchester. Improvements in and connected with galvanic batteries. February 2.

2066. L. Paget, London. Improvements in the manufacture of electrodes for secondary batteries or accumulators. Complete Specification. February 5.

2079. A. H. Norman, London. An improvement in plates for secondary voltaic batteries. February 5.

2151. W. J. Woodward and F. H. Judson, London. Improvements relating to electric batteries. February 6.

2206. T. P. C. Crampton, E. G. Colton, and The Medical and Scientific Apparatus Company, Limited, London. Improvements in the electro-deposition of metals, specially applicable for deposition on fragile articles, or coating, plating, or forming articles of irregular surface. February 7.

2276. E. Guillon.—From M. Sappey, France. Improvements in the construction and arrangement of primary batteries. Complete Specification. February 8.

2297. C. Smith.—From W. L. F. Hellesen, Denmark. Improvements in primary and secondary transportable galvanic dry elements. February 8.

2331. W. H. Dowland and W. Mills, London. An improved apparatus for economically effecting the double decomposition of certain substances by the aid of electricity. February 9.

2407. A. Bernstein, London. Improvements in dynamo-electric machines. Complete Specification. February 11.

2472. W. L. Wise.—From The Gibson Electric Co. of Europe, France. Improvements in secondary batteries, and plates or elements therefor. February 12.

2514. A. Douglass and F. Smith, London. Improvements in the form and manufacture of secondary battery frames and plates. February 13.

2642. G. Forbes, London. Improvements in dynamo-electric machines. February 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

2314. S. L. de Ferranti. Electrical safety-fuses. February 13.
 2316. S. L. de Ferranti. Dynamo-electrical machines and apparatus used therewith. February 13.
 2411. L. Mond and C. Langer. Gas batteries. January 16.
 3556. N. G. Thompson. An electrical regenerative battery. February 13.
 4153. P. King. Means for regulating secondary currents derived from continuous current transformers. February 6.
 4940. T. Parker. Alternating current dynamo-electric machines. January 23.
 5528. H. Hermite, E. J. Paterson, and C. F. Cooper. Voltaic batteries. February 13.
 5723. W. Webster. Production of ethylheate waters by electrolytic action, and apparatus therefor. February 6.
 5790. H. Stenach. Preparation of non-metallic porous bodies for electro-metallurgical deposits. February 20.
 15,252. O. E. Madden and A. F. Mullen. Machines for making battery plates. January 23.
 15,369. P. A. Fichet and A. Nodon. Secondary batteries. February 6.
 17,223. L. Paget. Secondary batteries, and electrodes therefor. February 20.
 17,225. L. Paget. Generation of electricity, and the simultaneous production of zinc chloride and other products. February 20.
 17,349. P. M. Justice.—From E. L. Smith. Electro depositing cells. January 23.

1889.

319. W. P. Kookozey. Apparatus for charging and discharging storage batteries. February 13.
 326. W. P. Kookozey. Preparing solution compounds for galvanic batteries. February 13.
 746. O. Lugo. Secondary batteries. February 20.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

1888.

- 11,266. E. Bentz and M. Schloss, Manchester. Improved method and means of refining vegetable oils. December 14.
 18,454. H. de la Spere, London. The making of a medicated soap. December 18.

1889.

1142. H. Guthrie, Liverpool. Improvements in and connected with the manufacture of "oil cake," and expression of oil from oleaginous seeds or kernels. January 22.
 1430. J. Ascouzh. See Class XVIII. C.
 1501. W. McLay, Charlton. Improvements in lubricants. January 28.
 1610. J. von Froeschauer, London. Improved saponaceous compounds and processes for manufacturing the same. January 29.
 2325. R. Hunt, Liverpool. Improvements in treating crude cotton-seed oil and oils containing resinous matter and free fatty acids to obtain oil, soap, and resinous colouring-matter. February 6.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

7830. J. Taylor. Manufacture of soaps. January 16.
 14,526. W. P. Thompson.—From M. Crawford. Treatment of oil-bearing substances during expression of the oil, and presses for receiving and discharging such substances without intermission. January 16.
 16,328. M. Crawford. Treatment of oil-bearing substances during expression of the oil, and presses for receiving and discharging such substances without intermission. January 23.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

1888.

- 18,645. A. Melville, London. Producing a new black solid writing and copying ink, and a new black and coloured solid non-copying ink for writing and drawing. December 20.

1889.

1282. J. B. Hanney, Glasgow. Improvements in making a white pigment of lead, and in apparatus therefor. January 24.
 1346. J. W. Hall, London. Improvements in and to the manufacture of carbonate of lead or white lead. January 24.
 1434. J. B. Hanney, Glasgow. Improvements in treating or purifying sulphate of lead. January 26.
 1578. R. Stone, London. Improvements in the manufacture of paint and pigments. January 23.
 2026. E. G. Soltmann, London. Improvements in ink and colour slabs. Complete Specification. February 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

- 15,971. J. Danby. A cement or paint coating for protecting iron ships and other structures liable to corrosion. January 16.
 17,679. A. J. Boulton.—From W. Kiel. Vulcanised plastic compounds. January 30.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

1888.

- 18,307. J. Hauff, London. A new or improved process for the preservation of extracts and liquids containing tannin and used for tanning purposes, by means of cresol, naphthol, cresotic acids, and their soluble salts, as well as a process for preserving kips, skins, or hides by means of cresol, naphthol, and their carbon, containing acids in suitable solution or mixed with suitable solvents. Complete Specification. December 14.
 18,399. M. P. Halseck, London. An improved extract for use as a ferment, and as leather food or dressing. December 17.
 18,429. W. Barnsdale. An improved process for desiccating blood and other analogous substances. Complete Specification. December 17.

1889.

1345. B. Nicholson and T. Palmer. See Class I.
 1492. J. Palmer, London. Discolouring hemlock, mimosa, divi-divi, and other red tannins. January 25.
 2771. W. Gridley and F. B. Pike, London. Improvements in the manufacture or treatment of gelatinous substances. February 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

1818. G. W. Rhodes. Tanning by electricity. January 16.
 4765. A. H. Hobson. See Class XV.
 7007. C. L. Royer. Treatment of hides for belting. February 13.
 18,307. J. Hauff. See application above. January 30.
 18,429. W. Barnsdale. See application above. January 23.

XV.—AGRICULTURE, MANURES, Etc.

APPLICATIONS.

1888.

1617. F. Parlenkoff, London. An apparatus for obtaining a fertiliser by separating the liquid from the solid parts of excreta sewage, and the like, and by automatically mixing the solid parts with peat or the like. January 29.
 1710. W. Riddough, Bradford. Improvements in the means or method of treating or preparing certain refuse matter to increase its fertilising properties. January 31.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

4765. A. H. Hobson. Treatment of bones and animal refuse for rendering same suitable for fertilising purposes, and for obtaining gelatine, glue, and size. January 30.
 18,906. P. M. Justice.—From W. J. Williams. Manufacturing nitrogenous fertilisers from phosphates of iron and alumina. January 30.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

1888.

18,380, S. C. Whitting and G. Turk, Berlin. Improvements in the method of extracting starch from straw bollings. December 17.

1889.

16,000, G. B. Mee.—From E. C. da Silva, Brazil. Improvements in the extraction of sugar from syrups. January 29.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

245, W. H. Stead. Manufacture and purification of gums. January 16.

4209, A. Chapman. Sugar-cane mills. January 23.

4893, H. V. R. Read. Sugar-cane mills. February 6.

6030, R. Harvey.—From T. S. Cornish. Defecators for saccharine and other liquids. February 13.

6778, H. Kiel and R. Stoltenhoff. Manufacture of starch. February 13.

13,334, J. Grass, G. C. Heilman, and O. Olmce. Manufacture of saccharine liquors for brewing and other purposes. January 16.

1889.

75, O. Lenz. Manufacturing crystallised maltose. February 13.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

1888.

18,286, H. A. Birrell, London. Improvements in the treatment of ground malt for brewing purposes. December 14.

18,422, C. Philippart, London. Improvements in the treatment of alcohols and alcoholic liquors for the purpose of improving their quality. December 17.

18,618, C. M. Pielsticker, London. Improvements in the purification of alcohol. December 20.

1889.

1582, C. R. Bonne, London. Improvements in the preparation of fermentable, especially brewers', worts. January 29.

1912, G. G. Cave and J. H. Howell, Bristol. Improvements in apparatus for promoting circulation and aeration of brewers' wort. February 4.

2110, K. Moller, London. Apparatus, methods, and arrangements adapted for breweries, distilleries, and other installations for charging spaces or chambers with air free from micro-organisms (microbes) and their germs, and preventing air containing the same from penetrating therein and into wort and other substances. February 6.

2291, T. D. Challoner, Newcastle-on-Tyne. The manufacture of liquid yeast. February 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

3193, E. Thatcher. Manufacture of brewers' finings, and apparatus therefor. January 16.

3510, E. Maubre. Process and plant for treating cereals and starchy substances for making alcohol and vinegar, &c. February 6.

3574, B. W. Valentin. Improvement in brewing. January 16.

4616, K. Bernreuther and W. Kumpfmüller. Apparatus for ascertaining the degree of maceration of barley when malting. January 23.

13,534, J. Graso and others. See Class XVI.

15,261a, W. Kuhn. Treatment of beer, wine, and other liquids. February 6.

17,549, E. Barbe. Manufacture of vinegar. February 20.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

1889.

1201, W. Gerbel, London. Improvements in and relating to the manufacture of milk-powder and effervescent beverages. Complete Specification. January 22.

1423, F. McIntyre, Glasgow. An improved process and means for the preservation of milk. January 25.

1449, E. Pott, London. Improved mode of and means to be used in preserving organic substances. January 26.

B.—SANITARY CHEMISTRY.

1888.

18,568, C. H. Beloe, Liverpool. Improvements in and connected with the purification of sewage and other foul liquids. December 19.

1889.

1144, C. F. Gower, Ipswich. An improved apparatus for extracting the solid suspended matter from sewage or other liquid. January 22.

1628, J. Bradbury, London. Improvements in or relating to the construction of destructor furnaces, and in means for heating the same for burning noxious vapours, gases, refuse, garbage, and other analogous substances. January 30.

2381, B. D. Henley, Bamber Bridge. An improved method of applying gaseous fuel for treating towns' refuse and the fumes therefrom. February 11.

2541, J. Martin, London. A new or improved method of treating sewage and the effluent therefrom. February 13.

2543, G. Forbes, London. Improvements in apparatus for utilising town refuse. February 14.

C.—DISINFECTANTS.

1888.

18,620, J. Ascough, Birmingham. Improved antiseptic washing and cleansing compounds. December 20.

1889.

1430, J. Ascough, Birmingham. A new and improved method of manufacturing glazing, antiseptic, and washing compounds. January 26.

2537, A. J. Shilton, Reading. A new disinfectant and deodoriser. February 13.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1888.

3530, Brin's Oxygen Company Limited, and P. B. W. Goble. Carbonated oxygen water. January 23.

5042, J. White. Manufacturing flaked Indian corn. January 30.

12,774, H. H. Lake.—From F. S. Van Choate. Composition and devices for preserving animal and vegetable substances. February 6.

15,364, Sir E. B. Sladen, R. McLeod, and C. H. White. Treating Dangway beans as a substitute for coffee. February 13.

B.—SANITARY CHEMISTRY.

1888.

2561, R. E. Phillips.—From F. S. Harwood. Softening and purifying water. January 23.

2592, R. E. Phillips.—From F. S. Harwood. Disinfecting and purifying sewage. January 23.

4547, T. L. Seaton. Apparatus for separating solid matter from water or other liquids. January 30.

5861, G. W. Bremner. Preparation and combination of ingredients for precipitating and disinfecting sewage. February 13.

C.—DISINFECTANTS.

1888.

5631, J. Johnson. Composition for cleaning and disinfecting culinary and table utensils. February 20.

6407, H. H. Lake.—From C. H. Shaw. Disinfectants. February 20.

18,775, W. B. Giles, A. Shearer, and F. G. A. Roberts. Production of bisulphite and meta-bisulphite of sodium or potassium. February 20.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

1888.

18,658. A. Diana, London. An improved manufacture of paper and cardboard. Complete Specification. December 20.

1889.

1433. R. Hamilton and J. C. Hamilton, Glasgow. Improvements in treating or cleansing paper-making materials and other fibrous materials and fabrics. January 26.

1834. C. Ramsey, London. Improvements in the manufacture and bleaching of wood and other pulps, and apparatus for that purpose. February 1.

2432. D. M. Watson and T. T. M. Lumsden, Glasgow. Improvements in apparatus for the manufacture of paper. February 12.

2792. E. C. de Mejer and T. Greenwood, London. A new and improved method of manufacturing "paper-stucco." Complete Specification. February 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

346. J. R. Thame, Barrels, &c., made from paper or like pulp, and apparatus employed. January 16.

3321. A. Bensinger. Producing indelible designs on celluloid or like compounds. January 16.

4931. J. Turnbull, jun. Apparatus for boiling esparto grass, &c. February 6.

12,682. J. Maclear. See Class V.

17,692. O. Imray.—From J. R. France. Manufacture of celluloid, &c., and apparatus therefor. January 23.

17,876. A. Lundberg. Boilers for treating wood and other fibrous matters with acid solutions. January 16.

18,658. A. Diana. See application above. February 6.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATION.

1888.

18,521. E. Schnauffer and Hupfeld, London. The manufacture of a substitute for musk. December 18.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS.

1889.

1461. W. J. Wilson, London. Improvements in photographic transparencies. Complete Specification. January 26.

2623. J. Leisk, Lerwick. A new or improved flash lamp for the rapid combustion of magnesium powder to be used for photographic or other purposes. February 14.

2723. F. W. Hart, London. Apparatus for controlling the exposure of photographically-sensitive plates, when using flash-lamps. February 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

4537. J. B. Germeil-Bonnaud. Photographing in colours. February 13.

4874. E. S. Williams. Photographic emulsions. January 16.

XXII.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

1888.

18,362. J. W. Skoglund, London. Improvements in the manufacture of explosive compounds. December 15.

18,663. H. S. Maxim, London. Improvements relating to the manufacture of explosives, and to apparatus therefor. December 20.

1889.

1115. H. M. Chapman, London. Improvements in or relating to the manufacture or treatment of explosives. January 21.

1988. A. V. Newton.—From A. Nobel, France. An improved mode of preparing explosive compounds for use. February 4.

2017. W. R. Barlow, Woolwich. A hydraulic time fuse. February 5.

2678. O. Imray.—From P. C. Fraser, Germany. A process for granulating and glazing gelatinous explosives. February 5.

2346. H. T. Robinson, London. A tool for operating on fuse lighters of the kind known as "Bickford's patent colliery fuse lighters." Complete Specification. February 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

1471. A. V. Newton.—From A. Nobel. Manufacture of explosives. January 16.

3989. C. L. Dressler. Explosive projectiles. February 6.

5624. C. A. McEvoy. Improvements in fuses. February 20.

5961. M. E. Hall. Torpedoes. February 6.

1889.

635. R. W. Heenan. Apparatus for charging cartridges with pulverulent explosive. February 13.

XXIII.—ANALYTICAL CHEMISTRY.

COMPLETE SPECIFICATION ACCEPTED.

1888.

2367. J. Marx. Method and means for separating matters in solution by osmose, dialysis, or diffusion; or by electrolysis, or by a combination of those processes. January 23.

THE JOURNAL OF THE Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 3.—VOL. VIII.]

MARCH 30, 1889.

[Non-Members 30/- per ann.; Members 21/- per Set of Extra or Back Nos.; Single Copies 2/6.

The Society of Chemical Industry.

Past Presidents:

Sir H. E. Roscoe, M.P., LL.D., V.P.R.S.	1881—1882.
Sir Frederick Abel, C.B., D.C.L., F.R.S.	1882—1883.
Walter Welton, F.R.S.	1883—1884.
W. H. Perkin, Ph.D., F.R.S.	1884—1885.
E. K. Muspratt	1885—1886.
David Howard	1886—1887.
Prof. James Dewar, F.R.S.	1887—1888.

COUNCIL FOR YEAR ENDING JULY, 1889.

President: Ludwig Mond.

Vice-Presidents:

Sir I. Lowthian Bell, F.R.S.	David Howard.
R. Forbes Carpenter.	Ivan Levinstein.
Prof. F. Clowes, D.Sc.	E. K. Muspratt.
Sir J. Neilson Cuthbertson.	Sir H. E. Roscoe, M.P., F.R.S.
Prof. James Dewar, F.R.S.	Prof. W. A. Tilden, F.R.S.
Dr. John Evans, F.R.S.	John Williams.

Ordinary Members of Council:

Alexander M. Chance.	F. J. Rowan.
James Duncan.	Dr. Edward Schunck, F.R.S.
A. E. Fletcher.	E. C. C. Stanford.
S. H. Johnson.	J. C. Stevenson, M.P.
B. E. R. Newlands.	T. W. Stuart.
B. S. Proctor.	Thos. Tyrer.

With the Chairmen and Secretaries of Sections.

Honorary Treasurer:

E. Rider Cook, East London Soapworks, Bow, E.

Honorary Foreign Secretary:

Dr. Ferdinand Hürter.

General Secretary: Charles G. Cresswell.

Offices:

Palace Chambers, 9, Bridge Street, Westminster, S.W.

THE JOURNAL.

Publication Committee:

The President.

Sir F. A. Abel, F.R.S.	Prof. A. K. Huntington.
A. H. Allen.	F. Hürter, Ph.D.
Prof. H. E. Armstrong, F.R.S.	F. Jones, F.R.S.E.
G. H. Bailey, D.Sc., Ph.D.	Ivan Levinstein.
Joseph Bernays, M.I.C.E.	Prof. R. Meldola, F.R.S.
H. Brunner.	E. K. Muspratt.
W. Lant Carpenter.	C. O'Sullivan, F.R.S.
Prof. Frank Clowes, D.Sc.	John Pattinson.
W. Y. Dent.	W. H. Perkin, Ph.D., F.R.S.
Prof. Jas. Dewar, F.R.S.	Sir H. E. Roscoe, M.P., F.R.S.
John Heron.	John Spiller.
D. B. Hewitt, M.D.	A. Norman Tate.
David Howard.	Thomas Tyrer.
Prof. J. J. Hummel.	

Editor:

Watson Smith, The Owens College Manchester.

ASSISTED BY THE FOLLOWING STAFF OF

Abstractors:

T. L. Bailey, Ph.D.	A. J. King, B.Sc.
G. H. Beckett.	F. S. Kipping, D.Sc.
D. Bendix.	Chas. A. Kohn, Ph.D.
E. Bentz.	F. W. T. Krolin.
E. E. Berry.	T. A. Lawson, Ph.D.
E. J. Bovan.	J. Walter Leather, Ph.D.
Bertram Blount.	A. Liebmann, Ph.D.
Arthur G. Bloxam.	D. A. Louis.
C. H. Bothamley.	W. Maenab.
E. G. Clayton.	G. Harris Morris, Ph.D.
Julius B. Cohen, Ph.D.	J. M. H. Munro, D.Sc.
C. F. Cross.	H. S. Pattinson, Ph.D.
A. R. Davis.	H. T. Penttermann.
W. W. Haldane Gee, B.Sc.	S. G. Rawson, B.Sc.
C. Napier Hake.	A. Rée, Ph.D.
S. Hamburger, Ph.D.	F. W. Renaut.
Oswald Hamilton.	A. J. Smith, B.Sc.
John Heron.	A. Studer, Ph.D.
Bertram Hunt.	Bertram Thomas.
C. C. Hutchinson.	Eustace Thomas.
D. E. Jones, B.Sc.	V. H. Veley, M.A.
W. E. Kay.	R. Lloyd Whiteley.
	A. Wingham.

NOTICES.

Notice is hereby given that the Annual General Meeting will be held in London in the month of July next. Full particulars will appear in a subsequent issue.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Post Office Orders in payment of subscriptions should in all instances be made payable at the General Post Office, London.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

LIST OF MEMBERS ELECTED, 22nd MARCH, 1889.

Anderson, Clement W., Mass. Inst. of Technology, Boston, Mass., U.S.A., chemical demonstrator.

Callander, Wm. S., Mill Brow, Appleton, Widnes, alkali works manager.

Chase, Roseoe L., 1336, Spring Garden Street, Philadelphia, Pa., U.S.A., professor of chemistry.

Evans, Reginald E., Beaulieu, Mornington Road, Woodford, Essex, chemical student.

Ford, Jno. S., 11, Abbotsford Park, Edinburgh, chemical demonstrator.

Glaser, Chas., P.O. Box 437, Baltimore, Md., U.S.A., chemist and manufacturer.

Gregory, Wm., Trent Valley Brewery, Lichfield, brewer and chemist.

Heath, Geo. L., Mass. Inst. of Technology, Boston, Mass., U.S.A., chemist's assistant.

Hunt, Fred. J., Bow Bridge Soap Works, Stratford, E., soap maker.

Jarvis, Jno. W., 6, Princess Street, Leicester, headmaster, Newton's School.

Lewis, Arthur E., 3, Upper Fitzwilliam Street, Dublin, analytical chemist.

Lowman, Dr. Oscar, 185, Jefferson Avenue, Detroit, Mich., U.S.A., manufacturing chemist.

Scovell, M. A., Lexington, Kentucky, U.S.A., Director of Agric. Expt. Station.

Shield, Henry, Messrs. Fawcett, Preston, and Co., Ltd., 17, York Street, Liverpool, civil engineer.

Singer, Lematus, c/o J. Carter Bell, Higher Broughton, Manchester, manufacturing chemist.

Smith, George, 60, Whitworth Road, Rochdale, chemist.

Sulman, H., Livingstone, c/o Hopkin and Williams, Waterside, Wandsworth, chemist.

Taylor, Richard H., 21, Marjorie Street, Leicester, manager.

Tothill, Mortimer A. L., Kieboek Square, Cape Town, South Africa, manufacturing chemist.

Turner, Percy R., Tar Works, Rothwell Haigh, near Leeds, manager.

Williams, Outram F. Monier, Bow Foundry, Bow, E., ironfounder.

CHANGES OF ADDRESS.

Carnelley, Prof. T., 1/o Dundee; The University, Aberdeen.

Cunningham, A. Auchie, 1/o Edinburgh; American Sugar Refinery, San Francisco, Cal., U.S.A.

Doolittle, O. S., 1/o Altoona; Philadelphia and Reading Railroad, cor. 7th and Franklin Streets, Reading, Pa., U.S.A.

Dugzan, T. R., 1/o Clapton; Sunnysbank, Vanbrugh Hill, Blackheath, S.E.

Eschellmann, Dr. G., 1/o Northwich; c/o P. Eschellmann, O. 7, No. 8, Mannheim, Germany.

Hall, Edgar, 1/o Mitchell; Chemical Laboratory, The University, Sydney, N.S.W.

Hartley, Jos., 1/o Brook Road; Dalton Chemical Works, Brook Street, West Gorton, Manchester.

James, J. H., 1/o Old Broad Street; 337, Brixton Road, S.W.

Kay, H. A., 1/o 13; 71, Maida Vale, London, N.W.

King, C. M., 1/o Finchley; Helens, North Green, Highgate, N.

Lawrence, Jas., 1/o Toms River; Repanno Chemical Co., Gibbstown, N.J., U.S.A.

McCubbin, W. A., 1/o The Elms; Mill Bank, West Derby, Liverpool.

Metcalf, Wm., 1/o Stanhill House; Aspin House, Oswaldtwistle.

Miller, Geo., 1/o Runcorn; Fern Villa, Bold, Widnes.

Newbury, Prof. S. B., 1/o Cornell University; c/o Munroe and Co., Bankers, Paris.

Orr, Alex.; Journals to 118, Pitt Street, Sydney, New South Wales.

Samuel, W. Cobden, 1/o 203; 337, Norwood Road, West Norwood, S.E.

Smith, J. Tertius, 1/o Braintree; Tyne Vale Chemical Works, Forth Banks, Newcastle-on-Tyne.

Steinhart, Dr. O. J., 1/o Garrett Lane; 15, Bolton Gardens West, South Kensington, S.W.

Tennant, Sir Charles; Journals to St. Rollox, Glasgow.

Terry, Albert, 1/o London; c/o Buckhurst and Buxton, Clarendon Street, South Melbourne, Victoria.

Thomas, H., 1/o Sunderland; 9, Millicent Terrace, Gateshead.

Walsh, P. H.; Journals to Shadyside, Crescent Ridge Avenue, Clifton, Ohio, U.S.A.

Whitehouse, Enoch, 1/o 128; 118, Coventry Road, Birmingham.

Zinkeisen, Wm.; Journals to Krausenstrasse 61 III, Berlin, Germany.

NAMES WRONGLY OMITTED FROM LIST OF MEMBERS.

Rawcliffe, Harold, Gillibrand Hall, Chorley, Lancashire.
Stanning, John, Broadfield, Leyland, Preston.

Death.

Williams, John, 63, Warwick Gardens, Kensington, W. March 2.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	R. Messel.
H. E. Armstrong.	B. E. R. Newlands.
W. Lant Carpenter.	B. Redwood.
W. Crowder.	T. Royle.
W. J. Dibdin.	John Spiller.
C. Graham.	Wm. Thorp.
S. Hall.	C. R. Alder Wright.
C. C. Hutchinson.	

Hon. Local Sec. and Treasurer:

Thos. Tyrer, Garden Wharf, Battersea, S.W.

SESSION 1888-89.

- April 1st.—Dr. Percy F. Frankland. "The Action of Water on Lead."
"Messrs. Cross and Bevan. "Economy of Pure Caustic Soda."
May 6th.—Mr. C. Napier Hake. "Notes on Explosives."
June 3rd.—Messrs. Newlands Bros. "Improvements in Centrifugal Machines."
"Dr. W. S. Squire. "The Purification of Alcohol by means of Hydrocarbon Oils."
July. — Annual General Meeting.

Meeting held Monday, March 4th, 1889.

MR. DAVID HOWARD IN THE CHAIR.

SPECIFIC GRAVITIES OF PARAFFIN WAXES AT DIFFERENT TEMPERATURES.

BY LTJED L. REDWOOD.

As but few data have been published in regard to the specific gravity of paraffin waxes at different

temperatures, it is hoped that the following figures will be of interest and value, especially to manufacturers and those who have to deal with wax in the molten state.

Mr. Alfred H. Allen states* that the specific gravity of paraffin wax at a temperature of 140° F. is 780.5, and at a temperature of 208.4° F., 753; but he omitted to mention what the melting point of the wax was.

The same author, in a paper "On the specific gravity and some other characters of waxes and allied bodies"† shows that a wax of 130° F. melting point has a specific gravity of 909 at 60° F., and 753 at 210.2° F.

In the second edition of his "Commercial Organic Analysis," Vol. II., page 411, Mr. Allen gives the following table showing the specific gravity and melting point of paraffin wax from different sources:—

Origin of Sample of Wax.	Specific Gravity.		Solidifying Point, ° C.
	Solid, at 15.5° C.	Liquid, at 19° C.	
1. Shale oil	78506	77481	14.0
2. Shale oil	78961	77494	17.0
3. Shale oil	79000	77517	22.0
4. Shale oil	79111	77572	58.5
5. American petroleum	79083	77535	53.8
6. Ozokerite .....	..	77531	61.5
7. Rangoon tar	78831	77571	49.0

According to Mr. Galletty‡ the specific gravities of Boghead coal waxes, in the solid state, are as follows:—

Specific Gravity.	Melting Point.
823.6	89.6° F.
848.0	102.2
852.0	104.9
903.0	128.0
911.0	128.0
924.3	130.4
924.8	138.2
940.0	170.0

The specific gravities of refined American paraffin waxes as given below were determined, in the molten state, by weighing quantities of one litre, the flask being maintained at the given temperature while being filled, and for some time afterwards, by submersion in a vessel containing a large quantity of water at the required temperature; and, in the solid state, by making mixtures of alcohol and water of such density that the wax would remain suspended at any point in the liquid at which it might be

placed. The specific gravities of the mixtures were then determined by the specific gravity bottle.

Temp.	Specific Gravity of Molten Waxes.						
	F.	M.P.	M.P.	M.P.	M.P.	M.P.	M.P.
	108°	114°	120½°	122½°	122½°	128½°	133½°
160	770.69	771.93	773.91	770.79	770.23	775.73	777.23
155	771.19	773.30	775.31	771.49	771.63	776.53	778.53
150	773.09	774.73	776.57	773.19	772.83	778.03	780.03
145	775.09	776.20	777.77	775.19	774.63	779.73	781.53
140	776.79	777.63	778.47	776.89	776.33	781.33	783.33
135	778.99	779.53	781.47	778.69	778.43	783.03	..
130	780.49	781.13	782.67	780.29	779.73	..	..
125	781.99	783.43	784.41	..	..	..	..
120	783.59	784.73	..	..	..	..	..
115	785.29	..	..	..	..	..	..

Specific Gravity of Solid Waxes.					
M.P.	M.P.	M.P.	M.P.	M.P.	M.P.
106	111½°	120½°	122½°	125½°	131
60	875.25	882.30	898.95	901.05	903.50 908.65

These figures show that the variations in specific gravity are not quite regular, and that the rise from 135° to 140° affects the 108°, 120½°, and 122½° waxes much more than any of the other alterations in temperature; while the greatest alteration in the case of the 114° and 122½° waxes is between the temperatures 125° and 130°, and 145° and 150° respectively.

A curious peculiarity of the 122½° and 122¾° waxes will also be noticed, namely, that although they increase in specific gravity in the solid state with the rise in melting point, yet, in the molten condition they are lighter than waxes of a far lower melting point. This peculiarity was first noted in the 122¾° wax, and three separate sets of determinations were made, and as the results agreed exactly, it was thought that it might be a characteristic of one particular batch of wax. Therefore a second sample, but of 122½° melting point, was secured after a lapse of about 10 days, and as it was taken from a freshly cast cake it could have had no connexion with the first sample experimented with. This wax gave very similar results, and therefore it would appear that the peculiarity is a characteristic of, at any rate some, paraffin waxes of this melting point.

* This Journal, 1886, page 67.

† The Analyst, 1886, page 225.

‡ Alfred H. Allen's Commercial Organic Analysis, Vol. II, page 40 (first edition).

Liverpool Section.

Chairman : F. Hurter.

Vice-Chairman : A. Norman Tate.

Committee :

E. Bibby.	H. Gaskell, jun.
J. Campbell Brown.	S. Hamburger.
H. Brunner.	J. W. Kynaston.
E. Carey.	E. K. Muspratt.
H. Deacon.	G. Shack-Sommer.
T. Fletcher.	James Simpson.

Hon. Local Sec. and Treasurer :

W. P. Thompson, 6, Lord Street, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

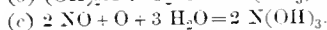
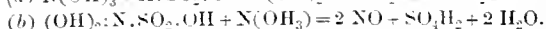
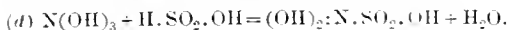
Meeting held Monday, 11th March 1889, at
University College, Brownlow Street.

DR. F. HURTER IN THE CHAIR.

MODERN THEORIES OF THE SULPHURIC ACID PROCESS.

BY DR. S. HAMBURGER.

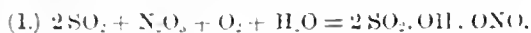
THE sulphuric acid process has proved, as regards theories, an inexhaustible mine to chemical philosophers. Chemists of the highest reputation found this process interesting enough to spend years of research over it, and although the literature of the process is already enormous, it appears that the final word has not been spoken. In 1887, Raschig, in order to supply a long-felt want, published a new theory (Annalen, 241, 242—250; this Journal, 1887, 820) which, to say the least, has the merit of originality. On investigating the action of sulphurous acid on nitrous acid, or more especially the action of sulphites on nitrites, he found that sulphurous acid did not reduce nitrous acid, either in an alkaline or in an acid solution. Products of condensation were always formed in the first instance, which, by their splitting up into simple compounds, made it appear as if a reduction had taken place. The formation of sulphuric acid in the vitriol chambers was explained by a series of similar reactions, and the process proper was subdivided into three phases :—



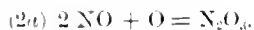
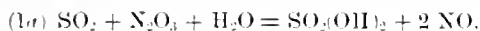
Nitrous acid first combined with sulphurous acid in the presence of water to dihydroxyamine sulphonic acid. The latter reacted with another molecule of nitrous acid to nitric oxide, and sulphuric acid and nitric oxide was finally reoxidised to nitrous acid. The reason for introducing this new intermediary product appeared to be based on the fact that solutions of nitrites and sulphites gave rise to the formation of a basic salt of the dihydroxyamine sulphonic acid. According to Raschig's own admission it would be scarcely possible to prepare this acid in a free state, as it at once reacts with another molecule of nitrous acid. It is not my intention to-night to criticise Raschig's theory, especially as this subject has been very extensively treated (Ber. 21, 67—87; this Journal, 1888, 208) by the

distinguished author of the classical Handbook on the Manufacture of Sulphuric Acid and Alkali. I therefore content myself this evening with laying before you the principal arguments which Professor Lunge, in upholding and extending his own theory, brings forward against that proposed by Raschig. Lunge first of all calls attention to the fact that Raschig, in establishing his new theory, never experimented with nitrous or sulphurous acid in a gaseous state, nor did he make experiments with gases taken from vitriol chambers in actual work. The first equation (a) must be rejected, as, according to Raschig's own admission, dihydroxyamine sulphonic acid can only be formed if aqueous solutions of nitrites and sulphites act upon each other at a certain concentration and at a temperature below freezing point. Such conditions never occur in any part of the vitriol chamber. According to equation (b) the dihydroxyamine sulphonic acid formed would at once react *in statu nascendi* with nitrous acid, giving rise to the formation of nitric oxide. But in order that this reaction may take place, nitrous acid must be present in excess in every part of the chamber, as, in the absence of nitrous acid, the dihydroxyamine sulphonic acid splits up into sulphuric acid, nitrous oxide, and water. It is scarcely probable that the dihydroxyamine sulphonic acid would always find nitrous acid ready at hand, and consequently nitrous oxide should be found in more than moderate quantities in the gases of the vitriol chamber, which is fortunately not the case, as it would be equivalent to a great loss of "nitre," nitrous oxide being, as is well known, a very stable compound. Neither does equation (c) correspond with facts ascertained by actual experiments. Nitric oxide, oxygen in excess, and water produce nitric acid, and, in the absence of water, nitrogen peroxide. Again, if nitric oxide and oxygen combine in contact with sulphuric acid, nitrososulphonic acid is formed. Raschig finds a support of his theory in the fact of having found 0.0028 to 0.0138 per cent. of ammonia in chamber acid, and thinks the latter the final product of his reactions; but it is just as likely for small traces of ammonia being produced more simply by the complete reduction of nitrogen oxides by sulphurous acid. If Raschig asserts that his theory alone accounts for nitrous acid acting on sulphurous acid only in the presence of water, he evidently overlooks the fact that sulphuric acid— SO_3H_2 —and not sulphur trioxide— SO_3 —is formed in the chambers, and that apart from other considerations, the sulphuric acid must not be too concentrated, to avoid the solution of very much nitrous acid, which would thus get temporarily eliminated from the process. Why is it necessary at all to leave out of consideration the gases, admittedly present in the chambers in enormous quantities, and call to assistance compounds which no one has ever seen or suspected, which the author himself proclaims as unable to exist in a free state, and which are made to undergo changes under circumstances which are never likely to occur in vitriol chambers? Raschig's theory is, therefore, not likely to revolutionise our present ideas on the sulphuric acid process, but Lunge adds, the time has now arrived when to modify his own theory to some extent. In 1885 Lunge, in bringing his views before the scientific world, stated that sulphuric acid combined with nitrous acid, oxygen, and a small quantity of water, to nitrososulphonic acid, which hovered as a mist in the atmosphere of the chamber. On meeting with more water, which was also distributed as a mist, the nitrososulphonic acid was split up into sulphuric acid, which fell to the bottom, and nitrous acid, which could act afresh. It was, therefore, the

nitrous acid, and not the nitric oxide, which played the part of oxygen-carrier in the sulphuric acid process, and the reactions were represented by the equation 1 and 2, thus:—

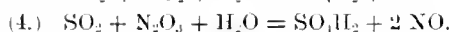
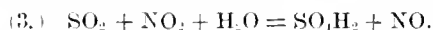


At the same time the admission was made that local circumstances might partly modify and complicate these principal reactions. Lunge and Naef proved, in 1884, that the composition of the nitrous gases in a chamber working under normal conditions was incompatible with the presence of nitrogen peroxide. In the first chamber nitric oxide was also present, later on only nitrous acid could be detected, whereas nitrogen peroxide made its appearance, if the excess of nitrous compounds in the latter part of the chamber system was abnormally large. It might be objected that the existence of nitrous acid in a gaseous state was still doubtful, but this made no difference, as the theory held equally good for nitrous acid as a hydrate— NOOH . As a further objection against the nitrous acid theory, the argument has been brought forward that the analyses of the gases might be equally well interpreted as showing the presence of a mixture of nitric oxide and nitrogen peroxide. But could this objection be upheld? Would it not be curious, if one molecule of nitric oxide were always accompanied by one molecule of nitrous acid, never by more, never by less? The universally admitted fact of the ready oxidation of nitric oxide also spoke against this supposition. Again, in the atmosphere of the chamber, many particles of sulphuric acid and water floated as a mist; the former on meeting with nitrogen peroxide was bound to form nitrososulphonic acid and nitric acid, and still more of the latter would be produced by the reaction of nitric oxide, oxygen and water. The whole amount of nitric acid would be dissolved in the chamber acid, as nitric acid is only slowly reduced by sulphurous acid or nitric oxide. Such quantities of nitric acid in the chamber acid would be readily detected, whereas the chamber acid contained, as a rule, very little nitric acid. If it were now admitted that the yellow-red fumes in a vitriol chamber chiefly consisted of nitrous acid, the sulphuric acid process would apparently also conform to Berzelius' theory, as shown in the equations 1a and 2a.

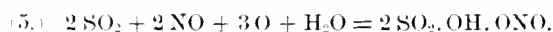


Lunge can no longer give his adherence to this theory. Firstly, wherever sulphuric acid is formed a large amount of nitric oxide should be found side by side with nitrous acid, whereas the analyses of gases taken from different parts of the chamber system prove that, as a rule, this is not the case. Secondly, nitric oxide and oxygen do not form nitrous acid in the immediate contact with sulphuric acid, and consequently all theories based on the reduction of the nitrous gases to nitric oxide must be rejected. It corresponds far more with facts to adopt the theory based on the formation of nitrososulphonic acid and its subsequent decomposition by steam. In connexion herewith it is important to remember that although sulphuric acid of the concentration of the chamber acid dissolves appreciable quantities of nitrososulphonic acid at common temperatures, the conditions in the vitriol chambers are altogether different. There, particles of the various compounds are intimately mixed in a fine diffusion and at an elevated temperature, which circumstances are all in

favour of the decomposition of the nitrososulphonic acid by steam, which is present everywhere. Indeed, before the general introduction of the Glover tower, nitrous vitriol was subjected to the treatment with steam for the purpose of denitration, which reaction is identically the same. It has been previously mentioned that Lunge and Naef found nitric oxide in the thick white fumes of the first working chamber just behind the Glover tower, and Lunge admits that his theory requires a modification for this part. Here sulphurous acid, nitrous gases, oxygen and water meet in the highest state of concentration, here the highest temperature predominates; it is also here that the reaction proceeds most freely, and the formation of sulphuric acid is most abundant. Under these circumstances it is not unlikely that a portion of the sulphurous acid is directly oxidised to sulphuric acid, thus:—



These reactions account for the presence of nitric oxide, which, no doubt, is afterwards oxidised, not simply by oxygen, but by oxygen in the presence of sulphurous acid and steam, thus:—

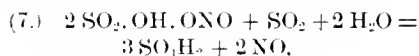


It is worth repeating that the gases of the second chamber contain nitrous acid only, and no nitric oxide.

A local excess of steam may oxidise nitric oxide to nitric acid, which, being in a gaseous state at the prevailing temperature, is quickly attacked by sulphurous acid and converted into nitrososulphonic acid according to the equation:—



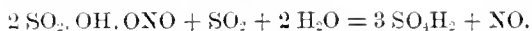
The oxidation of nitric oxide to nitrogen peroxide cannot here take place, as this reaction would require dry oxygen, which is out of the question in the comparatively steam-laden atmosphere of the chamber. There is still another explanation for the occurrence of nitric oxide in the first part of the chamber. It is quite conceivable that the excess of sulphurous acid, steam, and a high temperature, combine to denitrate nitrososulphonic acid, thus:—



This is indeed the same reaction which goes on immediately before in the Glover tower, where the nitrous vitriol from the Gay-Lussac tower, which is, of course, a solution of nitrososulphonic acid in sulphuric acid, is subjected to similar conditions. To sum up. According to Lunge, the equations 1 and 2 represent the principal reactions of the sulphuric acid process proper. Temporary and local conditions may alter the state of things to some extent, as shown by the equations 3 to 7. Or in other words: the sulphuric acid process is not an alternate reduction and oxidation of nitrous gases, but depends rather on a condensation of nitrous acid (or nitric oxide) with sulphurous acid and oxygen to nitrososulphonic acid, and on a splitting off of the nitrous acid by the action of steam on nitrososulphonic acid.

No theory on the sulphuric acid process can be considered complete or satisfactory that takes no cognisance of the unavoidable loss of "nitre" during the process of manufacture. Whereas the "mechanical" loss will vary in different works with the apparatus in use, the scientist may confine himself to

the explanation of the "chemical" loss. Raschig pleads for his theory that it is the only one which rightly explains this loss. Whereas, theoretically, a certain quantity of nitrous acid should oxidise an infinite amount of sulphurous acid, we find in practice that 1 mol. of nitrous acid is actually consumed for every 75 mols. of sulphurous acid. In other words, of every 75 mols. of nitrous acid introduced into the chamber, one does not return to it in a useful form: in what manner it is lost is not positively known. If the formation of dihydroxyamine sulphonic acid be admitted as an intermediary product of the sulphuric acid process, it may occur that one molecule of this compound on the point of splitting up does not find ready at hand the second molecule of nitrous acid, which is necessary to form nitric oxide. The dihydroxyamine sulphonic acid would then split up to sulphuric acid and nitrous oxide, which latter is lost to the process. To avoid this, care must be taken to have always a large excess of nitrous acid in the chambers, and nothing is better known in the practice of the sulphuric acid maker that the loss of nitre is least under these circumstances. Furthermore, it is conceivable, that dihydroxyamine sulphonic acid sometimes reacts with sulphurous acid instead of with nitrous acid, and is thereby reduced to hydroxyamine disulphonic acid, hydroxylamine, and even ammonia. As previously mentioned, Raschig has proved the existence of minute quantities of ammonia in a crude chamber acid, which contained no nitrous acid. His experience has recently been confirmed by Mr. Hasenlever of the "Rhenania" and Dr. Häussermann of Griessheim, near Frankfurt a M. Lunge's explanation of the "chemical" loss of nitre is based on the formation of nitrous oxide and nitrogen peroxide, and he traces the causes that tend to bring about this undesirable result. The reduction of nitrous acid to nitrous oxide by sulphurous acid can only take place in the presence of much water or a more dilute acid than ever occurs in vitriol chambers. The excess of water in chambers being at best local only, this reaction takes place comparatively rarely. Far more frequent is the occurrence of nitrogen peroxide in the latter part of the chamber system. Its presence is altogether independent of the amount of oxygen present at the same time, but is caused by the excess of nitrous gases being exceptionally large. Under these circumstances the reaction is completed long before the gases leave the last chamber. No mist of sulphuric acid hangs here, nor is there any sulphurous acid left. The nitrous acid no longer finds compounds with which to combine, and is gradually dissociated in the large excess of oxygen and ultimately oxidised to nitrogen peroxide. One portion of the latter reacts with the chamber acid to form nitrososulphonic acid and nitric acid, whereas another portion enters the Gay-Lussac tower, the acid of which is unable to absorb this extra addition of nitrous gases. The process proceeds still more unfavourably if the supply of nitrous gases be insufficient. The formation of sulphuric acid in the last chamber is then very slow, and there is much sulphurous acid left, which, from want of nitrous acid, acts on the nitrososulphonic acid according to the equation—



Plenty of nitric oxide is formed, which, on account of the low temperature prevailing, combines only very tardily with sulphurous acid, despite the large excess of oxygen. The steam may also oxidise nitric oxide to nitric acid, which sinks unredacted into the chamber acid, thus still more depriving the chambers of their nitrous constituents. Another portion of nitric oxide is reduced to nitrous oxide, as there is

little sulphuric acid in the atmosphere compared with the amount of steam. Furthermore, some nitric oxide escapes unaltered into the Gay-Lussac tower, and, although there is oxygen present to oxidise it, still it is very much diluted with nitrogen, and the sulphurous acid also present counteracts oxidation. Under these circumstances it is frequently the case that the gases appear colourless on entering the Gay-Lussac tower, but turn reddish when they leave the tower and pass into the air. All these factors combine to bring about not only a great loss of nitre, but also a bad yield of sulphuric acid, and the loss grows all the more the poorer the chambers become in oxygen-carriers. That is also the cause of the well-known fact that, if the chambers are in this condition, the extra addition of nitre must be greatly in excess of that usually required, in order to bring the chambers back to their normal state of working. It will be seen that Raschig's and Lunge's views are here again at variance, for the former supposes the dihydroxyamine sulphonic acid to split up into sulphuric acid and nitrous oxide, whereas the latter (and Weber before him) maintain that nitrous oxide cannot be formed here, as it could only be produced from nitric oxide where sulphuric acid is rigidly excluded.

Lunge's severe criticism called forth a reply from Raschig (*Annalen*, 248, 123—140) (this *Journal*, 1888, 747), but the impartial observer will probably come to the conclusion that Raschig somewhat shifted his original position, and, in lieu of strictly answering Lunge's objections, preferred an attack on the "*tu quoque*" principle. This attack by Raschig was followed by another article by Lunge (*Ber.* 21, 3223—3240), and as both investigators have given notice to lay down arms, I have, in conclusion, the honour of laying before you the state of affairs between their rival theories. Raschig still upholds his dihydroxyamine sulphonic acid theory, which he calls a modification of Berzelius' theory. He contends that, although there is no probability of the existence of the dihydroxyamine sulphonic acid, his equation (a) need not be wrong on that account. The same may be said of Lunge's nitrososulphonic acid, "the existence of which even in small traces has never been proved in a well-working chamber." His second equation (b) is very valuable, as it shows the reason and the necessity for having nitrous acid everywhere in excess, in order to prevent the formation of nitrous oxide. Neither Berzelius' nor Lunge's theory explains the injury done by a decreased supply of nitre. His third equation (c), which may be also written $2 \text{NO} + \text{O} = \text{N}_2\text{O}_3$, is the same as that first introduced by Berzelius; and as Lunge denies its correctness, Raschig now brings forward experimental evidence in support of this equation, viz., that nitrous acid is certainly formed from nitric oxide and air. In his reply, Lunge claims credit for having been the first to point out the fact that it was nitrous acid exclusively, and no other nitrogen compound, that played the part of oxygen-carrier in the vitriol chamber. From Berzelius' writings it is clear that he was unacquainted with the fact that nitrous acid and nitrogen peroxide are separate compounds. Raschig's theory, therefore, is at best only a modification of Lunge's own. As regards Raschig's statement of the non-existence of nitrososulphonic acid, Lunge adds that every one acquainted with the process knows that both the chamber acids and the drips are daily tested for "nitre"—that is, their percentage of nitrososulphonic acid. To put the latter on the same footing as the dihydroxyamine sulphonic acid betrays a want of knowledge of the simplest facts of the sulphuric acid process. Raschig's statements show that he is

unable to interpret the results of experiments. He always draws a wrong conclusion or quotes experiments which have no connexion with the process going on in the chambers. In trying to prove the oxidation of nitric oxide by air to nitrous acid, he uses an apparatus which is badly arranged and does not allow of a thorough mixing of the gases. If this fault be remedied, nitrogen peroxide is the product of oxidation, as previously asserted by Lunge.

I have now given you a report of the latest investigations on this highly-interesting process. I think most of you will agree with me that Professor Lunge, in his thorough manner, has well nigh exhausted the subject, and unless our present means of investigation are enriched, Lunge's explanation of the reactions of the sulphuric acid process will not be shaken for some time to come. A future generation may strike out in a new direction, and some day Lunge's theory may receive the same pitiless treatment which he dealt out to his opponent.

Raschig's supposition of the dihydroxyamine sulphonic acid as an intermediary product is certainly bold, and we almost feel sorry that his facts are not on a par with his imagination. His explanation of the "chemical" loss of nitre is beautifully simple, but until he gives his supposition a more solid foundation by facts, we are bound to reject it. On the other hand, most of you will feel inclined to agree, on the whole, with Lunge's views; but I, for my part, am not satisfied with his explanation of the loss of nitre during the process. I am not speaking of certain extremes, where the supply of nitre is largely in excess or very deficient. Here Lunge may be right, although I doubt whether, in well-managed works, the amount of nitrous gases in the chambers is ever in so large an excess that nitrogen peroxide is found in large quantities in the last chamber. I may add that this is certainly against my experience. I never found more than traces of nitrogen peroxide in the gases entering the Gay-Lussac tower. You all know that a certain loss of nitre takes place even if the system works extremely well, the greater part of which comes under the head of "chemical" loss, and it is this loss which, in my opinion, has never been explained beyond doubt. I think I am well within the mark if I put down the mechanical loss of nitre at 25 per cent. of the total loss. In addition to it, there is a loss, due to an escape of nitric oxide, which leaves the system unoxidised; this loss is rarely more than 6 per cent. on the total nitre lost. There still remains another source of loss, viz., the reduction of nitrous gases by sulphurous acid in the presence of much water. Eschellmann estimates this reduction at 31.5 per cent. of the total loss, although I think this figure far too high. This liberal estimate at best accounts for two-thirds of the total nitrate used, and it seems only too likely that a reduction of nitrous gases into irrecoverable compounds is taking place during the process, probably in consequence of secondary reactions which are still unknown to us. Until more light is shed on this dark phase, we can scarcely hope to do away with the *bête noire* of the sulphuric acid maker, viz., the loss of nitre.

DISCUSSION.

Dr. HURTER said he was sure that they had all listened with great pleasure to the able account Dr. Hamburger had given them of the two rival theories of Raschig and Lunge. Dr. Raschig, in the course of researches on an entirely different subject, had evolved a theory of the sulphuric acid process based on the formation of dihydroxyamine sulphonic acid. As Dr. Hamburger had

said, in some respects it seemed a pretty theory, since it at first sight appeared to account for the unavoidable passage of nitrogen compounds from the chamber in a form in which they could not be recovered. He (Dr. Hurter) agreed with Lunge that Raschig's body could not be made the basis of a theory of the sulphuric acid process, since it had no existence under the conditions which obtained in the chambers.

Professor Lunge had done more in recent years to throw light upon the reactions which went on in the sulphuric acid chambers than any other investigator, and his theory was based upon the existence in the gaseous state of nitrous anhydride. They were aware that several eminent English chemists had objected to this, and published experiments which seemed to prove that nitrous anhydride did not exist as a gas. But it was sufficient for Lunge's theory if the nitrous anhydride existed as a gas only for a few moments, and his experiments seemed to demonstrate such an existence satisfactorily. Lunge's theory amounted to this: The main reaction was: sulphurous anhydride, oxygen, steam, and nitrous anhydride together formed nitrososulphonic acid, and this was decomposed by steam into sulphuric acid and nitrous anhydride. The secondary reaction was based upon the same combination, but instead of the nitrososulphonic acid being decomposed by steam, it was decomposed by sulphurous anhydride, with formation of sulphuric acid and nitric oxide. If Lunge had made his secondary reaction into his main reaction he would have been more in harmony with the facts, as established in the paper published in conjunction with Dr. Naef. That paper showed that where much sulphuric acid was produced much nitric oxide existed, whilst where little sulphuric acid was made little nitric oxide was found. This seemed to indicate a connexion between the formation of sulphuric acid and nitric oxide of more importance than Lunge had ascribed to it.

He would take the opportunity to call attention to another point of that paper of Lunge and Naef, about which he had been frequently questioned. These gentlemen found, both in works in Switzerland and in England, that the chief amount of sulphuric acid which was made in any chamber of a series was made in the first half of the chamber, and that the second half of the chamber did comparatively little. To many (himself included) this appeared incredible, considering the uniform distribution of all the gases through the chamber, according to Professor Lunge's own facts. The fact was that Lunge and Naef did not measure the amount of sulphuric acid made, they simply ascertained a rapid decrease in the percentage of sulphurous acid. But whether this decrease was due to the formation of sulphuric acid, or to a mere intermixture of the rich gases as they entered with the poorer gases of the chambers, no gas analysis could demonstrate. It would be easy to prove, with a few elementary equations, that it was utterly impossible for gas analysis to distinguish between the two causes for the decrease of sulphurous acid. Consequently, gas analysis could not be appealed to to say how much and where the sulphuric acid was made inside any particular chamber. The difference of percentage at inlet and outlet of a particular chamber could and would tell how much sulphuric acid was made in the particular chamber as a whole, but any further information gas analysis could not give.

Dr. S. HAMBURGER, in replying, said that if Dr. Hurter had seen the article in last week's *Chemische Industrie* by Schertel, he (Dr. Hurter) would not have told them all that he had about

the amount of acid made in different parts of the chamber. Schertel repeated Lunge and Naef's experiments, and completely confirmed them in that the first half of the chamber made the vastly greater portion of the acid, whereas in the latter half very little acid was made. Schertel did not agree with their explanation, and accounted for it in the following manner: In his opinion the nitrososulphonic acid required a great deal of steam to be decomposed. The steam in the chambers was very quickly taken up by the sulphuric acid formed, and the nitrososulphonic acid in the second part of the chamber did not find sufficient steam for decomposition, and consequently there was a scarcity of nitrous acid in that part. Dr. Hurter did not tell them that, when the gases went from the second part of the chamber into the next chamber, the reaction became very energetic and lively again (Dr. HURTER: "Yes, I said it"), and that the reaction became very energetic because of the fresh steam added. Schertel had illustrated this by an experiment which seemed to show that nitrososulphonic acid really required far more steam than was generally supposed. He passed gases as escaping from the first chamber through a long pipe filled with coke into the second chamber. Now, the acid formed in the pipe was only 98° Tw. strong—they would admit that it was far weaker than acid usually made in the chambers. When this pipe was opened a large amount of chamber crystals were found on that side of the coke which faced the current of the gas. Now, it could not be said that they were formed owing to want of water or steam; but it was worth remembering that they were formed in the presence of very much steam. He therefore thought that Schertel was right in ascribing the cause of the second part of the chamber not working as actively and energetically as the first part to want of steam, or, what came to the same thing under the circumstances, to want of nitrous acid.

Dr. HURTER: How did he ascertain that the first part of the chamber did all the work?

Dr. HAMBURGER: By gas analysis.

Dr. HURTER said that, in his opinion, was no use. He would only say that there was a good deal of difference of opinion, but at one time at Messrs. Gaskell, Deacon, and Co., before Glover towers were introduced, the production of sulphuric acid was worked out by means of rain gauges, and if he had happened to think of it he could have brought the books to show them how far the amount calculated from the rain gauges agreed with the amount of salt cake made, and he could assure them it did not differ more than 5 per cent. up or down. On the whole it came out exceedingly fair. Now if any member would use a rain gauge, and would tell him at the next meeting what amount of acid was collected at one end and what amount at the other end of a chamber, he would be glad. They made the experiments for Sir Henry Roscoe, and found very little difference between the two ends of the chamber.

AN IMPROVEMENT IN THE MANUFACTURE OF CHLORATE OF POTASH.

BY M. J. HAMMILL.

I HAVE ventured on reading a short paper on this subject, in the hope that it may be of some interest to members of this Section, and perhaps through the medium of our Journal to others interested in the manufacture of chlorate of potash. All such are well aware that, in the usual method of manufacture, there is a very considerable loss of chlorate in the mother-liquors of the first crystallisation, owing to the fact that it is not possible to crystallise out more, than about, on the average, from 76 to 77 per cent. of the total chlorate contained in the mixed solutions of potassium chlorate and calcium chloride, the remainder being left in the mother-liquor and altogether lost, except in some cases, so far as its chlorine is concerned. It is also a well-known fact that chlorate of potash is less soluble in cold than in warm solutions, and that in practice less chlorate is lost in cold than in warm weather or climates. The consideration of these facts led Mr. Wyld, Mr. Auer, and myself, to experiment on these liquors, by artificial refrigeration, in the hopes of obtaining thereby an increased production of chlorate. Our experiments were carried out at first in the laboratory, and subsequently at the works of the Widnes Alkali Company, Limited, on a manufacturing scale, and the results obtained were sufficiently satisfactory to warrant us in obtaining a patent for the process, no one having previously occupied the ground. These results I will to-night lay briefly before you. But first let me say, that we found, on lowering the temperature of highly concentrated solutions, calcium chloride crystallised out as well as chlorate of potash; but in less concentrated solutions this difficulty is avoided.

Subsequent experiments proved that—

In mother-liquors of—

° Tw.	° F.
82 CaCl ₂ begins to crystallise out at about 36	
80 " " " " " "	30
78 " " " " " "	24
76 " " " " " "	19
75 " " " " " "	11
74 " " " " " "	8
72 " " " " " "	- 10
70 (no calcium down at - 13° F.)	

Having ascertained these facts, we determined that it would be necessary, or at all events advisable, to dilute all solutions to the density at which it would be safe, without risk of crystallising out any calcium chloride, to reduce the temperature to the required point. It will be noticed that liquors of 72° Tw. or under may be safely reduced in temperature to below zero.

We next proceeded to carry the refrigeration of mother-liquors to a practical working trial, and for this purpose hired from Messrs. Siddeley and Co., of Liverpool, an ether refrigerating-machine (Mackay's patent), which they happened to have on stock, and which they were willing to let on hire for the trial. This machine is of a capacity equal to the manufacture of two tons of ice per day, and it was obviously not sufficiently powerful to reduce to zero the total quantity of our mother-liquors resulting from the manufacture of some 10 tons chlorate per week; but it was, we thought, sufficient to prove on a working scale the practicability or otherwise of recovering sufficient chlorate to reasonably repay the outlay for plant and the cost of treating a given amount of liquor.

I need not describe the apparatus in detail, as the principle of these machines is so well understood; and as they have for most purposes been superseded by machines using ammonia, the agent which is now generally allowed, on account of its great power of absorbing heat, owing to its high latent heat and the tension of its vapour, to be the most suitable for refrigerating purposes. The question of refrigeration is quite a subject—and a very interesting subject—of itself; and if any of my hearers or readers are desirous of extending their knowledge or refreshing their memories on the subject of refrigerating methods or machinery, they cannot do better than refer to three papers already read before Sections of this Society. I refer to a paper read by Mr. J. J. Coleman before the members of the Glasgow Section in May 1884; to one read by Mr. T. B. Lightfoot before the London Section in March 1886; and to one by Mr. G. E. Davis, read before the Manchester Section in April 1887. These papers deal somewhat exhaustively with the question of the various methods of refrigeration, and the advantages claimed for each, and I will not attempt to dwell on this side of the subject further than to say that, after full consideration, we have selected, and are now having made, a machine (of a capacity of six tons of ice per day) on the ammonia-absorption principle, manufactured, under the Mackay-Christiansen patent, by Messrs. Siddeley and Co., Limited, of Liverpool. This machine, which is of recent introduction, and but little known at present, commended itself on account of its possessing several distinct advantages to users who require a machine almost constantly at work and requiring very little attention.

I will, however, leave this branch of the subject, and proceed to give a short summary of the methods we have employed, and the results we have obtained on a two months' trial, with the 2-ton (ice-making capacity) ether machine, which, as I have already stated, was not powerful enough for our full work, and especially failed to reduce the temperature of the liquors with sufficient rapidity below about 15° F. To that point we were able, with this machine, to go with tolerable ease, but below that the reduction in temperature was very slow.

It was, of course, necessary to provide a tank or tanks in which to store and refrigerate the liquors, and for convenience in working it is better to provide two tanks, each capable of holding (as time, as well as cold, is required to obtain the best results) one week's liquors after their dilution to the required strength: No. 1 tank to be operated upon whilst No. 2 is being filled up, and No. 2 tank to receive a like attention whilst No. 1 is being emptied and refilled. There is thus no loss of time, which would be inevitable were only one tank employed. These tanks are each provided with a coil of 3-inch cast-iron piping, for the circulation of the brine or calcium chloride, the medium by which the heat is transferred from the liquor in the tanks to the refrigerating apparatus. The coils are arranged as shown in Figures 1, 2, and 3.

Fig. 1.

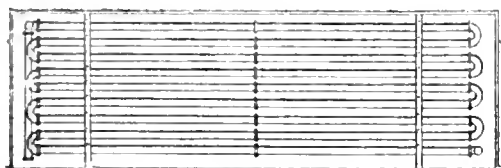


Fig. 2.

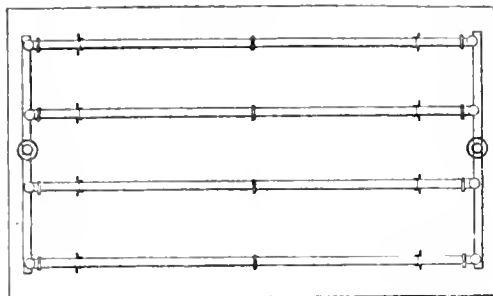
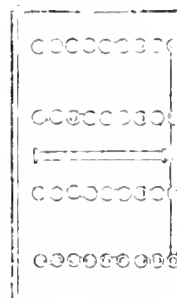


Fig.



The tanks are also lagged with boarding fixed about 3 inches from the iron, and the cavity between filled in with sawdust or other non-conducting material, to prevent heating by radiation. The top of each tank is also covered in with timber. It would obviously be an improvement to introduce some kind of fan or stirrer to keep the liquor in gentle circulation. This may easily be driven by means of a strap and pulley from the engine which drives the brine and ammonia pumps, and this we have provided for in the new and more powerful apparatus which we have ordered; but, so far, we have had nothing of the sort. The man in charge of the apparatus, who has otherwise very little to do, has occasionally stirred up the liquor with a wooden plunger.

When the required temperature is reached the stirring up is stopped for an hour or two, and then the contents of the tank are discharged by a tap (not shown in the tracing) fixed about 9 inches from the bottom. After the liquor is run off to this level the remainder is run out by raising a plug fixed in the bottom of the tank. This latter portion of the liquor, as it is liable to carry away some of the fine crystal, is strained through a canvas strainer, placed conveniently for the purpose.

The refuse liquor may, or may not, as may seem advisable, be run to the still and treated with HCl to set free the chlorine it contains; but it is plain that in this large bulk of liquor, reduced to a very low temperature, we have a very considerable amount of cold-producing power, which might with advantage be employed either to reduce the temperature of the next batch, by being pumped through the coil in the second tank, or in some other way. One very obvious use for it would be to employ it instead of, or supplemental to, the water used for vitriol cooling. Whatever use may be made of its cooling power, it would be no worse, but rather better, for subsequent treatment with HCl, if desired, in the still.

When all the liquor is run off the men go into the tank (the coils being far enough apart to admit of their free movement therein), and brush the crystal off the pipes and the bottom of the tank through a sluice valve into lead-lined barrows, and take it away to be dried in the centrifugal machine. As the crystal is in a very fine state of division, more than the ordinary quantity of it passes through the wire of the centrifugal machine, and it is advisable that all that escapes from the machine should be collected and sent back to the boiling-down pans: waste from this source is thus prevented. The dried crystal—samples of which I have here for inspection—has an average composition, as follows:—

	Recovered Crystal.	Ordinary First Crystal.
	Per Cent.	
Chlorate of Potash.....	86.40	85.16
Chloride.....	2.37	1.73
Chloride of calc. um.....	0.89	3.16
Moisture.....	7.80	8.96
Insoluble matter.....	2.00	0.60
	99.46	99.61

From this it will be seen that the recovered crystal is quite in a fit state to be made into finished

chlorate with no more than once redissolving. I have here samples of finished chlorate, made entirely from crystal recovered by refrigeration, which have been treated quite in the ordinary way with once redissolving in water. The sample contains 99.98 per cent. KClO_3 , and in appearance will be allowed to be fully equal to anything made in the ordinary way. The exceptionally fine crystals, also shown, are selected specimens made from the recovered crystal, and they show, I think, that as fine crystal in point of size, as well as purity, can be made from this source as from any other.

Before directing your attention to the all-important point, as to the amount of chlorate which is recoverable, by refrigeration, from ordinary mother-liquors, I may mention that there is a further advantage to be gained by adopting this method in the possible reduction of the number of vessels employed for the first crystallisation. It is, I believe, the usual custom to allow all liquors to stand for a period of from 10 to 14 days. Now, as the Table No. 1 shows, the chlorate left in solution is reduced to very reasonable limits within seven days, and if all liquors are to be ultimately reduced in temperature to zero or below, there seems to be no reason why any batch should be allowed to stand beyond the time taken in cooling down to atmospheric temperature; a period which in most cases will not exceed from three to four days. Such an arrangement would set free a large number of vessels, and the room they occupy.

TABLE No. 1.

Showing amount of KClO_3 left in Mother-Liquor at various Periods during Crystallisation.

	After 2 Days. Average Temp. 76° F.	After 3 Days. Average Temp. 69° F.	After 5 Days. Average Temp. 48° F.	After 6 Days. Average Temp. 47° F.	After 7 Days. Average Temp. 49° F.	After 8 Days. Average Temp. 49° F.	After 9 Days. Average Temp. 49° F.	After 10 Days. Average Temp. 41° F.	After 12 Days. Average Temp. 41° F.	After 13 Days. Average Temp. 39° F.	After 14 Days. Average Temp. 44° F.
	Grms. KClO_3 Per Litre.	Grms. KClO_3 Per Litre.	Grms. KClO_3 Per Litre.	Grms. KClO_3 Per Litre.	Grms. KClO_3 Per Litre.	Grms. KClO_3 Per Litre.	Grms. KClO_3 Per Litre.	Grms. KClO_3 Per Litre.	Grms. KClO_3 Per Litre.	Grms. KClO_3 Per Litre.	Grms. KClO_3 Per Litre.
No. 1 Batch	48.18	41.04	32.05	30.12	31.15	30.24	30.24	29.94	28.89	27.35	26.95
No. 2 "	48.18	40.62	33.17	31.64	32.38	30.82	30.97	30.52	29.50	27.54	27.15
No. 3 "	52.67	42.06	34.30	33.07	32.90	32.00	32.14	32.11	30.62	29.78	28.58
No. 4 "	54.30	45.32	35.83	34.71	35.64	34.92	34.64	34.20	32.66	31.03	30.50
No. 5 "	53.69	44.10	36.54	35.52	36.26	35.38	35.22	34.20	32.66	31.64	30.38

I may also mention, before going further, that we have made some experiments on the solubility of KClO_3 in solutions of MgCl_2 at abnormally low temperatures.

We prepared three samples:—

	° Tw.	Grms.	Grms.
No. 1.	52 containing 335 MgCl_2 and 18 KClO_3 per litre.		
No. 2.	54½ "	312 "	12 "
No. 3.	54½ "	366 "	13 "

After being reduced in temperature:—

	° F.	Grms.
No. 1 at 12	was found to contain 12 KClO_3 per litre.	
No. 2 at 10	" "	6.75 "
No. 3 at 30	" "	8.2 "

showing an average reduction by 37.3 per cent. of the chlorate in solution.

The sample No. 3 was found at 30° F. to be depositing crystals of MgCl_2 , which indicates that in magnesium, no less than in calcium chloride liquors, there is a point of concentration, *below* which it is advisable to have the liquors intended for refrigeration.

And now we come to the question of the quantity of chlorate which is recoverable from ordinary mother-liquors by refrigeration. Table No. 2 will throw some light on this interesting point; it is a return of what we have actually effected in practice during a two months' trial with the 2-ton ether machine.

TABLE No. 2.

Record of Results obtained—Chlorate Mother-Liquor Refrigeration.

Batch Started.	Con- sist- ing of Cubic Feet.	Tw.	F.	Grms. KClO ₃ per Litre from Analysis.	Batch Finished.	F.	Grms. KClO ₃ per Litre from Analysis.	Actual Weight Chlorate obtained after drying in Centrifugal.	Con- taining Per Cent. KClO ₃ .	Liquor from Centrifugal.				Total Chlorate, 100 per Cent. recovered.
										Ct., ft. Grms. per Litre = Chlorate.				
								Cwt. qr. lb.	Per Ct.				Cwt. qr. lb.	Cwt. qr. lb.
Dec. 10th	1,926	70 ³	55 ³	25.26	Dec. 10th	12	13.12	8 0 22	74.0	22	at	50.0	= 0 2 12	6 2 19
Dec. 17th	1,506	76	48	25.42	Dec. 21st	18	14.56	7 0 0	74.1	55	"	52.56	= 1 2 12	7 1 11
								23 3 14	32.5	20	"	51.0	= 0 2 7 3	
Dec. 30th	1,506	72	45	18.53	Jan. 5th	6	8.85	9 4 8	75.4	22	"	52.5	= 0 2 16	7 2 19
Jan. 7th	1,506	71½	48	22.41	Jan. 12th	11	12.41	9 2 0	84.0	27½	"	36.0	= 0 2 5	8 2 2
Jan. 14th	1,506	68	48	24.45	Jan. 21st	5	13.24	8 1 12	86.0	30	"	53.7	= 0 3 16	8 0 9
Jan. 22nd	1,506	73½	46	29.25	Jan. 30th	9	18.14	8 3 22	87.0	45	"	49.4	= 1 1 0	9 0 0
Jan. 31st	1,506	71½	58	28.72	Feb. 9th	7	14.80	12 2 0	85.0	46	"	51.0	= 1 1 6	11 3 20
Totals .				173.74				94.82						
Averages				24.82				13.74						

It will be noted that in batch No. 2 we were dealing with a liquor of too high concentration; the consequence was, at about 18° F. we found a large quantity of calcium chloride had been deposited. The refrigeration was therefore stopped, and the mixed crystal, after drying in the centrifugal machine, was found to contain 32.4 per cent. CaCl₂ and 32.5 per cent. KClO₃. This crystal was covered with a few inches of cold water, and after standing some time, was again dried with the result shown. It will be seen from the table that we have treated seven batches of mother-liquor with an average reduction of 11.28 grms. KClO₃ per litre, and that at

an average temperature of 9.7° F. And we have very little doubt that when we have more powerful apparatus at work, and are able to reduce the whole of our liquors to zero, or better still to *minus* 10° F., that we shall not leave more than, say 10 grms. KClO₃ per litre, in any mother-liquors we turn out. It may be said that this reduction to 10 grms. per litre is a figure not likely to be realised, but if you will refer to Table No. 3, which shows the downward progression of grms. chlorate per litre in the ratio of the reduction of temperature, I think you will agree that we have substantial grounds for our expectations.

TABLE No. 3.

	Batch 1. Grms. KClO ₃ per Litre.	Batch 2. Grms. KClO ₃ per Litre.	Batch 3. Grms. KClO ₃ per Litre.	Batch 4. Grms. KClO ₃ per Litre.	Batch 5. Grms. KClO ₃ per Litre.	Batch 6. Grms. KClO ₃ per Litre.	Batch 7. Grms. KClO ₃ per Litre.	Batch 8. Grms. KClO ₃ per Litre.
Before refrigeration,...	25.26	25.42	18.53	22.41	24.45	19.25	28.79	..
At 32° Fahr.	20.46	20.98	..	19.15	20.98	..	23.07	..
" 25° " .....	..	..	..	..	19.25	24.26	..	..
" 21° "	17.92	..	..	14.47	..	23.14	..	..
" 18° " .....	..	14.56	12.20	..	16.81	21.8	18.58	..
" 16° " .....	..	..	..	..	15.38	..	..	..
" 14° "	14.64	..	..	13.44	14.97	..	17.66	..
" 13° " .....	..	..	16.89	12.83	14.76	..	..	..
" 12° " .....	..	..	..	..	..	..	..	..
" 11° "	13.12	..	16.28	12.11	14.35	19.6	16.02	..
" 10° " .....	..	..	..	..	..	..	..	..
" 9° " .....	..	..	..	..	..	..	..	..
" 8° " .....	..	..	9.67	..	..	18.14	15.11	..
" 7° " .....	..	..	..	..	..	..	14.8	..
" 6° " .....	..	..	8.85	..	13.43	..	..	..
" 5° " .....	..	..	..	..	13.24	..	..	..

It may, I think, be taken as a general average that there are 340 cubic feet of mother-liquor to every ton of finished chlorate made, and that this liquor will contain on an average throughout the year not less than 25 grms. KClO_3 per litre, 340 cubic feet \times 25 oz. = 4 cwt. 3 qr. 5 lb. chlorate, which means a loss of 23.97 per cent. With 13.54 grms. per litre left in the liquors (the average figure we have reached with a reduction of temperature to 10° F. only) the loss is reduced to 12.88 per cent., and the production raised to 87.12 per cent. But if only 10 grms. KClO_3 per litre be left in the liquors (on a reduction in temperature to, say, -10° F.) then we should have a loss of only 9.46 per cent., and a production of 90.54 per cent. as against 76.03, the ordinary average—an increased production of 14.5 per cent., or, say, one ton in seven.

It may be said that for commercial reasons it is not desirable to increase the production of chlorate by one-seventh, but there can at all events be no question that it is very desirable, and especially so at the present time, to decrease by this amount the quantity of salt cake, hydrochloric acid, manganese, lime, potassium chloride, fuel, and labour required per ton of chlorate made. And this reduction by one-seventh of the cost of production, less the cost of packages and of carrying on the operation of refrigeration, will be the measure of the value of our process.

Chlorate makers will all know the cost of producing that article. It will vary, no doubt, somewhat according to circumstances. We will therefore consider only the cost of carrying on the refrigerating process necessary to obtain this increased production of one-seventh. In the first place, there is the cost of the apparatus, and that will of course depend upon the quantity of mother-liquor to be dealt with. It may be useful to say that we calculate, to deal with the liquors resulting from a weekly manufacture, not including the amount recovered, of—

10 tons chlorate	refrigerating	76 tons ice per day is
8	apparatus equal to	required.
5	"	5
"	"	4
"	"	"

We must add to the cost of the refrigerating apparatus that of the two tanks and circulating coils, &c.; but it would perhaps convey a better idea of the possible cost of the plant, to say that we calculate that an expenditure of 1,200*l.* is ample to provide for the treatment of liquors resulting from a manufacture of 10 tons chlorate per week, and for half that quantity it need not be much more than half that sum.

The labour necessary to carry on the refrigerating process can in no case amount to more than the wages of two men to attend to the apparatus; but in most cases no *extra* labour whatever will be required, as some of the existing staff (the octagon men, for instance) can give the amount of attention necessary to keep the apparatus working smoothly.

To assume, for the sake of example, that it is desired to deal with the liquors resulting from a manufacture of 10 tons chlorate per week, not including the amount recovered, the cost of refrigeration would be somewhat as follows:—

	£	s.	d.
Interest and depreciation on 1,200 <i>l.</i> at 10 per cent. for 50 working weeks	2	8	0
Loss of ammonia, say 10 <i>l.</i> per annum do., do.	0	4	0
Fuel, at $\frac{1}{2}$ cwt. per hour = 6 tons 6 cwt. per week, at 5 <i>s.</i>	1	11	6
Oil and stores, say, per week	0	1	6
Wages. None <i>extra</i> required.			
Water for cooling, 650 galls. per hour, available for other purposes.			
Total cost per week	4	5	0

Thus we have an increased production of one-seventh—on 10 tons equal to 1 ton 8 cwt. 2 qrs., for an expenditure of 4*l.* 5*s.*—a result which we think will compare very favourably with those claimed for more ambitious processes which have been tried to reach the same end, namely, to reduce the loss of chlorate of potash inherent to its manufacture, on account of its solubility at ordinary temperatures.

DISCUSSION.

Dr. HURTER said it was one of the most practical papers they had had that session. It dealt with a new process, and a very important one evidently, because anyone could see that the increase of one-seventh in the production of chlorate was not an unimportant item. He must congratulate Mr. Hammill and his friends upon having hit upon the simple expedient of refrigerating to get so largely an increased production as one-seventh of chlorate, and he congratulated him also upon the interesting paper he had written on the subject and on the practical results as shown in the tables.

Mr. H. BRUNNER said that Mr. Hammill mentioned that he found it advisable to dilute the mother-liquors before subjecting them to the refrigeration process. Now it struck him that there was a very considerable disadvantage in doing that, because he must use a considerable amount of water which had to be cooled down, and the cooling was an expensive business. Mr. Hammill had told them that if the mother-liquors were refrigerated without the addition of water, chloride of calcium would crystallise out. Well, of course, that one would expect; but he supposed it did not follow that the chlorate of potash would not crystallise out also; and if the two crystallised out together, one would naturally suppose that the more concentrated the solution the larger the quantity of chlorate of potash which would crystallise out. If the two crystallised out together and were allowed afterwards to come back to the ordinary temperature, there would be sufficient water present to redissolve all the calcium chloride which might have crystallised out, and there would be no difficulty in effecting the separation of the two. It would simply mean passing the mixture of calcium chloride solution and chlorate of potash crystals through the centrifugal.

Mr. E. CAREY had understood Mr. Hammill to say that on a production of 10 tons per week of chlorate the cost of his process was 4*l.* 5*s.*; that, he presumed, was the cost of refrigeration. Would Mr. Hammill put that into terms of ice and say the number of tons of water at 32° F. converted into ice at 32° F. for this 4*l.* 5*s.*

Dr. J. CAMPBELL BROWN asked whether Mr. Hammill knew whether the specific heat of the solution was much lower than that of water.

Mr. HAMMILL, in reply, assured Mr. Brunner that the increase in the bulk of the liquors, owing to the dilution with water, was very slight. The degrees Twaddle between which calcium chloride came out and when it did not, varied very slightly. At 72° Tw. they did not get any CaCl_2 down at 10° F., whilst at 74° Tw. it came down at 8° F. The dilution necessary to bring the liquors to a safe point was therefore inconsiderable. If the liquors were not diluted there would be a pasty mass of mixed crystal, which would be more difficult to deal with, and cost more trouble and more expenditure to separate, than diluting the liquors in the first instance would give rise to.

In reply to Mr. Carey, of course they would understand they did not make ice, and had none of the extensive appliances necessary for making and storing solid ice, nor the expense of handling it. What he spoke of was refrigerating power equal to the manufacture of 6 tons of ice per day, and Mr. Carey would be quite correct in saying that the figures mentioned, 4*l.* 5*s.*, represented the cost of refrigerating power equal to 36 tons of ice per week. The fuel, $\frac{3}{4}$ cwt. per hour, was not a large item, and as to the loss of ammonia, the makers of the refrigerating apparatus guaranteed the loss to be not more than 5*l.* per annum, but he had thought it safe to put it down at 10*l.* The total cost came to about 2*s.* 4*d.* per ton of ice-producing power. He might mention that he had heard of a contract being entered into by some makers of refrigerating machinery to erect an ice plant and work it for 12 months. They to be paid 2*s.* 4*d.* per ton of ice produced in the tanks, of course not to be charged with the handling, storing, or distribution of it. He was also informed that the contractors would make a profit at this figure. In thanking them for the kind reception given to his paper he must acknowledge that he had the co-operation all through of Mr. Wylde and Mr. Auer; only one of them could read a paper, but they had all been associated in the investigations.

Manchester Section.

Chairman: Edw. Schunck.
Vice-Chairman: G. H. Bailey.
Committee:

J. Angell.	I. Levinstein.
C. A. Burghardt.	Sir H. E. Roscoe, M.P.
R. F. Carpenter.	C. Truby.
H. Grimshaw.	D. Watson.
J. Grossmann.	T. Wardle.
P. Hart.	P. Winsor.

Hon. Local Secretary:

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Tuesday, March 5th, 1889.

DR. BAILEY IN THE CHAIR.

RESINOUS CONSTITUENTS OF CAOUTCHOUC.

BY HUBERT L. TERRY, A.I.C.

It has been shown by Spiller (*Jour. Chem. Soc.* 27, iii, 44) that decayed india-rubber, or that which has undergone atmospheric oxidation, consists in part of a hard resin containing 27 per cent. of oxygen. Burghardt (this Journal, 1883, 189) stated that Spiller's resin was an acid, was soluble in alcohol, ether, and benzene, and formed, with alkalis, soaps soluble in cold water. He also stated that another resinous body was produced by the oxidation of india-rubber, which had different properties from the above, being insoluble in alcohol, ether, and benzene, and not being saponified by alkalis. Burghardt further said that sound india-rubber, which might contain up to 3 per cent. of the soluble resin, never contained any of the insoluble.

Having had the opportunity of examining chemically both the raw and manufactured rubber, it seemed of interest to add a contribution to the meagre literature at present published on this subject.

I prefer to limit the word caoutchouc to the hydrocarbon $C_{10}H_{16}$, and to use the word india-rubber, or, more shortly, rubber, for all other purposes. It is well known that the various qualities of rubber which are imported to England have a very different commercial value according to the proportion of sand, water, resin, albumen, &c. contained in them.

The information already published concerning those impurities is of a very general character, and no detailed analyses are given.

To the statement that the difference in value of the rubber is due to the impurities contained, it must be added that it does not seem to have been proved whether there is any molecular difference in the hydrocarbon as obtained from the various species of trees; the firm elastic Para might, if mixed with the foreign matter that accompanies the African or Asiatic varieties, lose its best properties.

The processes of washing which the raw rubber goes through serve to free it from most of the impurities excepting the resins, which, of course, are unacted upon by water. It is to these latter that I wish to draw special attention, the object of this paper being to show the points of resemblance and difference between those resins naturally occurring in the sound rubber and those which are formed at a later period by the oxidation of the hydrocarbon.

Generally speaking, the value of raw rubber is inversely as the amount of resin contained, while in manufactured rubber the amount of resin has been taken as a direct indication of the degree of oxidation. It will be seen that the latter test would be erroneous if any quantity of natural resin was contained in the rubber under examination. The resin extracted should, therefore, be examined further to ascertain its origin.

The results of resin estimations made at various times have been collated, and are given in Table I., together with the melting points and physical nature.

TABLE I.

Name of Rubber.	Per Cent. of Resin.	M.P., °C.	Remarks.
Para.....	1.2	5	Dark brown colour, soft and sticky.
Coua.....	1.3	2	Yellow colour, soft and sticky.
Columbian....	2.5	..	Brown colour, dry.
Mozambique..	3.0	18	Yellow colour, glutinous.
Rio Janeiro...	5.8	64	Hard, powdery, colour yellow to white.
Madagascar...	6.1	..	..
Sierra Leão...	7.4	..	Brown colour, contained a glutinous body.
Borneo	7.9	28	Light brown colour, soft.
Assam	9.3 & 5.3 7.0	12 82	Yellow, sticky. Hard, like shellac.
Mangabeira...	10.5	48	Brittle, brown colour.
African ball (1)	18.5	58	Dark brown colour, of various melting points.
" " (2)	22.8	20	" "
" flake....	41.2	20	" "

The numbers were obtained after the rubber had gone through the processes of washing already referred to.

It is only in this way that comparative results can be given suitable to the purposes of this paper.

The resin was obtained by exhausting the rubber, cut into fragments, with 90 per cent. alcohol in a Soxhlet's tube. After distilling off the alcohol the residue was well washed with water to remove some nitrogenous and saccharine matters. By employing a porcelain Niekels' filter in connexion with the vacuum pump, the tedious operations of washing and filtering were much facilitated. The aqueous solution on evaporation to dryness often showed glucose by the Fehling reaction. This might be due to decomposition of natural glucosides from the tree, or the reduction might be caused by some benzoine compound. The latter is very probable, especially as tests of the resins seem to show that they belong to the group of aromatic gum resins. The above sweet substance has quite different properties from the methyl-ethers of inoside described by Girard (Compt. Rend. lxxiii., 426) as occurring in certain varieties of caoutchouc.

The melting point determinations are not of much value, as it is clear that the resins are mixtures, and also absorb oxygen from the air. The numbers, however, though not absolute, are of comparative value. The method adopted was to place the resin in a test tube containing a thermometer, insert the tube in a beaker of water, and heat on the sand-bath, the point at which the resin adhered to the glass being taken as the melting point. The method of "Curves of cooling" was of no value except as indicating that the substances were not uniform.

It will be seen by those acquainted with the subject that the value of the rubber is approximately inversely as the per cent. of resin as mentioned previously. All the varieties of rubber examined contained resins mostly peculiar to themselves. These have not yet all been examined in detail, and the further remarks on their chemistry will, in this paper, be limited to the Pará, Rio Janeiro, and African ball products. The very name of resin is a warning against assigning formulæ, yet, though no theoretical interest attaches, the ultimate analysis is of importance as showing the difference of constitution from the oxidation products already mentioned.

Combustion of Rio Resin with CuO .

The resin was washed with potassium carbonate dried at 100°C ., and kept over H_2SO_4 .

	Grms.
Weight taken	152
" of H_2O obtained.....	145
" of CO_2	422

Whence—

	Per Cent.
Carbon.....	75.72
Hydrogen	10.59
Oxygen.....	13.69
	<u>100.00</u>

Combustions of African ball resin gave oxygen 13 to 14 per cent., showing great difference from Spiller's resin.

Properties of Resins.

Solubility.—All the natural resins examined are soluble in alcohol, ether, chloroform, benzene, and CS_2 .

Pará.—This is a mixture of soft resin with phenolic compounds from wood tar, produced by the smoking process. This resin is characteristic of Pará rubber.

African Ball.—By the potash fusion test, Hlasiwetz and Barth (Annalen, 139, 225), it yields a phenol ether, and gives off an aromatic vapour. It is insoluble in alkaline carbonates. Fuming nitric acid yields other resins, and ultimately oxalic acid.

Soluble in petroleum ether.

Rio.—By potash fusion yields a slight aromatic vapour, but no phenol.

Alkalis and nitric acid same action as the last.

Only slightly soluble in petroleum ether.

Table II. gives the potash and bromine absorptions per cent.

No solid Br compounds were obtained from the natural resins, but the oxidised caoutchouc gave a body insoluble in ether; this has not yet been analysed. The Br absorption was determined by dissolving the resin in chloroform, adding excess of standard bromine in chloroform (strength 1 cc = .05 grms. Br) and allowing to stand for a few minutes. Potassium iodide was now added, and the solution titrated with thiosulphate after the well-known manner.

For the potash absorptions the resin was boiled with excess of seminormal alcoholic potash and titrated back with seminormal HCl and phenolphthaleïn.

TABLE II.

Resin.	KHO Absorption.	Br Absorption.
(Spiller's) resin A	20.08	129
Pará.....	18.59	46
African Ball.....	6.27	89
Rio.....	6.04	26

Having considered the natural resins, I now turn to those produced by the atmospheric oxidation of caoutchouc. These have been already mentioned at the commencement of this paper, and may be called, for distinction, resin A (Spiller's), and resin B (Burgardt). The latter is said to be insoluble in absolute alcohol, though I find a resin with its properties in the alcoholic extract from decayed rubber. It appears to undergo change on keeping, and to vary in its action towards alkalis. It is probable that both of them undergo molecular change under certain conditions. They were separated by means of benzene, and samples of both are now on the table. The above, when mixed with natural resins, as may occur in an alcoholic extract from decayed rubber, may be separated by the following method.

Separation of Resins.

The alcoholic extract of the rubber is evaporated to dryness on the water-bath. A small quantity, .2 grms., is weighed out into a tared test tube, and boiled with benzene. Resin B melts and sticks to the glass, when the solution of the other resins can be poured off. After passing a current of air through the test tube, it is reweighed.

The benzene solution is evaporated to dryness, and heated with potassium carbonate solution which saponifies resin A. Filter through a tared filter, dry and weigh. This gives the natural resin. The resin A, minus the per cent. of sulphur, is best obtained by difference. Sulphur is always present

to some extent in the alcoholic extract from vulcanised rubber; it is easily recognised under the microscope by the rhombic crystals, polarising strongly. It is estimated by oxidation with fuming nitric acid, and allowed for in the calculation.

Example.—A mixture was made of 127 grms. Rio resin, and 171 grms. mixed oxidised caoutchouc resins = 42.6 per cent. Rio resin, 57.4 per cent. A + B resins:—

	Per Cent.
Found:—Rio	44
Resin B	23
Resin A + sulphur	33
	<hr/> 100

The subject of decay has been gone into by Hoffmann (*Jour. Chem. Soc.* 1861, 87), and W. A. Miller (*ibid.* 1865, 273) for gutta percha, and more recently by Burghardt (*this Journal*, 1883, 119) and W. Thomson (*ibid.* 1885, 710) for india-rubber. Reference to these papers shows that further proof of the injurious action of oxygen is not required.

I hope, in a future paper, to go into the subject of decay, especially with respect to the various vulcanising processes. The subject is one of some complexity, and conclusions cannot be drawn from isolated analyses; much depends on the treatment the rubber receives, and the conditions of its manufacture. It is evident that the process of assimilating oxygen is a constant one, commencing with its extraction from the tree. Dr. Burghardt has given an analysis in which the carbon, hydrogen, and sulphur make up the sum total; this is, I think, not of frequent occurrence, as oxygen is rarely absent. Dr. Gladstone informed me that, when engaged in his recent research (Gladstone and Hibbert, *Jour. Chem. Soc.* 1888, 679), his great difficulty was to get the hydrocarbon free from oxygen. By precipitating the chloroform solution with alcohol, and drying in a vacuum, the caoutchouc obtained generally contained 3 per cent.

Divers and Kawakita (*ibid.* *ccciv.*, 270) found the caoutchouc obtained from "*Ilex aquifolium*" to contain 2 per cent. of oxygen. These analyses confirm my own results made on raw and masticated Pará.

It is important when investigating these resins to be sure that the *terminus a quo* of the rubber was really a tree, because, in these progressive days, it is possible to meet with rubber which never has had any botanical connexion. I am at present extending Dr. Gladstone's researches on Pará caoutchouc to the African and Asiatic imports.

In conclusion, I must express my thanks to Messrs. Chas. Macintosh and Co. for facilitating the production of this paper.

ESTIMATION OF IRON IN WATER.

BY J. CARTER BELL, A.R.S.M., F.I.C., ETC.

Is a water case in which I was engaged some months since, this question was asked in court: How much iron may a river water contain, and yet be fit for bleaching purposes? An eminent water analyst was in the witness box; he made reply, from 0.1 to 0.2 of a grain to the gallon. This gentleman could have had no experience in bleaching, or he could not have given such an absurd statement. I think I may safely assert that no river water in the kingdom contains so large a quantity of iron as 0.1 of a grain

to the gallon, of course chalybeate springs excepted, and even if these were to run into a river the iron would soon be deposited. The case in which I was engaged was where a firm of bleachers brought an action against a firm of dyers who were six miles up the river. The complaint was that waste dye waters containing iron were thrown into the river, and this polluted water found its way into the complainant's reservoir. At that time I obtained many samples of water from various points of the six miles course, and I analysed several hundred samples of water for iron, and in no one case when the sample was taken about a mile from the offending works could I find an amount of iron equal to 0.1 of a grain to the gallon, and I need not say that the quantity found at the point named would be infinitesimally small by the time it arrived at the complainant's works. The judge seemed greatly impressed with one of the complainant's experts, who gravely informed his Lordship that when the iron was once put into the water, the iron, being indestructible, must of necessity come down to the complainant's works and do the damage which was alleged. It would have been fairer on the part of this witness if he had said that the iron in the water at complainant's works was no more than is found in the Thames, Severn, or any other great river in England, which may vary from one part in five millions to one part in seven or ten millions.

The process I adopted for the estimation of the iron was a very considerable modification of Dr. Carnelley's method, of which he read an account before the Manchester Literary and Philosophical Society in 1874. This colorimetric method is not new for a paper was published in 1871 by H. Rheineck in Dingler's *Polytechnisches Journal* on the estimation of iron in liquids used in dye works.

Seventy cc. of the water were evaporated to dryness in a platinum dish, the residue gently ignited to burn off organic matter. One cc. of pure nitric acid were then added, and allowed to flow over all the residue. The nitric acid was evaporated off on the water-bath. The residue was again moistened, this time with 1 cc. of a 10 per cent. solution of hydrochloric acid, about 5 or 10 cc. of distilled water added, warmed on a water-bath, and the solution filtered into a 50 cc. Nessler tube. The filtrate was made up to 50 cc. This 50 cc. must be poured into another 50 cc. tube containing 1 cc. of freshly made ferrocyanide solution. To this mixture 1 cc. dilute nitric acid was added; this is then compared with a tube containing a known weight of iron.

Standard solution of iron: 1 cc. = .001 of iron.

This is made by taking the purest and finest iron wire, dissolving in nitrohydrochloric acid, evaporating to dryness, taking up with a slightly acid solution of hydrochloric acid. I consider this preferable, as it is more stable than the sulphate of iron and ammonium.

Standard ferrocyanide: 1 part of salt in 25 parts of water.

Standard nitric acid: 50 cc. of strong acid made up to litre.

Standard hydrochloric: 100 cc. of strong acid made up to litre.

It is absolutely necessary that a blank experiment be made with pure distilled water; if a slight blue colour is obtained, a correction can then be made in estimating the iron in the sample of water.

Newcastle Section.

Chairman: T. W. Stuart.

Vice-Chairman: P. P. Bedson.

Committee:

Alfred Allhusen.

G. T. France.

G. Gatheral.

John Glover.

T. W. Lovibond.

John Pattinson.

H. R. Procter.

B. S. Procter.

W. W. Procter.

W. L. Remondson.

C. H. Ridsdale.

J. E. Stead.

Hon. Local Secretary and Treasurer:

J. T. Dunn, The School, Gateshead.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held in the Durham College of Science,
Thursday, March 7th, 1889.

MR. T. W. STUART IN THE CHAIR.

ON GAS-TESTING AND SAMPLING APPARATUS.

BY J. E. STEAD.

SEVERAL times during the last ten years I have made communications to the Iron and Steel Institute, describing various forms of gas-testing apparatus which I have designed for the purpose of examining the gases from blast and other furnaces, and it is my intention this evening to exhibit and describe the apparatus, which has, however, undergone considerable improvement since attention was first drawn to it.

I. Sampling of Gases.

When it is required to sample gas which is constantly changing in composition, such as is the gas from all furnaces or fires using coal or coke as fuel, it is impossible to obtain any average representative portion of the gas by simply drawing off a single pipette full by means of the old-fashioned pump.

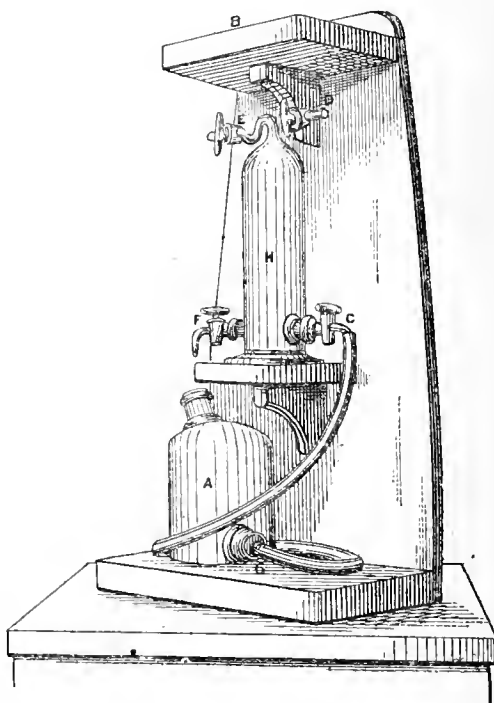
The old system used to be to draw several of such samples at different times over a considerable period, and to test each sample, and then average the results obtained. It was necessary, therefore, to make several analyses in order to obtain an average result.

Mons. Gruner describes a better method, by which a large vessel, filled with mercury, is used to collect the sample. The vessel has a tap both at the top and bottom. The upper end is placed, by means of a tube, into communication with the gas it is desired to sample, and a receiver is placed below. When both taps are opened the mercury flows from the vessel, and is replaced by the gas which is thus drawn in. By regulating the outward flow of the mercury, regular portions of gas may be drawn in, over any length of time, and a fair average sample obtained in one bottle.

The sampler which I have designed is based on the same principle, but it is so arranged as not only to take the sample, but also to take the place of the old form of gas pipette. It is in most compact and portable form, and may be enclosed in a suitable case. It can be placed on the ground, or hung up on the side of a gas-flue or wall to draw in the gas, and left to itself after once starting it.

With the help of a diagram the working of the apparatus will be readily understood.

Fig. 1.



H is the gas receiver.

A is the mercury reservoir.

E and D at the upper end in communication with the top of the receiver are gas passages.

F and C are mercury passages.

In taking a sample of gas the whole arrangement is hung on the side of the flue from which the sample is to be drawn.

The mercury reservoir is raised and placed on the shelf B, and the taps C and D are opened. The air in the vessel H, thus driven out, is completely replaced by mercury.

The tap C is now closed, and the reservoir lowered. The tube communicating with the flue is then connected to the limb E, and, after opening the taps E and D, the gas is sucked right through the upper tubes, by which means any air that may be present is drawn out of the tube connexions.

As soon as this is done, the tap D is closed, and the opening at the top of the reservoir A having been placed under the tap F, the latter is opened, and the mercury allowed to flow into A at any desired speed. As the quantity of gas flowing into the collector is the same as the quantity of mercury flowing out, it will be clear that the former can be regulated to the greatest exactness by measuring the mercury as it flows out in a graduated tube, noting the time required to pass 10 cc. mercury, and comparing this with the whole contents of the vessel H, and the period over which the sample is to be taken.

If it is desired to keep the sample for some time before testing, the passages in the upper tubes must be filled with mercury by inverting the apparatus and opening the taps for a moment.

The sample, when complete, can be taken to the laboratory, the reservoir A placed upon B, and the tap C opened.

When the gas-testing apparatus is ready to receive it, the tap D is opened, and, after a certain amount of the gas has thoroughly expelled the air from the tube D, it is connected directly to the apparatus, and the necessary quantity is drawn off for analysis.

In examining blast-furnace flues, it is always found that, when taking an average sample, the amount of dust is so great that the ends of the small tubes inserted are frequently choked up. It has been my practice, therefore, to cover the end of the inserted tube with asbestos, and the asbestos with copper-wire gauze. By this means, although the gauze gets covered with dust, the gas passage is always maintained.

In the apparatus most recently made by Messrs. Mawson and Swan, the vessel H is firmly secured on the stand, and both the stands B and G are made into trays, to prevent any loss of mercury.

As in all other glass gas apparatus, it is imperative that the taps be removed when not in use.

In sampling blast-furnace gases, it may fairly be assumed that the gas at any point across the section of a flue is approximately the same at any moment; in other words, that there is no disposition for carbonic acid, or any constituent, to concentrate itself near the walls or centre of the gas passage. This being the case, a small tube may be inserted at any distance into the flue, with the certainty of obtaining an average sample.

With some other gases it is very different. In the gases from boiler fires, for instance, at one time the fire-grate will be bare on one side or other, and a brisk current of air will be passing along that side, and will refuse to perfectly mix with the other gases before it passes to the chimney. If, then, the sample was drawn from one side of such a flue, it is clear that an erroneous sample would be obtained. In taking samples in cases of this class, a long slit tube should be used, which should be placed right across the central part of the flue. If it is practicable, two such tubes at right angles would be preferable, the gas being drawn off at the centre.

It is really a very difficult matter to obtain fair samples of waste gases in some cases, especially when they are below the atmospheric pressure.

Sometimes, at the chimney end of the boiler, there are fixed loosely-fitting draw-dampers, and large quantities of air are drawn into the flue, or near to the end of the boiler.

In such a case all these openings should be plastered up with clay before attempting to take a sample.

In other cases, owing to bad masonry or other causes, air finds its way in, in spite of all precautions.

In sampling the gases from portable engines, the smoke-box door should be carefully luted up, so as to avoid any entrance of air, and the sample should be drawn off near the funnel, through a slit tube, bent into a circle, so as to surround the exhaust-pipe.

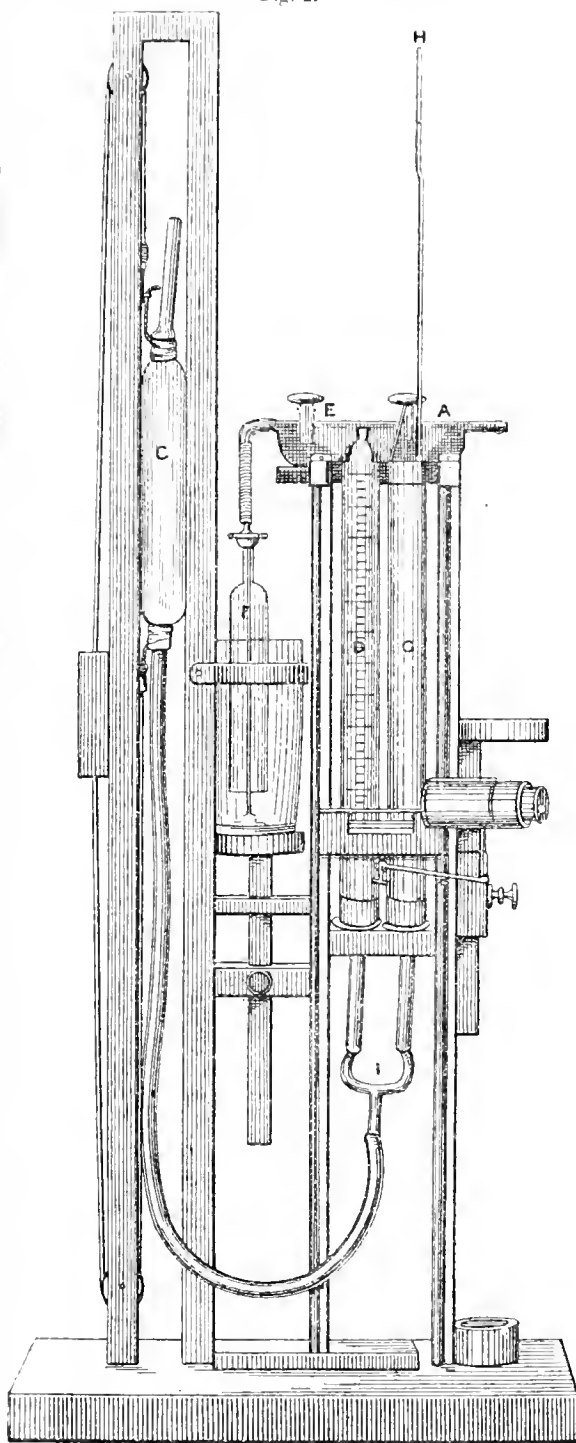
In all cases the intelligence of the operator must be used, so that the tubes may be in such a position as to receive an average sample.

II. Gas-Testing Apparatus.

The original form consists, as you will see from the diagram annexed, of a eudiometer tube, the upper end of which is joined at right angles to the capillary tube A E, furnished with taps, one on each side of the eudiometer. This part, when detached, has the appearance of the letter T. Platinum wires are fixed in the upper part of it, for the ignition, by the electric spark, of the combustible gases. The lower end is drawn out to a small diameter, and it communicates directly, by means of an india-rubber connexion, with the mercury reservoir C, which

slides perpendicularly between two grooved parallel guides, and, by means of the T-piece I, with the

Fig. 2.



tube G, which is of the same diameter as the eudiometer tube, and placed parallel with it at the right. The latter communicates with the air by the small tube H. The tube E communicates directly with the single absorption tube F.

The tube A on the left of the eudiometer is used to receive the sample of gas, and also the oxygen or hydrogen which may be required for the analysis. In front of the apparatus is a sliding spirit-level, to assist in adjusting the level of the mercury in the tubes D and G, and also for reading off the volume of the gas.

Both the eudiometer tube D and the parallel tube G are surrounded by a vessel containing water, for maintaining a constant temperature of the gas enclosed.

A small bichromate battery of two or three cells, a Ruhmkorff's coil, and a few yards of connecting wire, complete the apparatus.

Before using the apparatus it is necessary to calibrate the eudiometer tube. This is effected by first filling it completely with mercury, and after closing the lower india-rubber connecting tube with a screw-clip, and the T-piece I being withdrawn, successive portions of 10 measures of mercury are run out into a glass vessel and weighed until the lowest division in the eudiometer is reached, and from the weight obtained a capacity or calibration table is constructed.

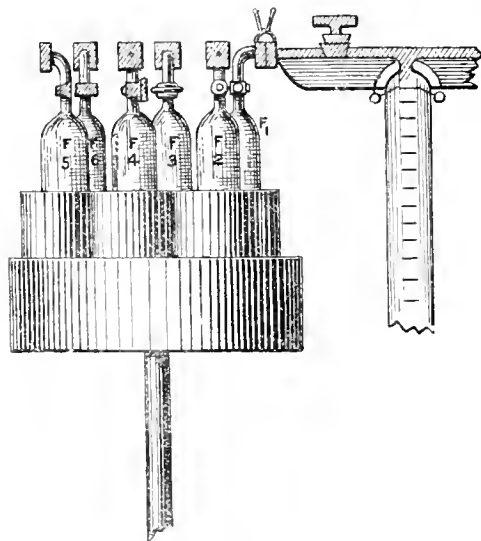
Second Form.

This form differs from the first in one particular only, viz., there are three absorption tubes connected to the eudiometer instead of only one. Each tube has an independent tap, so that each can be put into communication with the eudiometer without interfering with the other. The connexions are made with india-rubber tubing.

Third Form.

This apparatus (Fig. 3) which is an important departure from all existing gas-testing devices, is designed so as to rapidly and accurately test gases of the most complex kind. The laboratory vessels,

Fig. 3.

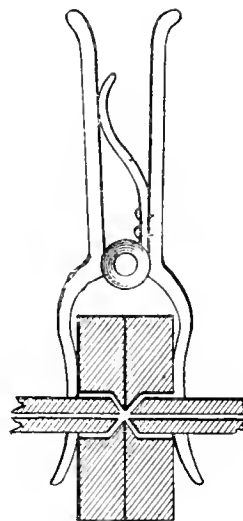


as will be seen from the diagrams, are increased to six in number, and are capable of being revolved on a suitable turntable, and by a special very simple device connected to the eudiometer tube, so that

six different reagents may successively be brought into communication with the gas under examination. Instead of the steel face-plates and screw clamps used by Dr. Frankland, or india-rubber connexions, the eudiometer tube and each of the absorption tubes is furnished with a solid, perfectly flat, piece of plate glass perforated in the centre. These plates are firmly cemented to the tubes by a suitable cement.

The face of each plate is slightly smeared with olive or other oil, and when it is desired to connect two tubes two face-plates are brought in conjunction and are pressed together by means of the little spring clamp illustrated in Fig. 4.

Fig. 4.



The new connector can be readily used with the first apparatus described, and with all gas-testing apparatus made.

Glasgow and Scottish Section.

Chairman: R. R. Tatlock.

Hon. Vice-Chairmen: { E. C. C. Stanford,
Sir J. Neilson Cuthbertson.

Committee:

J. Addie.	T. P. Miller.
G. Beilby.	E. J. Mills.
A. Crum Brown.	J. M. Milne.
J. Christie.	T. L. Pattison.
W. S. Curphey.	J. Pattison.
W. Dittmar.	F. J. Rowan.
D. B. Dott.	D. R. Steuart.
R. Irvine.	A. Whitelaw.

Hon. Treasurer: W. J. Chrystal.

Hon. Local Secretary:

G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Fifth Meeting of the Session was held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, 5th March 1889.

MR. E. C. C. STANFORD IN THE CHAIR.

ON FLAME.

BY P. J. ROWAN.

THE subject of flame possesses considerable interest from a technical point of view, because the questions connected with its nature and propagation enter into our understanding of several problems which are of first-rate importance to practical applications of science.

The nature of flame and the temperature which results from its existence bear directly upon our application of fuel and on the intensity of the heat which we produce by combustion. The velocity of ignition is a matter which in several ways is closely connected with the safe working of collieries; and recent research has shown us that the principles of gas-engine practice embrace considerations alike of the nature, temperature, and propagation of flame.

In the following remarks the author aims merely at setting forth some of the general principles of the subject, without making any specific application of them to the important problems indicated.

Nature of Flame.—What is flame? Dr. Mills has remarked that a flame may be regarded as volatile matter undergoing chemical change at a visibly red heat; and Dr. Percy, with more minuteness, says: "Ordinary flame is gas or vapour of which the surface, in contact with atmospheric air, is burning with the emission of light."

These definitions leave little to be desired, as they properly direct attention to *visibility* rather than to temperature, and to the fact that the presence of combustible *gas* or *vapour* is a necessary condition to the existence of flame. We may have a solid, such as iron, magnesium, or carbon,* burning in oxygen or air, at a high temperature, with brilliant incandescence, or glowing, but without flame, whilst, on the other hand, the flame of boric methide shows that flame may exist without a high temperature.

Flames are usually regarded as simple or compound, according to the number of products which result from them. Those which are ordinarily used in the arts and manufactures are compound flames.

From the foregoing definition of flame, it will be readily understood that all flames are more or less hollow in structure. In the centre is a space occupied by unconsumed gases; surrounding that is the luminous portion of the flame; and outside of all is the non-luminous part, or "mantle," as it is called. The unconsumed inflammable gases can be collected from the centre of the flame and afterwards ignited, and the mantle can be rendered more visible (according to Bloxam†) by burning sodium near the flame, when the mantle will acquire a strong yellow tinge.

In a blow-pipe flame, the same construction is observed, the flame, however, being diminished in

size and luminosity; but by mixing air with gas before ignition, the three portions of a flame are reduced to two, with a considerable reduction in the luminosity of the flame. The combustion becomes complete at an earlier period, and the luminous cone has the same character as the mantle in the former case.

Temperature and Propagation of Flame.—Some interesting observations made by Deville* on the flame of carbonic oxide burned with oxygen show the chemical composition of the gases at various parts of the flame. He found that when a mixture of carbonic oxide and oxygen in the combining proportions (2 vols. CO to 1 vol. O) was allowed to issue, under a slight pressure, from a jet having an area of 5 square mm., a flame of 70 to 100 mm. high was formed, consisting of an inner and an outer cone. The outer cone, in which combustion takes place, was deep blue at the base and yellowish or nearly colourless towards the apex. In the inner cone, which was only 10 mm. high, no combustion took place, because the rapidity of displacement of the particles of gas was there superior to the very slow rate of propagation of heat in the mixture.

To collect the gases from the different parts of the flame, a silver tube, pierced with a small aperture, was placed across it in the part to be examined, and the gases were aspirated by passing a rapid stream of water through the tube. They were thus quickly cooled, and, passing along the tube together with the water, were collected, by means of a bent delivery tube, in jars over water.

The following table gives the results of the various observations, the first column giving the positions of the silver tube above the orifice from which the gases issued, the second column the temperatures approximately at these points, and the last division of the table the composition of the gas at the different portions of the flame:—

Height above Orifice.	Corresponding Temperatures.	Composition of the Gas.		
		CO.	O.	CO ₂ .
Min.				
67	Melting heat of silver, and above.....	0.2	21.3	78.5
54	Melting heat of gold.....	6.2	28.1	65.7
41	Commencing white heat of platinum.....	10.0	20.0	70.0
35	White heat of platinum.....	17.3	24.8	57.9
28	Strong white heat of platinum.....	19.4	26.5	54.1
18	Intense white heat of platinum.....	29.0	25.1	45.9
15	Incipient fusion of platinum.....	49.0	32.9	27.1
12	Melting point of platinum.....	47.0	36.0	17.0
(1) 10	Sparkling of the melted platinum.....	55.3	35.3	9.4
(2) 10	Still higher temperature.....	55.1	36.5	8.4
(3) 0	.....	61.4	33.3	2.3

(1) A little above the apex of the inner cone.

(2) Somewhat below the apex of the inner cone.

(3) Original mixture.

These numbers show that the highest temperature is at the apex of the inner cone, or a little below it; that the temperature gradually diminishes towards the apex of the flame; and that the quantity of

* This is true of single pieces of carbon—a mass of carbon burning in air or oxygen generally shows a lambent blue flame on the surface, which is due to the burning of carbonic oxide, CO, formed by the reduction of the carbonic anhydride, CO₂, in its passage through the glowing carbon.

† "Chemistry," edition 1867, p. 95.

* "Bull. Soc. Chim." [2], v. 111: also Watts, "Dict. of Chemistry."

carbonic anhydride increases in the same proportion from the apex of the inner cone, where, at most, two-thirds of the carbonic oxide and oxygen enter into combination, to the vertex of the flame itself, where carbonic oxide can no longer be detected. At the apex and edges of the inner cone the carbonic oxide and oxygen unite almost instantaneously, but only partially, on account of the very high temperature there existing.* Bunsen also carefully investigated this subject, and introduced† some modifications of the views held previously. Watts (Dict. of Chem., i. 860, Affinity) has summarised this matter as follows:—When a combustible gas mixed with oxygen is set on fire, a rise of temperature takes place, which, supposing the combustion to be perfect, may be calculated from the heat of combustion of the gases and the specific heat of the products. If, on the other hand, the combustion is imperfect, the temperature may still be calculated with the aid of Mariotte's and Gay-Lussac's laws, provided the pressure exerted by the gaseous mixture when ex-

ploded in a closed vessel be known. This pressure has been determined by Bunsen for mixtures of hydrogen and carbonic oxide with oxygen, or with oxygen and nitrogen together, by means of a eudiometer having a loaded safety valve. From this and the observed temperature of combustion, the quantity of the combustible gas (carbonic oxide or hydrogen) which has been burnt at the moment when the flame attains its maximum temperature, and thence also the quantity which at this temperature has lost its power of combining, may be calculated.

The following table contains the results of Bunsen's experiments arranged according to the maxima of temperature (t' — t) which the several gaseous mixtures, calculated for volumes at 0° C., attain by combustion in a closed vessel. Columns I. and II. give the mixtures of gases used; $\frac{P}{P_0}$ = the pressure produced in atmospheres by explosion; t = the calculated temperatures; and k = the calculated proportion of combination.

No.	Mixtures of Gases.		$\frac{P}{P_0}$	t .	k .	Mean.	Deviation from Mean.
	I.	II.	III.	IV.	V.		
1	$\frac{2}{3}$ vol. CO + $\frac{1}{3}$ vol. O.....		10.78	3,172	0.351	0.3316	+ 0.0194
2	$\frac{1}{2}$ " CO + $\frac{1}{2}$ " O.....		11.19	2,893	0.319		— 0.0126
3	$\frac{1}{2}$ " H + $\frac{1}{2}$ " O.....		9.97	2,854	0.338		+ 0.0064
4	$\frac{1}{2}$ " H + $\frac{1}{2}$ " O.....		9.75	2,833	0.336		+ 0.0044
5	$\frac{1}{3}$ " CO + $\frac{1}{3}$ " O + 0.1079 vol. O.....		9.05	2,558	0.314	0.5021	— 0.0176
6	$\frac{1}{3}$ " CO + $\frac{1}{3}$ " O + 0.6857 " CO.....		8.89	2,471	0.469		— 0.0121
7	$\frac{1}{2}$ " CO + $\frac{1}{2}$ " O + 0.8854 " O.....		8.44	2,325	0.478		— 0.0241
8	$\frac{1}{2}$ " CO + $\frac{1}{2}$ " O + 1.0861 " O.....		7.86	2,117	0.490		— 0.0121
9	$\frac{1}{2}$ " CO + $\frac{1}{2}$ " O + 1.2563 " N.....		7.73	2,084	0.515	0.5021	+ 0.0129
10	$\frac{1}{2}$ " H + $\frac{1}{2}$ " O + 1.2509 " N.....		7.49	2,024	0.547		+ 0.0449
11	$\frac{1}{2}$ " CO + $\frac{1}{2}$ " O + 1.2563 " N.....		7.35	1,909	0.470		— 0.0321
12	$\frac{1}{2}$ " CO + $\frac{1}{2}$ " O + 1.7145 " O.....		6.67	1,723	0.520		+ 0.0179
13	$\frac{1}{2}$ " CO + $\frac{1}{2}$ " O + 2.1559 vols. O.....		5.83	1,469	0.512	0.527	+ 0.0099
14	$\frac{1}{2}$ " CO + $\frac{1}{2}$ " O + 3.1629 " CO.....		4.79	1,146	0.527		+ 0.0249

These numbers, in Bunsen's view, show that, in a mixture of carbonic oxide or hydrogen with the exact proportion of oxygen required for combustion, and unmixed with any diluent gas, only one-third of the carbonic oxide or hydrogen is burnt at the maximum temperature, whilst the other two-thirds, by being raised to the high temperatures of 2,558° to 3,033°, have lost the power of combining; moreover, that, when one volume of the same mixture is diluted with 0.686 to 3.163 volumes of any gas that does not burn with it, and the temperature of the flame is successively reduced thereby from 2,471 to 1,146°, then, at all temperatures within these, exactly half of the carbonic oxide or hydrogen is burnt, the other half having lost the power of combining.

From this it has been inferred that the combustion of gases takes place in a manner different from that which had been previously supposed. When a mixture of two volumes of carbonic oxide with one

volume of oxygen is set on fire, and its temperature thereby raised from 0° to 3,033° C., two-thirds of the carbonic oxide remains in an unburnt, and for the time incombustible, state. The temperature is then lowered by radiation and conduction from 3,033° to 2,558° without any combustion of the carbonic oxide, but when the temperature falls somewhat lower, combustion recommences, restoring the heat lost by radiation and conduction, and raising the temperature again to 2,558° but not above that point. The gradual fall of temperature from 3,033° is followed by a continuance of the temperature 2,558° till exactly half the carbonic oxide is burnt, whereupon a third phase sets in, during which, again, no combustion takes place until the inflamed gaseous mixture has cooled down to at least 1,146°. As however, the gaseous mixture, after cooling, consists almost wholly of carbonic anhydride, these alternate phases of constant and decreasing temperature must be repeated below 1,146° until the last portion of the gas is burnt. This discontinuous combustion of a uniform mixture of a combustible gas with oxygen is referred by Bunsen to a law of combination established by him.

* See also Thorpe on the Theory of the Bunsen Lamp, "Jour. Chem. Soc.," 1877, i., p. 627, for Blochmann's investigations, or "Annalen Chem. Pharm.," vol. cxlviii., p. 295.

† "Phil. Mag.," vol. xxxiv., p. 489, and "Gasometry," by R. Bunsen.

These facts, as observed by Bunsen, are of great importance in connexion with the inflammation of gases, although it is probable, as Berthelot has indicated, that Bunsen's temperatures are too high in consequence of his not having considered the contraction of volume due to combination.

Berthelot* announced that the combustion temperatures in Bunsen's experiments may be anything between the limits shown in the following numbers, keeping the same numerical order as in the foregoing table:—

No.	t_1	t_2	No.	t_1	t_2
1	4,140	2,612	8	2,280	1,875
2	3,960	2,537	9	2,203	1,838
3	3,809	2,419	10	2,126	1,715
4	3,718	2,389	11	2,083	1,734
5	3,066	2,198	12	1,875	1,518
6	2,760	2,151	13	1,505	1,319
7	2,537	2,031	14	1,150	1,031

A number of experiments on this subject have been made since Berthelot's criticism appeared, but the conclusions arrived at are contradictory. All, however, agree in observing a great absorption of heat at high temperatures, which is thought to be due either to a change in the specific heat of gases or to dissociation. Messrs. Berthelot and Vieille† and Mallard and Le Chatelier‡ have advanced and supported the former view, while the latter has been advocated by Mr. Dugald Clerk§ and Professor Rücker, of Leeds. It is probable that both causes operate to produce the phenomena which have been observed.

The rate of ignition of gaseous mixtures is also a point of considerable importance. Sir H. Davy|| propounded a theory of this action, but it does not seem to be entirely supported by more recent investigations.

Bunsen found that the velocity of the propagation of combustion in a pure detonating mixture of hydrogen and oxygen was 34 metres per second, and in a maximum explosive mixture of carbonic oxide and oxygen it was less than 1 metre per second. When the explosive gases are gradually diluted with a gas that does not take part in the combustion, the rate is lowered, and it can be brought down thus until the progress of combustion is made visible to the eye.

Bunsen's method of determining these velocities is thus described by Dugald Clerk (*loc. cit.*):—The explosive mixture was allowed to burn from a fine orifice of known diameter, and the rate of the current of the gaseous mixture was carefully regulated by diminishing the pressure to the point at which flame passed back through the orifice and ignited the gases below it. This passing back of the flame occurs when the velocity with which the gaseous mixture issues from the orifice is inappreciably less than the velocity with which the inflammation of the upper layers of

burning gas is propagated to the lower and unignited layers.

Professor Mallard,* of the Ecole des Mines, made a series of observations by this method on the rate of the propagation of combustion in mixtures of coal-gas and air, and of marsh-gas and air. In the latter mixtures, the maximum rapidity of inflammation was found to be about 0.56 metre, or rather more than half a yard, per second. This velocity was attained with a mixture of 1 vol. marsh-gas and 8½ vols. air. When the proportion of air was increased to 12 vols. or diminished to 5.9 vols., the mixture was neither explosive nor inflammable.† Professor Thorpe remarks on this that it is worthy of note that the proportion of air corresponding with the maximum rate of inflammation is less than that which contains oxygen sufficient for the complete combustion of the marsh-gas. This, however, is what the observations by Bunsen and others, previously quoted, would lead us to expect.

The maximum rapidity of inflammation in mixtures of coal-gas and air was attained with a mixture of 5 vols. of air and 1 vol. of coal-gas, and was 1.02 metre, or rather more than 1 yard, per second. One volume of coal-gas with 6½ vols. of air gave a rate of 0.285 metre, or 11 inches, per second. The rate was very rapidly diminished by an excess of either constituent; a mixture containing more than 8 vols. and less than 3½ vols. of air to 1 of coal-gas was found to be unflammable in the way described.‡

Dugald Clerk has pointed out that these are the rates of ignition at constant pressure, and that in a closed space the conditions of inflammation are quite different in consequence of the expansion of the ignited portion and mechanical disturbance of the remaining part of the gaseous mixture. Experiments are needed to determine the rate of ignition for constant volume. Some remarkable results are given by this author, which were obtained by so arranging the plan of ignition that a small volume of gases was first ignited, which expanded and projected a flame through a passage into the mass of an inflammable mixture, thus adding to the rate of ignition the mechanical disturbance produced by the entering flame. He succeeded by this means in producing maximum pressure (or maximum ignition) in $\frac{1}{100}$ th part of a second in a space containing 200 cubic inches of gas. By firing a mixture with varying amounts of mechanical disturbance, almost any time of ignition could be obtained between $\frac{1}{100}$ th and $\frac{1}{10}$ th of a second. It did not matter whether the mixture used was rich or weak in gas; the rich mixture could be fired slowly, and the weak one rapidly, just as was required. He found that the rate of ignition of the strongest possible mixture is so slow that the time of attaining complete inflammation depends on the amount of mechanical disturbance permitted.

Mr. Lewis T. Wright has recorded§ some interesting observations on the velocity of the propagation of flame, and has announced that, when flame travels at a greater velocity than 4½ feet per second, it will pass through the gauze used in safety lamps. He also found that a flame of low velocity in a confined space may become so much agitated by an increase in its own oscillations as to cause the introduction of a very rapid rate of ignition in the remaining portions of the gaseous mixture. He

* *Ann. de Chim. et Phys.* [5] vol. xii., pp. 302–310; "J. Chem. Soc.," vol. xxiv., p. 5; *Compt. Rend.*, vol. lxxiv. (1877), p. 407.

† *Essai de Mécanique Chimique*, Paris, 1879; *Ann. de Chim. et de Phys.*, 5^{me} ser. xxviii. and xxviii.; 6^{me} ser. iv., pp. 13–84.

‡ *Compt. Rend.*, 1880, 1881, vols. xcii., xciii.; *Annales des Mines*, 8^{me} ser. Mémoires, iv., p. 274.

§ On the Theory of the Gas Engine, "Min. Proc. Inst. C.E.," vol. lxxx., part iii., also *ibid.*, vol. lxxxv., pp. 1–53. See also Rossetti, On the Temperatures of Flames, "J. Chem. Soc.," vol. xxiv., pp. 467, 694, &c.

|| "Researches on Flame." See also Watts, Dict. of Chem. "Combustion," i. 1089.

* *Annales des Mines*, vol. vii. 1875, p. 355. Thorpe, on the Theory of the Bunsen Lamp, "J. Chem. Soc.," 1877, i., p. 631.

† See also Coquilhon's results in "J. Chem. Soc.," 1877, i., p. 166, and in *Compt. Rend.*, 1876, vol. xxiii., p. 709.

‡ *Comp. Rend.*, vol. xc., pp. 151–157; *Ann. de Chim. et Phys.* [6], vol. vi., 1885, pp. 548, 556.

§ "J. Soc. Chem. Ind.," vol. vi., pp. 362–364.

remarks that "a definite explosive mixture may have a velocity of propagation of flame, when it is undergoing explosion of the first order, as low as $1\frac{1}{2}$ foot per second; but when it becomes sufficiently agitated to give an explosion of the second order, the rate of propagation of flame is several thousand feet per second."

The following table shows the results of experiments with various mixtures of gases, giving the rate at which an explosion of the first order (that is, a slow ignition) travels with each mixture in a glass tube 13 feet long and 0.75 inch diameter:—

Mixtures.		Lineal Velocity of Efflux of Mixture.	Rate at which Explosion of First Order travels in Tube.	Total Velocity of Propagation of Flame.
Gas.	Air.	Feet per Second.	Feet per Second.	Feet per Second.
Per Cent. 10.3	Per Cent. 89.7	1.21	1.1	2.31
12.2	87.8	1.24	2.0	3.24
15.0	85.0	1.28	3.0	4.28
17.7	82.3	1.32	4.8	6.12
19.6	80.4	1.35	3.0	4.35
21.2	78.8	1.38	2.4	3.78
22.1	77.9	1.39	1.3	2.69
23.0	77.0	1.41	Stationary.	..

Wright also found that, whenever an explosion is produced inside a safety lamp having ordinary gauze the flame was projected through the gauze, and could ignite gas at a considerable distance from the lamp. By employing stiff wires for the woof and lighter wires for the warp, he produced a "basket-work" gauze having small tortuous openings and a relatively large weight of metal, which did not allow flame from an explosion to pass through.

Luminosity of Flames.—According to the commonly received theory of the causes of luminosity in flames (first propounded by Sir H. Davy*), the presence of solid particles suspended in the flame (or in immediate contact with the burning gas) is essential to its luminosity.

There is no doubt that the introduction of solid particles in a fine state of division into a flame of feeble luminosity will impart to it a considerable degree of brilliancy by the incandescence of the solid particles, or perhaps in some cases by reflection of the light from their many surfaces. No sound conclusion, however, as to the luminosity of flames in general can be drawn from such an analogy as is afforded by the result of such an experiment, because Tyndall has shown that the same result is produced when the solid introduced is one that does not burn. The presence of solid particles, according to the common idea, in luminous flames is only assumed, not proved. It is usual, however, to refer to the black deposit which is formed upon a glass rod or similar body, when it is held in the flame of a candle or of hydrocarbon gas, as a proof that such flames contain solid particles. This, however, is not a conclusive proof, for Dr. Frankland† has pointed out that this deposit is not pure carbon, but is a hydro-

carbon compound. To this Dr. Percy* objects that it is fixed, not volatile, whatever its composition may be; but the objection seems to be irrelevant, because it refers to the substance as deposited, and we do not know that such a substance existed in the flame. The introduction of the cold surface of the glass rod not only condenses some vaporous hydrocarbon, but doubtless also causes decomposition of some of the many hydrocarbons which make their appearance in the gradual resolution of carbonaceous matter. As, therefore, we do not know in what combination this substance producing the black deposit existed while it was originally in the burning gas, it cannot properly be asserted that it was "fixed, not volatile."

The phenomena of many luminous flames are explained by various writers, with more or less ingenuity, on the hypothesis of solid particles, but the experiments and observations of Dr. Frankland† have shown that that hypothesis is not wholly satisfactory, because luminous effects have been produced where it could not account for them, such, for example, as the luminosity of the flame of hydrogen burning in oxygen under pressure; and secondly, because in many of the brightest flames the temperature is such that fuliginous matter‡ could not exist in them. In many cases, it might seem, therefore, to be a more satisfactory explanation, that the luminosity of flames depends on the existence of a comparatively high temperature, and on the presence of gases or vapours of considerable density.§

Soret|| made, in 1874, some experiments which were intended to refute the opinion previously given by Hirn adverse to Davy's theory of solid particles. These experiments consisted in projecting, by means of lenses, the image of the sun on to the surface of several hydrocarbon flames, and examining the degree of polarisation of the reflected light by the use of a Nicol's prism. As the light was observed by the eye, it was necessary to interpose several plates of cobalt-coloured glass, and the sunlight was distinguishable from the light of the flame merely by means of a trace of blue which was ascribed to it as distinct from the purple colour yielded by the flame light.

Soret obtained similar results, though in varying degree, with sunlight when reflected from lampblack, from non-incandescient smoke, from smoky carbon flames, and from the flames of candles and hydrocarbon gas having different degrees of carburization. When, however, the flame, even of highly-carburetted gas, burned in an atmosphere of abundant oxygen, the blue trace and the polarisation effect were invisible. In fact, his best results were obtained in proportion to the decrease of luminosity. On this account Soret was not warranted in concluding, as he did, that his results support Davy's theory, because they failed just when it was important that they should not fail, namely, when the luminosity of the flames was largely increased. If we accept these experiments as showing that sunlight was reflected from finely-divided particles in these flames, they also indicate that the luminosity of these flames was not only *not due* to the presence of these solid particles, but that, on the contrary, it was *diminished*

* "Metallurgy," vol. "Fuel," p. 158.

† *Op. cit.*, and "J. Chem. Soc. Lond.," 1864, vol. xvii., pp. 52–55; "Brit. Assoc. Reports," vol. xxviii., p. 37; "Proc. Roy. Inst.," vol. v., 1869, pp. 419–423; "Proc. Roy. Soc. Lond.," vol. xxx., No. 201.

‡ See Lectures on Coal Gas, delivered at the Royal Institution, London, March 1867, by Dr. Frankland, published in the "Journ. of Gas Lighting," &c., London.

§ *Journ. Soc. Chem.*, 1862, vol. xv., p. 168; Watts, "Dict. of Chemistry," 1st sup., p. 485.

|| "Phil. Mag.," ser. 4, vol. xlvii., p. 205; vol. 1875, p. 50. Translated from *Archives des Sciences* of the *Bibliothèque Universelle*, 1873 and 1874.

* "Phil. Trans.," for 1817, p. 75.

† "Proc. Roy. Soc. Lond.," vol. xvi., 1868; "Phil. Mag.," vol. xxxvi., 1868, pp. 309–311; "Experimental Researches"; "Lectures on Coal Gas."

by them, as they disappeared from the brighter flame.

More recently Burch* has to some extent repeated Soret's experiments, making use, however, of the spectroscopic in the examination of the light from the flame, and thus being better able to distinguish between it and the reflected sunlight. He found that the reflected sunlight showed all the Fraunhofer lines, and that, on using the Nicol's prism, it was polarised at right angles to the line of incidence; and he compared this result with that obtained from the reflection from finely-divided particles of shellac as precipitated by and suspended in water.

The observed effects being the same, he was perhaps justified in concluding that in the flames which he examined, the sunlight was reflected from finely-divided solid particles; although in the present state of this branch of the science of optics, it would be foolish to consider this matter *proved*. Finely-divided solid matter suspended in a viscous fluid, and rushing through a flame, represent very different physical conditions, and it is extremely improbable that we can safely reason from results afforded by one phenomenon to those of the other. The flame itself, by reason of the intense vibrations which constitute its existence, may behave towards sunlight in a manner very different from that of a transparent and almost quiescent liquid.

At any rate, Burch's results are far from proving that the *luminosity* of these flames was in any way dependent upon the presence of solid particles, except in so far (as Soret's experiments teach) as they may have acted in diminishing the degree of luminosity. The mere fact of the *presence* of solid particles, supposing that to be established, does not prove anything regarding any relation between them and luminosity. This is a distinct subject for proof.

On the other hand, the effect of high temperature is seen in the greater brightness of the flames of sulphur, phosphorus, and, indeed, all substances when burnt in pure oxygen, as compared with the result of their combustion in air. Direct evidence of the effect of high temperature is also afforded by the combustion of phosphorus in chlorine, for, whilst at ordinary temperatures only a feeble light is produced by this combustion (although the product PCl_3 has considerable density), strongly heated phosphorus vapour burns in hot chlorine with a dazzling white light.

A comparison of the relative densities of gases and vapours shows that the brightest flames in general are those which contain the densest vapours.

Relative Densities of some Gases and Vapours.

Hydrogen	1
Water	9
Hydrochloric acid	18½
Arsenious chloride	91
Metallic arsenic	150
Arsenious oxide	198
Air	14·5
Oxygen	16
Carbon dioxide	22
Sulphur dioxide	32
Phosphoric oxide	71 or 142
Chlorine	35·5
Mercury	209

Hydrogen burning in chlorine produces a vapour more than twice as heavy as that resulting from its combustion in oxygen, and accordingly the light produced in the former case is stronger than in the latter. Carbon and sulphur burning in oxygen

produce vapours of still greater density (viz., CO_2 and SO_2), and their combustion gives a still brighter light. Phosphorus, also, which has a very dense vapour, and yields, in burning, a product of great vapour density, burns in oxygen with a brilliancy almost blinding.

The luminosity of a flame is increased by compressing around it the surrounding gaseous atmosphere, and it is diminished by rarefying it. Thus, mixtures of hydrogen and carbonic oxide with oxygen emit but little light when they are burnt or exploded in free air, but exhibit intense luminosity when exploded in closed vessels so as to prevent expansion of the gases at the moment of combustion.

Frankland experimented with jets of hydrogen and carbonic oxide burning in oxygen under a pressure which he gradually increased to twenty atmospheres, and obtained brilliant luminous effects, including bright and continuous spectra. Even the faint flame of alcohol, as in an ordinary spirit lamp, becomes highly luminous under the receiver of a condensing pump, when the pressure of air is increased to 120 inches of mercury.

We are indebted to Frankland* also for the observation that the diminution in illuminating power is directly proportional to the diminution in pressure; and, as applied to ordinary domestic gas-burners, this means that, as the barometer falls, the light from them diminishes at the rate of 5·1 per cent. for every inch of fall. According to Dr. Letheby,† “in London the difference in the value of the light when the barometer is 31, as compared with what it is at 28, is fully 25 per cent.”

The flame of arsenic burning in oxygen may also be rendered quite feeble by rarefying the oxygen; and, at high altitudes, flames exhibit the effects of rarefied air. Tyndall and Frankland‡ made observations on the combustion of stearin candles at the summit of Mount Blanc and at Chamouni, and found a considerable decrease in luminosity at the high elevation, although the rate of combustion of the candles remained the same in both places. The energy of combustion was therefore unaltered, although the flame in one case had a higher temperature than in the other, resulting from the increased density of the gaseous atmosphere. Percy shows (vol. “Fuel,” p. 159) that this conclusion should be drawn even from the theory propounded by Tyndall in explanation of the diminished luminosity which he observed on Mount Blanc. Tyndall's theory was, that the decrease in luminosity was mainly due to the greater mobility of the air. From this Percy reasons, “Now, if increased mobility of the air be caused by rarefaction, the opposite should result from compression, in which case the movement of the particles would become sluggish, intermixture of the air and flame-producing gas would be less rapid, and the diffusion of the gaseous products of combustion in the surrounding air would be retarded, with consequent increase of temperature.”

Frankland's conclusions have also been confirmed by some experiments by Professor V. Wartha§ on the influence of pressure on flames.

* *Op. cit.*, and “Phil. Trans.,” vol. cli, 1861, p. 629.

† “Common Sense for Gas Users,” by R. Wilson, p. 19 (London: Crosby, Lockwood, & Co.).

‡ “Heat considered as a Mode of Motion,” by J. Tyndall, F.R.S., 1865, p. 50.

§ “Jour. für Gasbeleuchtung,” vol. xiv., p. 761; “Min. Proc. Inst. C.E.,” vol. xlviii., part ii., p. 329.

Obituary.

JOHN WILLIAMS, F.I.C., F.C.S.

A VICE-PRESIDENT OF THE SOCIETY OF CHEMICAL INDUSTRY.

It is with great regret that the death on Sunday, March 3rd, of Mr. John Williams, is herewith recorded, and to this record we may fittingly, as well as truly, add that there are few men whose lives pass away from among us, to whom the tributes of respect for their knowledge and attainments as well as of love and esteem for their personal qualities and character, are at once so largely and so equally due.

Mr. Williams was born in London on March 9th, 1824, and so his death, which took place after but a short illness, ensued within a few days of his 65th birthday. He was the son of Mr. John Williams, sometime Secretary of the Royal Astronomical Society and other learned Societies. As a youth he entered the service of Mr. Thos. Morson, whose assistant he was for some years, and indeed until he became the partner of Mr. W. King Hopkin. In the well-known firm of Hopkin and Williams he continued his labours for nearly 40 years. John Williams was for 17 years a member of the Council of the Pharmaceutical Society of Great Britain, for three years of which he acted as Treasurer, and during three years more he filled the office of President of that Society. In June 1887, fearing that failing health would debar him from what he considered the proper fulfilment of his duties as a member of the Council of that Society, he resigned the post, and this resignation was shortly afterwards followed by his retirement from active business life. He has been officially connected with the Society of Chemical Industry from the very first, and was most regular in his attendance at the Council meetings of that Society. No member of the Society more thoroughly enjoyed the Annual Meetings, or entered, so far as his strength and the increasing infirmities of age would permit, more enthusiastically into the festivities and excursions of that season, than Mr. John Williams. During the last three years Mr. Williams has held the honourable position of a Vice-President of the Society, and it need scarcely be added that the duties of that position have received his most assiduous attention.

Besides being a pharmacist and a manufacturer, Mr. Williams was a sound chemist, and as a consequence of this, the name of his firm became especially associated with the supply of fine chemicals. To this sound knowledge of practical chemistry, his numerous published papers bear ample testimony. The principal of these it may be interesting to enumerate, with the dates of their publication. In 1872, "Note on Guaiacol" and "Guaranine." 1874, "Note on the Administration of Phosphorus." 1874 and 1875, "Notes on the Preservation of Hydrocyanic Acid." 1875, "Note on Salicylate of Methyl." 1876, "Salicylate and Sulphosalicylate of Sodium;" also "Note on some Reactions of the Glycerol of Nitrate of

Bismuth." 1877, "Nitrite of Ethyl." 1878, "Note on Salicylic Acid;" also "Preliminary Note on Aceto-Nitrate of Iron as a Medicinal Agent." 1884, "Note on certain Anhydrous Essential Oils." 1885, in conjunction with Mr. H. Smith, "Note on the Preparation of Amyl Nitrite." 1886, "Crystallised Aconitine;" also "Note on the Preservation of Ethyl Nitrite." 1887, "Note on the Testing and Purification of Hydrochloride of Cocaine;" also "New Process for the Preparation of Aconitine."

In 1883 John Williams was elected President of the British Pharmaceutical Conference, and delivered an exceedingly interesting presidential address at the meeting at Hastings in the following year.—W. S.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

New Apparatus for the Concentration of Extracts in vacuo. L. A. Adrian. Bull. Soc. Chim. 1889, 228—234.

As the result of attempts to avoid the decomposition of the organic substances contained in pharmaceutical extracts by heat and exposure to air during concentration, the author describes the following apparatus, by which the evaporation is effected with a minimum amount of change either in colour, taste, or composition. Although the vacuum method has long been employed for the concentration of sugar solutions, the apparatus here described is considerably modified to meet conditions dependent on the nature of the substances under treatment.

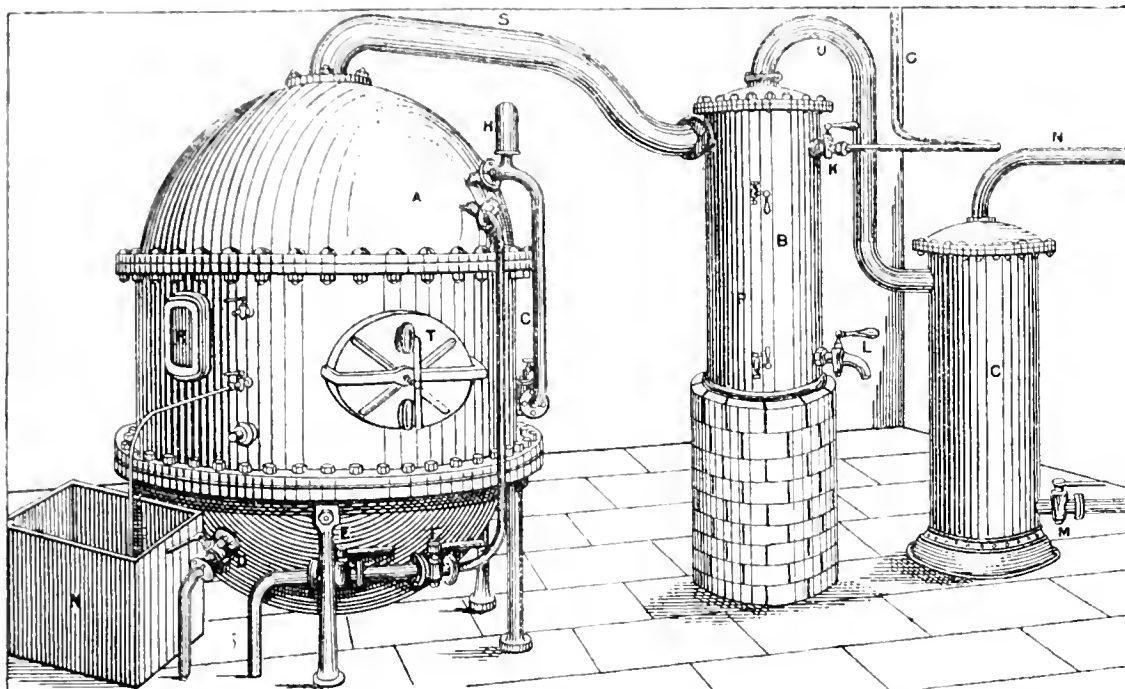
The first apparatus, as shown in Fig. 1, was constructed in 1873, and comprises:—

A, the vacuum pan, of about 1,000 litres capacity, is cylindrical and terminated above and below by hemispherical steam jackets. B, a cylindrical reservoir serving as a trap for particles of liquid mechanically carried over during violent ebullition. C, a second reservoir in which the vapours are condensed by a shower of water supplied by the pipe N. S and U are the connecting pipes conveying the vapours which are drawn over by the vacuum maintained through the pipe M. N, a tank containing the liquid to be concentrated. G, a pipe conveying steam to the upper jacket. F, a pipe conveying the steam after use in the upper jacket to the lower jacket. E, a cock for the introduction of cold water along with the steam to the lower jacket, in which any desired lower temperature may be thus maintained. D, outlet for the hot water or steam. R, sight glass to view the course of the evaporation. T, manhole for removing the finished product.

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	4d.
Above 8d., and not exceeding 1s. 6d.	1d.
" 1s. 6d., " " 2s. 4d.	1½d.
" 2s. 4d., " " 3s. 4d.	2d.

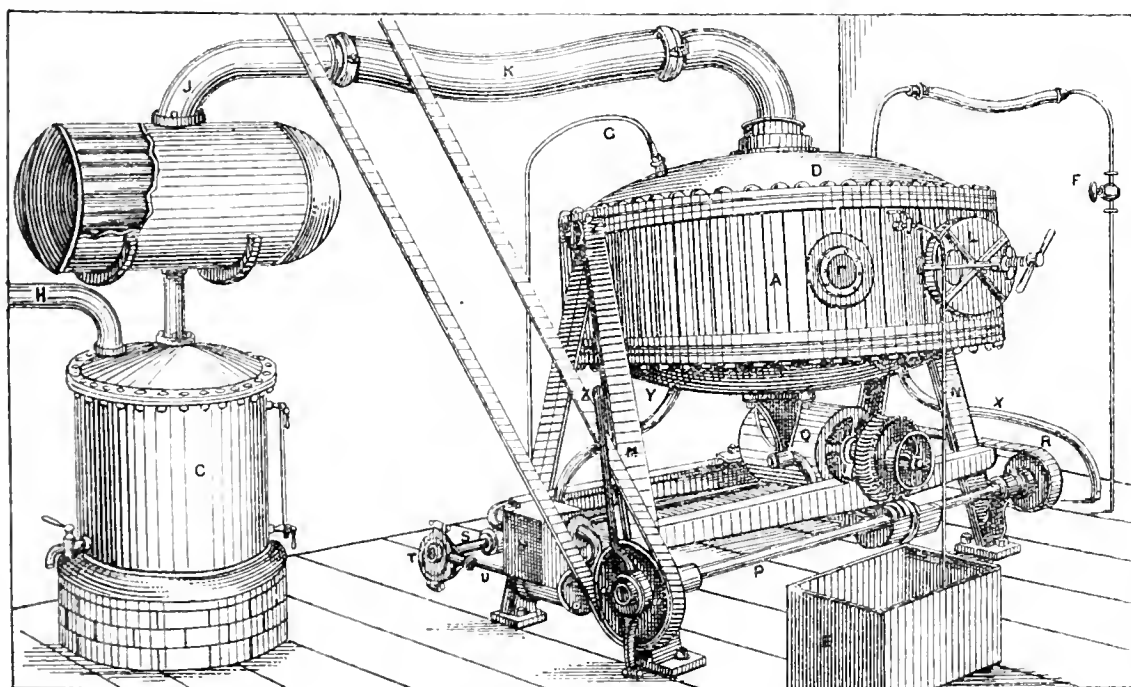
Fig. 1.



A vacuum having been established in the apparatus, about 150 kilos. of the liquid are let into A, and the heating is regulated by the several cocks and a thermometer inserted into A. To secure tightness in the vacuum pump the pistons work under a cushion of water. The evaporator is fed with liquor until about 25 to 30 kilos. of extract are obtained, when it is removed through the manhole preparatory to introducing a fresh charge. The function of the upper steam jacket is simply to prevent condensation of the

vapours in the evaporator. This apparatus has served with success in concentrating the mother-liquors of sulphate of quinine, but it presented two principal defects, first, that the curved bottom was unsuitable for a quick and complete removal of the finished product, especially if that were quite dry, and secondly, the absence of any kind of agitation was favourable to the formation of a crust on the surface of the liquid which hindered evaporation and required the application of an undesirably high temperature. The

Fig. 2.



oscillating apparatus shown in Fig. 2 was designed to overcome these defects, and has been in successful operation for two years.

A is an evaporator of tinned copper, with a flat bottom and a capacity of 700 litres, the diameter being equal to four times the height. There are two manholes at opposite sides. The evaporator is double-jacketed above and below, D being heated by steam from F, of which the outlet is at G. The pump V injects warm water into the lower jacket, and ejects it through the pipe X, in which a thermometer is placed to register the temperature. The evaporator is hung on an axis Z, resting on the supports M N, and an oscillating motion is communicated by a projecting piece from A, carrying a cam which works in an endless groove in the revolving cylinder Q geared to a shaft driven by a belt. The dome of the evaporator is connected by an india rubber pipe K to the condensing cylinder J, containing 400 tubes through which cold water flows. The products of condensation are collected in C, which is in communication with the vacuum pump by the pipe H. r is one of the sight glasses, to view the course of the evaporation, and to regulate the additions of liquid by the pipe dipping into the tank E. The sides of the evaporator are covered with wood, to hinder condensation within. A charge of 80 litres of liquid is let into the evaporator, and water of 80° into the lower double jacket, steam being let into the upper one. On setting the oscillating movement to work, the evaporating liquid is kept in constant motion, exposing always a fresh surface for evaporation. This condition is very favourable to rapid evaporation and the maintenance of a low temperature, 50 litres of condensed water per hour being easily obtained with a temperature of 35° to 36° C. in the interior of the evaporator, and the desiccation of the residue may be made complete. If the residue be pasty it may be removed through the manhole by tilting the evaporator to one side, and if dry raked out whilst still warm.—G. H. B.

Improvements in Filters. P. A. Maignen, London. Eng. Pat. 17,220, December 14, 1887. *Sd.*

THE inventor claims "the construction of a filtering device consisting of a cloth, such as asbestos, with alternate internal supports and external constrictions, presenting a corrugated surface of large area within a small compass;" also the construction of the internal supports in the form of ceramic or other plates with or without central orifices; also various other devices and combinations; for details of which the drawings must be consulted.—E. G. C.

PATENTS.

Improvements in the Method of and in Apparatus for Purifying Water. A. H. Hobson and C. H. Rooker, London. Eng. Pat. 17,650, December 22, 1887. *11d.*

"A FILTER having an inlet and settling chamber beneath the filter-bed, a water-space above, and an overflow lip, or equivalent dripping device, in a surrounding drip chamber for receiving the filtered water." For further particulars, the three sheets of drawings attached to the Specification must be consulted.—E. G. C.

Improved Machine for making Scorifiers, Cupels, and Crucibles. T. P. Sims, Swansea. Eng. Pat. 445, January 11, 1888. *Sd.*

A VERTICAL cylinder or rod which works in guides carries the mould for the crucible, &c. at the top. This rod receives an up and down motion by means of a crank which connects it with a rotating horizontal shaft. A second vertical rod is situated centrally above the former cylinder, and has a rotatory motion communicated to it by means of suitable gearing which connects it with the rotating horizontal shaft. The lower end of this second rod carries the inner form of the mould. A suitable lump of clay is placed in the mould, and, as this ascends, the

clay is pressed against the revolving internal mould. The rotation of the latter prevents adhesion when the mould with the finished crucible descends. The base of the crucible rests on a movable rod which works like a piston inside the cylinder, and as the latter descends, the descent of this internal rod is arrested and the crucible thus forced out of the mould. The finished crucible can then be easily removed.—F. W. T. K.

Improvements in or connected with Filter-Presses. J. A. Drake and R. Muirhead, Maidstone. Eng. Pat. 1923, February 8, 1888. *Sd.*

To facilitate the passage of liquid from the interior of the filter-press chambers described in Eng. Pat. 10,143 of 1885 (this Journal), the distance rings are provided at their rims, where the plates and frame are in close contact, with a circular and somewhat deep groove, from which slits or channels, radially placed, conduct the liquid freely to the exterior of the apparatus. The filtering plates are sometimes formed from two discs of perforated metal kept asunder by distance pieces, the space between the two plates being tightly packed with bass, coir, coker fibre, or other similar material.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

The Chemical Changes in the Preparation of Water Gas and Heating Gas. J. Laug. Journ. f. Gasbel. 1888, 932. (See also this Journal, 1888, 554—556.)

THE author has examined the action of steam and of marsh gas on pure carbon at various temperatures, and also the conditions under which the resulting products are obtained. Temperatures up to 600° were measured by means of various salts enclosed in small glass tubes, above this by observing the point at which beads of various salts fused on a platinum wire and melted off completely, and the highest temperatures by means of metals. Marsh gas begins to reduce carbon dioxide between 700° and 800° C., at which temperatures 0.6 per cent. of carbon monoxide is formed; at 954° and 1,054° C., 6.4 per cent. and 8.2 per cent. of carbon monoxide were obtained respectively. In each case a separation of carbon was observed in the tube through which the mixed gases were passed; this was also noted on passing marsh gas alone through the tube. The action of marsh gas on steam is small unless a considerable excess of the latter (2:1 or more) is present, when at a temperature of about 1,000° a mixture of gases results consisting of about equal volumes of hydrogen and marsh gas, together with small quantities of carbon monoxide and carbon dioxide. The large amount of hydrogen is due to the direct decomposition of the marsh gas, as well as to the latter being decomposed by the steam; the carbon monoxide results, as in the decomposition of steam by carbon dioxide, by the action of the latter on the carbon deposited in the tube, and its formation begins at 600° C. and becomes considerable at 954° C. The decomposition of steam by carbon starts at 600° C. and is considerable at 1,000° C. Oxygen attacks carbon (gas coke or blast-furnace coke) at 500° C., and provided the former be passed slowly, little or no carbon monoxide is obtained. If, however, a rapid current of oxygen be passed over carbon at this temperature, which is not sufficiently high to cause a reduction of carbon dioxide, the monoxide is formed owing to the higher temperature developed by the combustion of the carbon. On passing a mixture of oxygen and carbon monoxide (containing nitrogen) over coke at 500° C., slowly, carbon dioxide is obtained by the action of the oxygen on the coke, whilst the carbon monoxide passes through unchanged; if the mixed gases be passed over rapidly, a portion of the carbon dioxide formed is reduced, and the resulting mixture contains more carbon monoxide than was originally present. This goes to show that the formation

of the latter precedes that of the former, and if the gaseous mixture be passed very rapidly it takes fire owing to the heat developed by the burning of the coke. Steam acts on coke below 600° C., forming hydrogen and carbon dioxide; nitrogen saturated with steam and passed over coke at 630° C. yields hydrogen and carbon dioxide, together with a little carbon monoxide formed by the reduction of the latter. At 800° to 1,000° C., graphite decomposes steam to a considerable extent, and carbon monoxide is also formed. The author's experiments show that there is a limit to the decompositions expressed by the equations $C + CO_2 = 2 CO$; $C + 2 H_2O = CO_2 + 2 H_2$; and $CO + H_2O = CO_2 + H_2$; for by passing 100 cc. of carbon dioxide slowly over coke at 600° C. for four hours, only 2.3 per cent. of carbon monoxide was formed, and with a rapid current only 2 per cent.; at 1,054° C., 3 per cent. of carbon dioxide remained undecomposed after passing the gas for two hours, and the author was unable to accomplish the complete conversion of the dioxide into the monoxide. Similarly with steam and carbon monoxide there appears a limit to the decomposition, for by passing the mixed gases through a porcelain tube 20 times at 950° C., the decomposition products remained the same as after the mixture had been passed twice, 56.4 per cent. to 62.2 per cent. of the carbon monoxide remaining undecomposed. And finally, steam, when passed over coke, behaves in a like manner. Nitrogen saturated with steam and passed over the coke twice at 1,000° yielded a mixture of carbon monoxide, hydrogen, nitrogen, and a little carbon dioxide, the composition of which suffered little change by passing the gas over the coke 20 times. The formation of the carbon dioxide is due to the action of the steam on the monoxide, whereby the quantity of hydrogen resulting is also increased.—C. A. K.

IV.—COLOURING MATTERS AND DYES.

On the Theory of the Aniline Blue Process. R. Hirsch. Chem. Zeit. 12, 1725—1726.

THE author describes, after some general remarks, an experiment which he made in order to see whether and which aniline blue was formed by the action of paratoluidine on rosaniline. A very pure rosaniline, prepared according to the arsenic acid method, was used, and one part of it heated with five parts of paratoluidine to 190° C. No blue was, however, formed. There was a weak evolution of ammonia, which also takes place when pure aniline is heated with rosaniline, but in neither case did a formation of blue take place. This proves that the presence of an organic acid, such as benzoic or acetic acid, is essential for the formation of the blue, contrary to Nietzki's view that paratoluidine is capable of producing a blue in the absence of an organic acid. The action of organic acids on amines is well known. They form amides, and some further experiments are described to show the action of acetanilide and benzanilide on rosaniline. 10 grms. of rosaniline, 50 grms. of aniline, and 10 grms. of acetanilide were heated to 180° C., and at the end of two hours no blue had been formed. 5 grms. of rosaniline and 10 grms. of acetanilide were heated for two hours to 200° C. There was a faint smell of acetanilide and a trace of blue had been formed (the alcoholic solution appeared, after addition of acetic acid, reddish violet), but the bulk of the rosaniline had not been changed. The theory, therefore, is not admissible, that in the aniline blue process intermediate amides of aniline are produced, which act on the rosaniline and form the new compound. An experiment to convert leuco-rosaniline into leuco-phenyl-rosaniline proved a failure. 10 grms. of leuco-rosaniline, 50 grms. of aniline, and 1 gm. of benzoic acid were heated to 180° C. for two hours, carbonic acid being passed through the flask to prevent oxidation. A small part of the base was, however, oxidised and converted into rosaniline blue, but the bulk of the leuco base had not been acted upon,

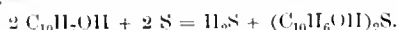
and yielded rosaniline on oxidation with chloranil. This observation seems to show that the carbinol group plays an important part in the formation of the blue from rosaniline.—A. L.

On the Preparation of Thiophenols or Thiophenylethers. Leuckart. Chem. Zeit. 12, 1728.

DIAZO-COMPOUNDS acting on salts of mono-, di-, and trithio-carbonic acids are converted into the corresponding thiophenyl ethers, from which the thiophenols can be easily prepared.—A. L.

β-Naphtholsulphide. S. Onufrowicz. Ber. 21, 3559—3563.

THIS substance is manufactured by Dahl and Co. according to the following method:—250 grms. of β-naphthol and 55 grms. of sulphur are heated together to 170°—180°, sulphuretted hydrogen is slowly evolved, and 200 grms. of lead oxide are added gradually. The residue is extracted with alcohol, and the solution deposits crystals on cooling, the analysis of which agrees with the formula $(C_{10}H_6OH)_2S$. The reaction probably takes place as follows:



When boiled with acetic anhydride it yields the diacetate, with benzoyl chloride a dibenzoate. On heating thionaphthol with finely-divided copper in an iron tube to 230°—240° a black mass is obtained, from which β-dinaphthol may be separated.—J. B. C.

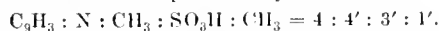
The Formation of Durene, and the Application of Aluminium Chloride to the Preparation of Benzylidurene. M. Beaurepaire. Bull. Soc. Chim. 1888, 676—679.

TO prepare durene the author takes 300 grms. of toluene, and 60 grms. of aluminium chloride, and the vapour of methyl chloride is introduced through the bottom of the mixture so that it passes through a column of about 30 to 40 cm. of liquid. The vessel is placed in a calcium chloride bath and warmed. At 60° no action takes place, at 60°—80° methyl chloride is absorbed, but not until the liquid is at 90°—95° does the characteristic reaction of aluminium chloride begin, hydrochloric acid being evolved. The action appears to slacken at 100°, and at 110° products of the anthracene series appear to be formed. At 93°—95°, 400 grms. of toluene yielded 180 grms. of crude durene, the remainder being higher boiling products.

To prepare benzylidurene the author uses a mixture of 10 grms. of crystallised durene, 7 grms. of benzylchloride, 50 grms. of carbon bisulphide, and traces of aluminium chloride, and the mixture is heated until hydrochloric acid is no longer evolved. The product is washed with water, filtered, and distilled in fractions. The principal portion passes over at 300°—350°, and is solid at ordinary temperatures. The pure substance, after recrystallisation from acetic acid, distils at 325°—327°, and has the composition of benzylidurene, $C_6H(CH_2)_4(CH_2.C_6H_5)$.—J. B. C.

Some Derivatives of Paraxyloquinoline. E. Noelting and I. Fruchling. Bull. Soc. Ind. Mulhouse, 1888, 727—729.

THE paraxyloquinoline sulphonic acid prepared from paraxyldine sulphonic acid by Skraup's reaction can only have the constitution represented by the formula—



The crude product is purified by repeated crystallisation from boiling water, and then appears in the form of small white prisms, slightly soluble in cold but very readily soluble in hot water. The barium salt forms small needles, very soluble in boiling water, moderately so in cold water, containing one molecule of water of crystallisation. The potassium salt contains one molecule of water of crystallisation, and is easily soluble. The isomeric xyloquinoline

sulphonic acid was prepared in a similar manner from paraxyldine parasulphonic acid; its constitution is represented by the formula—



This acid also crystallises in small white prisms, but is less soluble in water than the other. Its barium salt forms pearly plates, moderately soluble; according to the conditions of crystallisation it contains either one or two molecules of water. The potassium salt is anhydrous and appears as fine plates, very soluble in water.

These points of difference regarding the solubilities and crystalline forms of the acids and their salts, and the amounts of water of crystallisation contained in the salts, are sufficient to distinguish the two acids. Heated with excess of ammonium chloride, both acids and the barium salts yield paraxyloquinoline, which is, however, more easily prepared from paraxyldine. Paraxyloquinoline is only acted upon with difficulty by sulphuric acid; the monosulphonic acid was obtained by heating the base on the water-bath for 36 hours with five times its weight of sulphuric acid, containing 25 per cent. of SO_3 . This monosulphonic acid was proved to be identical with that obtained from paraxyldine parasulphonic acid.—E. B.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

PATENT.

Improved Process of Manufacturing Artificial Wool from Ramie and other Fibrous Vegetable Matters. R. Haddan, London. From P. Mol, Antwerp, Belgium. Eng. Pat. 9145, June 22, 1888. 4d.

THE object of this invention is to produce a material resembling wool by treating ramie and other fibrous substances for two or three hours with a hot solution of potash, and subsequently with a 10 per cent. solution of bleaching powder for three hours.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

The Application of Antimony Salts in Cotton Dyeing.
H. Lange. *Färberei Must. Zeit.*, 1889, 35.

THE author recommends the use of the double salt of antimony fluoride and ammonium sulphate, $\text{SbF}_3 \cdot (\text{NH}_4)_2\text{SO}_4$, in cotton dyeing. (See this Journal, 1888, 727.) Cotton mordanted with tannin and this salt gives lighter and brighter colours than when tannin and tartar-emetic are used. An addition of caustic soda of one-fourth to one-fifth of the weight of the double salt may be added, but not more; good results are obtained, and the antimony bath may be used repeatedly, if an addition of the salt is made each time to compensate for the amount precipitated by the tannin. Both the cheapness and solubility in water of this double salt recommend it as a substitute for tartar-emetic; also it can be employed in dyeing mixed fabrics containing half wool or half silk.—C. A. K.

Report on a Memoir of M. Fischli on Turkey-Red Dyeing.
E. Noeltting and F. Binder. *Bull. Soc. Ind. Mulhouse*, 1888, 730—734.

IN this paper, which has been recommended for prize No. 3 offered by the Industrial Society of Mulhouse, M. Fischli states that the chief constituent of the commercial turkey-red oils is ricinoleic acid, either in the free state or combined with alkalis. When the crude article, after being washed with water and freed from uncombined

sulphuric acid, is boiled with dilute hydrochloric acid, the sulphuric acid compound is decomposed, sulphuric acid being liberated and ricinoleic acid formed. This fact is confirmed by Benedikt. For the purposes of this research ricinoleic acid was prepared pure, as shown by the analysis of its barium salt, and was found to give coloured lakes quite as bright as those obtained with the commercial oleines.

Taking a known quantity of the alkaline ricinate and gradually adding aluminium sulphate or acetate to it, a viscid semi-fluid precipitate was first obtained; continuing the addition of aluminium salt, the precipitate clotted, and after purification by solution in ether, evaporation to dryness, and washing with alcohol, it became pulverulent. Thus purified the aluminium ricinolate, on analysis, was found to correspond to the formula $\text{Al}_2\text{O}(\text{OH})_2(\text{C}_{18}\text{H}_{33}\text{O}_2)_2$. The aluminium ricinolate heated in water with alizarin begins to attract the colouring matter at 40° C. (confirmed in dyeing), then melts, and gradually, whilst the temperature is increased to 105° C., takes a bright red appearance.

The lake so formed is unaltered by boiling with soap; alcohol and ether after prolonged action dissolve it, and these solutions can be used for dyeing samples of cotton turkey-red.

After making these preliminary experiments the following process of dyeing was adopted:—

1. Preparing with oil. 2. Mordanting with alumina.
3. Fixing with chalk. 4. Dyeing. 5. Preparing with oil.
6. Steaming. 7. Soaping.

Preparing with Oil.—For this operation ammonium and sodium ricinoleates were used. At a high temperature the fibre fixes the fatty acid and allows the ammonia to escape; only partial decomposition takes place on drying at 50°—60° C. The sodium ricinate under the same conditions is decomposed, ricinoleic acid being liberated and carbonate of soda formed by the action of the fibre and the air.

The fatty mordant when fixed, particularly if pure ricinoleic acid has been used, does not, as shown by analysis, undergo oxidation.

Mordanting.—Different aluminium salts are in use. On padding with the acetate the cloth acquires a sticky touch, due to the formation of the above-mentioned aluminium ricinolate. After drying, Fischli washed with water and found aluminium acetate in solution, showing that complete fixing of this mordant does not take place. A second extraction with alcohol yielded a mixture of fatty acid and aluminium ricinolate capable of mordanting cotton for pink. Further, cellulose precipitates alumina.

Fixing with Chalk.—The purpose of this process is to precipitate the aluminium salt and to deposit a certain amount of lime on the cloth.

Dyeing.—The dyed fabric, on testing, gave the following results:—

On treatment with alcohol, a powdery red substance remained, corresponding to the colour-lake less its fatty constituent, which was removed; furthermore, a soluble colour, aluminio-ricinoleic lake, was formed, capable of dyeing unmordanted cotton a rose tint.

When a ricinolate is added to the dye-bath, the dyed fibre contains free ricinoleic acid in addition to the two substances mentioned.

Preparing with Oil.—This process is unnecessary when a ricinolate is added to the dye-bath. Unless such addition is made, the tissue has a brownish appearance. No action takes place on padding and drying.

Steaming.—According to Fischli's experiments, air at 105° C. has no action, whilst, when steam is present, the colour brightens instantly. This change is due to the action of the fatty matter on the alizarin-lime-alumina lake, and microscopic examination shows that steaming favours the penetration of the fibre by the colouring matter. The first oil preparation causes the penetration to be less thorough. Immediately after steaming, the cloth has a sticky touch on account of the presence of a portion of the lake in a melted state and of an excess of fatty matter.

Brightening.—The tin salt used along with the soap in this operation has a chemical action, tin entering into com-

bination with the lake and increasing its brightness. The brightening process is useful after dyeing with alizarin or anthrapurpurin; it can well be omitted in the case of flavopurpurin. Flavopurpurin, according to the author, is most suitable for calico printing, seeing that only a simple soaping is requisite to brighten it.

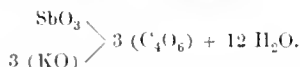
The latter part of the memoir deals with the process of discharging in pattern by the bleach-bath. It is shown that alizarin on being so destroyed yields phthalic acid, the bleach-bath acting like other oxidising agents. Alizarin offers most resistance to discharging in this way, then anthrapurpurin, and, lastly, flavopurpurin. Finally, it is remarked that the phenomena mentioned above take place when dyeing with the sulphocates; and the decomposition of these bodies, on steaming, into fatty acid and sulphuric acid, is described.—E. B.

Industrial Society of Malthouse. Report of the Meeting held November 14, 1888.

CHARLES KOFF read a paper on starch and its derivatives, giving an account of the manufacture of maize and wheat, starch, dextrin, calcined farina, and British gum. To these direct derivatives of starch must be added glucose in the form of clear syrup, solid glucose, and crude dextrose of 75 per cent., refined dextrose of 80 per cent., and, finally, a liquid maltose. A firm in Alsace now prepares soluble starch and starch gums of great purity, which, for many purposes, are capable of replacing *gum-arabic* and *gum-senegal*. Soluble starches are formed by the action of sulphur dioxide on starch under pressure, and at a high temperature. The liquid mass thus obtained is clarified completely and made perfectly colourless, and then evaporated in vacuo. It is lastly dried by warm air. With hot water the soluble starches give sticky and gum-like liquids; they also turn iodine blue. *Tragantin* is soluble in cold water. They are suitable for fine finishing, for printing paper and textiles, and for confectionery. The *gommes universelles*, prepared from starch, are soluble in hot and cold water. They have all the properties of gum-arabic. Prudhomme submitted a paper in which he describes the spontaneous decomposition of dinitrosoresorcinol on standing into a brown paste, soluble in water, and which gives with acetate of chromium a fast steam colour. It withstands light and acids very well. It is probable that the dinitroso-compound was not pure when prepared, as it is very stable in the pure state.—J. B. C.

On Potassium Antimony Oxalate. R. Wagner. Chem. Zeit. 12, 1726.

According to Lensen and Souhay this salt, formerly called tartar-emetic substitute, consists of—



on heating to 100° C. it loses 6 molecules of water. The author examined a commercial product, which he found sufficiently pure for analysis. His analysis led him to the formula $\text{Sb}_2(\text{C}_2\text{O}_4)_3 + 3\text{K}_2\text{C}_2\text{O}_4 + 8\text{H}_2\text{O}$. On heating to 75° C. it loses 2½ mols. of water; the rest escapes at 130° C. If heated to a higher temperature it is rapidly decomposed.

—A. L.

Paraphenylene Blue—A New Fast Blue for Cotton. R. B. G. Chem. Zeit. 12, 1748—1749.

PARAPHENYLENE blue belongs to the class of indulines which are soluble in water, and is obtained by the action of the diamines of the benzene series upon amidohydroxy compounds. In dyeing, the cloth is mordanted with 4 per cent. of tannin and then worked in a bath of chromium acetate of ½°—10° B. to which 2 per cent. of tartar-emetic is added. After two hours standing the cloth is washed and dyed in paraphenylene blue. It is better to add a further quantity of the blue when the bath is nearly exhausted. Excellent results are always obtained. The colour has many advantages. It dyes yarn and woven

goods equally well and evenly, gives a fine deep blue, and can be mixed with other aniline colours so as to give a variety of shades. The colour is faster than indigo.

—J. B. C.

On Indophenol Indigo Vat. E. Noelting. Chem. Zeit. 13, 191.

HITHERTO the application of indophenol in dyeing has been very limited. The blue has not the indigo shade, and is too easily decomposed by acids. Lately, Durand, Huguenin, and Co. made the remarkable discovery that a mixed indigo indophenol vat yields very excellent results. They proceed in the following way: 66 litres of indigo ground with water (corresponding to 20 kilos. of solid indigo; 6½ kilos. of indophenol; 96 kilos. of sodium bisulphite, 39½—40° B.; 13½ kilos. of tin protochloride crystals ($\text{SnCl}_2 + 2\text{H}_2\text{O}$); 16½ kilos. of zinc dust; and 660 litres of water, are mixed and stirred well for one hour. Then 52 litres of caustic soda, 38° B., are added, and the mixture once more stirred and allowed to stand to the following morning. The concentrated vat thus obtained is poured into the dye vat containing 5,500 litres of water and 340 litres of hyposulphite. The dye vat has to be kept always at the same strength. This can be easily done by allowing some of the concentrated vat to run through a funnel into the dye vat. In the evening, some solution of hyposulphite is added to the vat to prevent oxidation during the night. The hyposulphite solution is prepared by gradually adding 160 grms. of zinc dust, 200 grms. of tin crystals to 1 litre of bisulphite of 39—40° B. and 4 litres of water. These vats work continually, as there is nearly no precipitate. After dyeing it is better to pass through a cold bath, containing 2½—3 per cent. of bichromate. Cotton yarn is dyed as usual; wool is dyed from the warm vat. The saving of indigo in this process is considerable—at least 25 per cent.; 55 kilos. of indigo and 15—19 kilos. of indophenol have the colouring power of 100 kilos. of indigo. The shades are brighter, and the mixed vat also dyes "dead" cotton.

For printing, the following paste is recommended: 10 litres of starch solution, 10 kilos. of potassium bichromate, 7½ litres of ammonia 20°—21° B., and 3 kilos. of china clay, the goods being afterwards passed through a bath of sulphuric and oxalic acids at 50°—55° C. for ½—¾ of a minute. For coloured printing, albumen colours are used as with indigo, only the quantity of bichromate has to be increased.—A. L.

PATENTS.

Improvements in Machinery or Apparatus for Felling, Washing, Scouring, Cleaning, Beating, Softening, and Beetling of Yarns and Textile Fabrics. W. A. L. Hammersley, Leek. Eng. Pat. 15,097, November 5, 1887. 8d.

In this improved machine, the bunks of yarn, working on horizontal "rice heads," made of brass or other bars, and loose adjustable or weighted rollers, are passed in front of buffers (inclined at an angle of 5° to the perpendicular to avoid undue strain on the yarn), against which they are banged by means of beaters mounted on a rocking shaft and worked by an eccentric. Perforated pipes are suitably arranged for delivering water or other liquid against the yarn or fabric. For details and modifications the specification must be referred to.—O. H.

Improvements in Printing Paper, Paper-hangings, Calicoes, other Woven Fabrics, Warps, and Oil-cloths. J. Walker and H. Carver, Pendleton. Eng. Pat. 2838, February 25, 1888. 8d.

THE purpose of this invention is to dispense with the use of "doctors" in the printing of paper and calicoes. In the usual way, the colour is applied to the engraved portion of the copper rollers, and the excess of colour removed from the unengraved surface by means of "doctors." By this invention the colour is supplied to the unengraved surface

of the rollers, the engraved portions remaining free from colour. This is effected as follows: The printing colour is supplied from a box or trough containing a wooden roller which dips into the colour. In contact with this roller is an india-rubber-covered colour-carrying roller, which latter is in contact with two india-rubber-covered colour-distributing rollers, these distributing rollers being also in contact with the surface of the engraved printing roller. The amount of colour supplied to the carrying roller is regulated by a smaller roller also fixed in the colour box, but above the surface of the colour itself. By means of adjusting screws this roller is pressed against the colour-supplying roller and the amount of colour supplied is regulated by this pressure. The distributing rollers are mounted in links to facilitate removal for cleaning, and are held in position by regulating screws. Rotary motion is imparted to the roller in the box and to the carrying rollers in contact with it by means of toothed wheels geared up with the engraved roller. It is claimed that by this invention a finer and clearer impression can be obtained upon paper, calico, &c. than has hitherto been possible.—W. E. K.

Improvements in Apparatus for Dyeing or Scouring Yarn. C. L. Klander, Philadelphia, U.S.A. Eng. Pat. 16,756, November 17, 1888. 8d.

This is an improvement on Eng. Pat. 8803 of 1887. (This Journal 1887, 595.) The yarn is supported on two sets of transverse bars in a suitable frame or wheel, which by its rotation moves the yarn in and out of the dye-liquor. The outer set of bars are also themselves adapted to rotate so as gradually to move the position of the yarn on the bars, and by a mechanical arrangement of pivoted stop and regulating spring a bell is rung to warn the workman when any stoppage in this rotation of the hanks occurs. For details the specification and accompanying drawings must be consulted.—W. E. K.

Improvements in Dyeing Woollen and other Woven or Felted Fabrics. J. W. Bannister, Leeds. Eng. Pat. 17,347, November 29, 1888. 4d.

For the purpose of dyeing woollen fabrics in one vat, without the employment of a mordant, a vat is prepared by dissolving copperas, bluestone, soda, and oxalic acid in hot water; logwood and fustic are then added to this solution, and in the vat thus prepared the goods are dyed in one operation.—W. E. K.

VII.—ACIDS, ALKALIS, AND SALTS.

The Action of Sulphuretted Hydrogen on Solutions of Sulphate of Zinc. H. Baubigny. Compt. Rend. **107**, 1148—1150. See under XXIII. page 216.

Methods and Processes for the Manufacture of Chlorine and Hydrochloric Acid from Magnesium Chloride. G. Eschellmann. Chem. Ind. 1889, 2—9, 25—32, and 51—54.

In the Stassfurt industry large quantities of magnesium chloride in solution are run away to waste, which amounted in the year 1887 to 200,000 tons. The following table shows its importance for the manufacture of chlorine products:—

Present production.*	Chlorine used with existing Methods.	Chlorine which would be used by employing the Weldon-Pechiney Process, and with 78 per cent. Cl. Recovery.
		260,000 tons $MgCl_2$ = 150,000 tons Cl. = 428,570 tons Bleaching Powder.

BLEACHING POWDER.

	Tons.	Tons Cl.	Tons Cl.	Tons Cl.
England	142,605	49,912	149,736	63,990
Continent	40,000	13,000	42,000	17,950
Total	182,605	63,912	191,736	81,940

CHLORATE OF POTASSIUM.

England	6,000	1,737	48,387	3,320
Continent	1,500	435	12,096	830
Total	7,500	2,172	60,483	4,150

HYDROCHLORIC ACID.

Germany 118,450, 20° Bé.	49,000	+ 5 % loss	51,450		51,450
Total Cl	115,084	Total Cl used....	303,669	Total Cl used.....	137,540
				Total Cl. contained in MgCl ₂	150,000
				„ used.....	137,540
				Difference.....	12,460 = 8 % loss.

* In the second column for bleach, the Weldon's process is taken with 30 per cent. chlorine recovery, and with the chlorate of potassium the old lime process is taken with 70 per cent. recovery and a proportion of the chlorate liquors of 1:5.5.

With the chlorate of potassium, in the third column, the combination of the Weldon-Pechiney and the Muspratt-Eschellmann processes is taken, and a proportion of chlorate liquors of 1:5.2 and a 92 per cent. recovery of chlorate of potassium.

For this manufacture a large number of patents have been taken out.

Davy and Graham achieved the decomposition of magnesium chloride by heating it with air.

1847. Tilghman, 1 February.

1864. Dr. Clemm describes his two methods in the Zeit. Ver. deutsch Ing. Vol. VIII.

1. Manufacture of chlorine by heating a mixture of magnesium chloride and manganese dioxide with steam.

2. Manufacture of hydrochloric acid from magnesium chloride in a sulphate muffle furnace with superheated steam.

1870. H. M. Baker, New York. Patents for decomposing magnesium chloride in the presence of clay and silicic acid.

1871. W. Weldon. Decomposition of magnesium chloride with steam.

1877—1888. E. Solvay, with the following number of patents:—10 July 1877, Ger. Pat. 1185; 2 July 1880, Ger. Pat. 13,528; 7 May 1884, Ger. Pat. 29,846; 7 May 1884, Ger. Pat. 31,219; 3 December 1884, Ger. Pat. 32,331; 28 July 1885, Ger. Pat. 34,404; 8 August 1885, Ger. Pat. 34,690; 6 December 1887, Ger. Pat. 44,865.

1879. Randohr, 19 August, Ger. Pat. 9473; 9 October, Ger. Pat.

1881. W. Weldon, 4 May, Ger. Pat. 17,050 (Eng. Pat. 7 March 1881).

1881. G. Eschellmann, 17 July, Ger. Pat. 17,058.

1881. Randohr, Blumenthal and Co., 6 September, Ger. Pat. 19,259.

1884—1887. Pechiney and Weldon, 1 July 1884, Ger. Pat. 30,841; 8 August 1884, Ger. Pat. 31,671; 31 May 1885, Ger. Pat. 34,397; 20 August 1885, Ger. Pat. 35,227; 27 October 1887, Eng. Pat. 14,653; 27 October 1887, Eng. Pat. 14,654.

1885. Neu-Stassfurt, 25 September, Ger. Pat. 36,673.

1885. A. Vogt, 27 November, Ger. Pat. 37,083.

1886. Bohlig and Heyne, 3 July, Ger. Pat. 39,566.

1887. Konther, 20 January, Ger. Pat. 41,351.

1887. Heinzerling and Schmid, 24 March, Ger. Pat. 41,596.

1887. Vereinigte Chemische Fabriken Leopoldshall, 25 June, Ger. Pat. 43,500.

1887. Schlösing, 31 August, Eng. Pat. 11,821.

1888. Neu-Stassfurt, additional patent to 3,673, 22 October, S. 4353 Ger. Pat.

The author exposes these patents to criticism, and for the same object carries out extensive experiments in the laboratory by special methods to find out the chemical behaviour of magnesium chloride when heated.

Magnesium chloride solution can only be evaporated to form $\text{MgCl}_2 + 6 \text{H}_2\text{O}$, after which decomposition into hydrochloric acid sets in.

On heating it further to 550°C . all the water can be driven off, but about 50 per cent. of the chlorine is also driven off as hydrochloric acid and a magnesium oxychloride remains, corresponding to MgO , MgCl_2 .

THERMOCHEMICAL DATA OF MAGNESIUM CHLORIDE.

$\text{MgCl}_2 + 6 \text{H}_2\text{O}$	32,970 cal.
MgCl_2	151,010 "
MgO	146,992 "

I.—FOR HYDROCHLORIC ACID.

Negative.	Positive.
MgCl_2	151,010 cal.
$\text{MgCl}_2 + 6 \text{H}_2\text{O}$	32,970 "
One H_2O decomposed	58,161 "
5 H_2O evaporated	58,800 "
	<u>301,004 "</u>

For decomposing $\text{MgCl}_2 + 6 \text{H}_2\text{O}$ into MgO , MgCl_2 and $5 \text{H}_2\text{O}$.

— 301,004
+ 146,994
— 110,007

Calories have to be introduced.

II. FOR CHLORINE.

In case all $6 \text{H}_2\text{O}$ can be driven off as such:—

Negative.	Positive.
MgCl_2	151,010
$\text{MgCl}_2 + 6 \text{H}_2\text{O}$	32,970
$6 \text{H}_2\text{O}$ evaporated at 156°	70,632
	<u>254,612</u>

therefore for $\text{MgCl}_2 + 6 \text{H}_2\text{O}$ there have to be introduced:—

— 254,612
+ 146,992
— 107,620

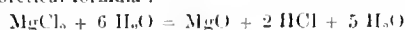
Calories.

Under the theoretically most favourable conditions in both cases a large quantity of heat must be introduced for decomposition, and for all the processes the fuel required will prove a great expense, especially as these reactions do not take place at the ordinary temperature, but at 550°C .

HYDROCHLORIC ACID.

In order to manufacture hydrochloric acid from magnesium chloride liquor, the large quantity of water contained therein must be reduced. This is done by evaporation to 45°B . at a temperature of 156°C ., which is equal to $\text{MgCl}_2 + 6 \text{H}_2\text{O}$.

As in further heating only 50 per cent. of the chlorine are obtained as hydrochloric acid, more water must be introduced to obtain a complete decomposition, although the theoretical formula:—



shows plenty of water present originally for complete decomposition. The following methods for manufacturing hydrochloric acid are possible.

I. Heating the $\text{MgCl}_2 + 6 \text{H}_2\text{O}$ from outside and introduction of steam over the salt during the heating.

II. Mixing $\text{MgCl}_2 + 6 \text{H}_2\text{O}$ with such salts as lose their water only at a red heat, and subsequent heating of these mixtures, and recovery of the salts.

III. Heating $\text{MgCl}_2 + 6 \text{H}_2\text{O}$ by direct flame, and either using a coal containing a large quantity of water, or mixing steam with the combustion gases.

Group I. comprises the following patents:—

Clemm, 1864, W. Weldon, 1871, Heinzerling and Schmid, 1887.

The advantages consist in an easy condensation, and the purity of the hydrochloric acid.

The disadvantages are numerous.

The whole of the heat necessary for decomposing and heating up must be introduced from outside, and this is so much the more difficult, as the furnace cannot be constructed of iron on account of its corrosion by the acid which is heated above 500°C .

The steam, moreover, must of necessity be superheated to avoid cooling of the furnace, and lastly the steam does not penetrate the mass, but passes over it. This renders a quick decomposition difficult on account of want of contact, not even rendered possible by agitation.

Group II.—G. Eschellmann, 1881; E. Bohlig and Heyne, 1886; and Konther, 1887.

The difficulty of these patents consist in extra cost entailed in heating the mixture, and the cost of the recovery of these salts.

The Bohlig and Heyne patent also possesses all the disadvantages of Group I., and the acid produced by it is contaminated by organic substances.

Group III.—Solvay's Patents, 1877—1888; Randohr, 1879; W. Weldon, 1881; Randohr, Blumenthal and Co., 1881; A. Vogt, 1885; Neu-Stassfurt, 1885; Neu-Stassfurt, additional patent, 1888; and Vereinigte Chemische Fabriken Leopoldshall, 1887.

The advantages of this group consist in the substitution of the heating up from outside by direct contact of the combustion gases with the magnesium chloride, and the omission of the separate superheating of the steam.

The considerable difficulties consist in the complete condensation of the hydrochloric acid to high strength. This acid will also be contaminated by the combustion gases, and the firing has to be carefully superintended to avoid excess of oxygen in the combustion gases which would set chlorine free.

If these difficulties can be overcome, the patents of Neu-Stassfurt and Vereinigte chem. Fabriken Leopoldshall might possibly lead to the successful manufacture of hydrochloric acid for purposes of sale, if the fuel does not reach too high a figure.

A probable cost of this hydrochloric acid of 20° B. would be 15s. per ton.

In case this acid is used for manufacturing bleaching powder by the old Weldon process, a ton of bleaching powder would cost, in Stassfurt, 5*l.* 5s.

The Weldon-Pechiney process, as far as it concerns the manufacture of hydrochloric acid from magnesium chloride, cannot be classed under any of these three groups, as it involves a principle of its own as regards the decomposer used.

The conditions for a successful manufacture of hydrochloric acid seem to be overcome by this process; they are:—

1. Good contact between steam and magnesium oxychloride by forming the pieces.
2. The heating up from outside and the disadvantages of direct contact of the combustion gases with the oxychloride are avoided by storing the heat in the furnace for decomposition and heating up, which take place simultaneously.
3. Good condensation.
4. The decomposer is built of fire-clay, which withstands the highly-heated hydrochloric acid gas.
5. Purity and strength of the acid for sale.

The disadvantages are:—High consumption of fuel, dealing with large masses of material, and expensive plant.

However, these disadvantages are common to all magnesium chloride processes.

CHLORINE.

The patents for direct production of chlorine are:—

Tilgman, 1847; Clennu, 1864; Solvay, 1877—1888; Randöhr, 1879; Weldon, 1881; Randöhr, Blumenthal, and Co., 1881; Weldon-Pechiney, 1884—1887; Vogt, 1885; Konther, 1887; Heinzerling and Schmid, 1887; Schlösing, 1887.

The following conditions have to be observed in manufacturing chlorine direct:—

I. The magnesium chloride liquor must be converted into a form which allows the air to penetrate it for oxidation.

II. The six equivalents of water must be reduced as much as possible, to obtain a minimum of hydrochloric acid.

III. The oxychloride must be heated up quickly to the oxidising temperature.

Point I. Surface oxidation is impracticable on account of the length of time required and the weakness of the chlorine produced.

The only material which brings the liquor into a convenient oxidisable form, and which allows the recovery of the magnesia also, is magnesia itself.

Point II. is obvious.

Point III. It is not impossible to heat up large masses from the outside to a red heat, but only at the expense of much time and fuel, on account of the bad conductivity of the oxychloride for heat. These operations cannot be carried on in iron vessels on account of the corrosion of the iron by chlorine and hydrochloric acid gas. To line such vessels with fire-clay is very difficult on account of the difference of expansion between fire-clay and iron, which difficulty is the greater the larger the dimensions of such apparatus. In addition to this, the bad conductivity for heat of such a lining has to be considered.

During the oxidation the oxychloride falls to dust. For all these reasons a quick heating up is imperative.

Pechiney carries these points out practically in his decomposer.

Schlösing proposes an oxidiser which is continuous and utilises its heat by gradually raising that of the oxychloride. The whole of the heat for heating up and oxidising is introduced by superheated air of 760° C. The possibility of this is proved by calculation. In case the oxychloride as briquettes does not fall to dust altogether, this oxidiser might prove a practical success.

The manufacture of the anhydrous magnesium oxychloride, according to the first part of the patent, yields 37 per cent. of the chlorine contained in the original $MgCl_2 + 6 H_2O$ as hydrochloric acid. Taking into consideration this quantity of hydrochloric acid, and the practical difficulties to be encountered, the success of this part of the process is doubtful.

The only process besides this, which is worth a detailed criticism, is the Weldon-Pechiney process. It carries out practically the conditions for a successful chlorine manufacture as well as possible.

The process consumes, per 35.5 grms. of chlorine,—

	Calories.
For oxidation of the dried oxychloride.....	85,626
For drying the oxychloride.....	37,617
Total.....	123,243

This necessitates a large consumption of fuel, but this is common to all such processes.

By adding magnesia, it converts the magnesium chloride into an oxidisable form, and makes possible the recovery of the magnesia from the decomposition product in a useful form.

The reduction of the water in the magnesium chloride is also carried out to a large extent.

The difficulties of separate heating up and oxidising are overcome by carrying on both operations collaterally, and storing the necessary heat in the walls of the oxidiser.

There are still many improvements possible, and the following points deserve consideration:—

(1.) It is impossible to entirely avoid the evolution of hydrochloric acid in the drying of the oxychloride, and this acid will have to be condensed in Germany and England.

(2.) The decomposer might need more repairs after heating into a still higher temperature than at present (1,000° C.).

(3.) If highly superheated air could be used for oxidation, economy of time and improvement in the volume per cent. of the chlorine obtained would result.

(4.) The hydrochloric acid gas in the chlorine might be advantageously absorbed by magnesia, as described in Mond and Eschellmann's patent (Ger. Pat. 44,109, 13 January 1888), and by oxidising the oxychloride, this hydrochloric acid would be transformed into chlorine.

(5.) The oxidation might be carried out in Schlösing's oxidiser, the use of which, however, depends on the possibility of moving the oxychloride.

(6.) The chlorine volume per cent. of 6—8, are good enough for bleach making.

(7.) The cost of a plant is twice as much as with the old Weldon's process, and time must decide how much the repairs will influence the cost of production per ton of chlorine.

One ton of bleaching powder by the Weldon-Pechiney process would probably cost—

£ s.
3. 10 in Stassfurt.
4. 5 in Hamburg.

if the figure of 5*l.* per ton of chlorine in Stassfurt can be realised.

With the success of the Weldon-Pechiney process the magnesia process for producing chlorate of potassium by Muspratt and Eschellmann's patents will supersede the old lime process.

The advantages of this process combined with the Weldon-Pechiney process consist in—

(1.) The whole of the chlorine and magnesia being recovered, minus mechanical losses.

(2.) The production of 92 per cent. of the chlorate, against 70 per cent. by the lime process, being as near to the theoretical yield as can be practically expected.

Messrs. J. Muspratt and Sons, in Widnes, have carried out this process for three years quite successfully on a weekly production of 12 tons, and the process has answered all expectations.

The cost per ton of chlorate by the combined processes in Stassfurt is 26*l.*, without general expenses, &c.

According to the author, no other proposed process for producing chlorine from magnesium chloride, except the Weldon-Pechiney process, is capable of a commercial practical success, unless the future brings further inventions, which, however, would have a difficult position in contending it with the Weldon-Pechiney process.—G. E.

PATENTS.

Improvements in the Treatment of Sulphide of Calcium for the Purpose of obtaining Sulphide of Ammonium and Sulphuretted Hydrogen. E. H. Parnell and J. Simpson, Liverpool. Eng. Pat. 2831, February 25, 1888. 6*d.*

In the first operation of the "Parnell and Simpson process" (this Journal, 1885, 198) calcium sulphide is distilled with an excess of a dilute solution of ammonium chloride. In order to economise the latter it is desirable to avoid an excess, and by proceeding in a special manner, which forms the feature of this invention, the sulphur of the calcium sulphide can be obtained without even using as much ammonium chloride as corresponds to the chemical equivalent of the calcium sulphide. If calcium sulphide and water be subjected to the pressure of steam, at a temperature of 300° F., it is decomposed into calcium hydrate and sulphuretted hydrogen. This fact is made use of in the process of distillation. Ammonium chloride and an excess of calcium sulphide are heated in a still of sufficient height to give the temperature and pressure necessary for decomposing the calcium sulphide, and when steam is passed through the apparatus, the calcium sulphide is thus not only decomposed by the ammonium chloride, but also by the heat and pressure of the steam with liberation of sulphuretted hydrogen and ammonium sulphide. It is found that it is possible to extract the sulphur in the calcium sulphide with about half its chemical equivalent of ammonium chloride.—S. H.

Improved Economic Treatment of certain By-Products of Gas and Tin-Plate Manufactures. E. Bowen, Pontardulais. Eng. Pat. 3179, March 2, 1888. 4*d.*

This invention relates to the treatment of the liquor used in "pickling" iron and steel plates in the process of the tin-plate manufacture. When this solution has done a certain amount of work it becomes unfit for further use, and now consists of water, sulphuric acid, and iron sulphate. According to this invention this liquor is mixed with the ammoniacal liquor of the coal-gas manufacture. The result is a solution of ammonium sulphate and a precipitate of iron in the form of hydrate and carbonate. After separating the precipitate the sulphate of ammonia is obtained by evaporation, whereas the precipitate is calcined and converted into iron peroxide for use as a pigment or otherwise.—S. H.

Improvements in Apparatus for Treating Ammoniacal Liquor. H. Green, Preston. Eng. Pat. 3428, March 6, 1888. 8*d.*

This apparatus consists of two parts, the "free ammonia evolver" and the "fixed ammonia evolver." By means of a syphon and float arrangement a regular and continuous flow of ammoniacal liquor is made to enter a horizontal pipe, where it is heated by contact with a steam pipe. Ammoniacal gas is thereby given off which passes away to a saturator. The liquor then passes on to a series of communicating annular chambers, into which milk of lime is introduced for liberating the fixed ammonia, steam and agitation at the same time assisting the operation. The ammoniacal gas given off flows to the same saturator, which is of conical form at the lower part. The pipe for admitting

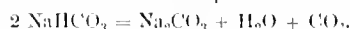
the ammoniacal gas is fixed near the lower end, whereby the contents of the vessel is set in motion. Below the saturator a tumbler on trunnions is provided, to receive the contents of the saturator. By tilting the tumbler the liquor can be poured off and the salts allowed to remain until they are dry, or nearly so.—S. H.

An Improved Process of Manufacturing Soda by means of Ammonia, and Producing Carbonate of Soda, Caustic Soda, and Hydrochloric Acid or Chlorine. A. M. Clark, London. From J. B. Daguin, Paris, France. Eng. Pat. 3668, March 9, 1888. 8*d.*

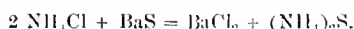
The process consists essentially of the following operations and reactions:—

(I.) A mixture of solutions of sodium chloride and ammonium sulphide in suitable proportions is treated with carbonic acid, whereby sodium bicarbonate is precipitated, ammonium chloride remaining in solution and sulphuretted hydrogen being liberated, $2 \text{NaCl} + (\text{NH}_4)_2\text{S} + 2 \text{CO}_2 + 2 \text{H}_2\text{O} = 2 \text{NaHCO}_3 + 2 \text{NH}_4\text{Cl} + 2 \text{H}_2\text{S}$.

(II.) The sodium bicarbonate is calcined, giving off carbonic acid for use in the first operation—



(III.) The filtrate from the first operation, containing all the ammonium chloride, is boiled with barium sulphide, barium chloride being formed and ammonium sulphide given off, which is absorbed in brine for use in the first operation—

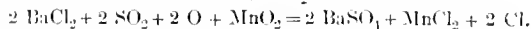
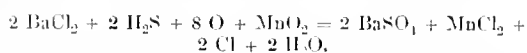


(IV.) The barium chloride is treated by one of the following methods:—

(a.) Sulphuretted hydrogen and air are passed at a red heat over barium chloride, obtained by evaporation of the solution, thus: $\text{BaCl}_2 + \text{H}_2\text{S} + \text{O} = \text{BaSO}_4 + 2 \text{HCl}$.

(b.) Sulphuretted hydrogen is burnt and the gases given off caused to bubble through a solution of barium chloride: $\text{BaCl}_2 + \text{SO}_2 + \text{O} + \text{H}_2\text{O} = \text{BaSO}_4 + 2 \text{HCl}$. This reaction will only take place in the presence of certain chlorides, such as the chlorides of manganese, copper, iron, &c., which promote, catalytically, the oxidation of sulphurous acid.

(c.) Barium chloride is treated either in the dry way or in the humid way with manganese peroxide, and subjected to the action of sulphuretted hydrogen or sulphurous acid:—



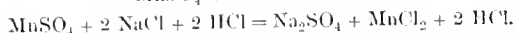
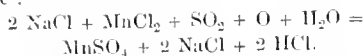
(V.) The barium sulphate produced in the fourth operation is reduced by charcoal to sulphide, partly for use in the third operation. Another portion of the sulphide is boiled with water, when it is decomposed into barium hydrate and sulphhydrate, the latter of which replaces a certain amount of sulphide in the third operation, whereas the barium hydrate is used for causticising sodium sulphate or carbonate. It will be seen that the feature of the process is the circumstance that the whole of the ammonia, baryta, sulphur, and carbonic acid, with the exception of that which passes away with the sodium carbonate, are recovered.—S. H.

A Process for Facilitating the Oxidation of Sulphurous Acid for the Manufacture of Sulphuric Acid and of Hydrochloric Acid and Chlorine, and for other Industrial Purposes. A. M. Clark, London. From J. B. Daguin, Paris, France. Eng. Pat. 3669, March 9, 1888. 6*d.*

This invention relates to a process for facilitating the oxidation of sulphurous acid by means of oxygen or air. The process consists essentially in treating a mixture of sulphurous acid and air in the presence of salts of manganese, copper, iron, or tin. It appears that these salts act catalytically and favour the rapid oxidation of sulphurous acid. This process is therefore applicable for the manufacture of sulphuric acid, and in the second instance for the direct manufacture of hydrochloric acid or chlorine.

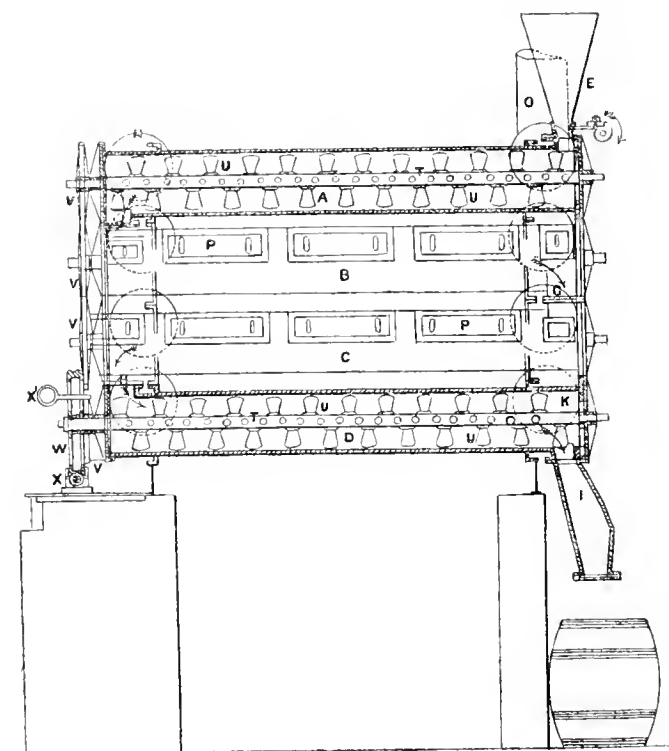
1. *Manufacture of Sulphuric Acid.*—Sulphurous acid and air are caused to bubble through a solution of the sulphates of manganese, copper, iron, or tin, or caused to traverse a column filled with coke and impregnated with any of the solutions mentioned. In both cases the resulting liquid contains sulphuric acid, mixed with the sulphate employed.

11. *Manufacture of Hydrochloric Acid and Chlorine.*—Any chloride is treated with sulphurous acid and air in the presence of a catalytic agent; the following reactions take place :



The catalytic agent, in this case manganese chloride, is always regenerated. If manganese peroxide be present at the same time, the hydrochloric acid acts on it, producing free chlorine.—S. H.

Fig. 1.

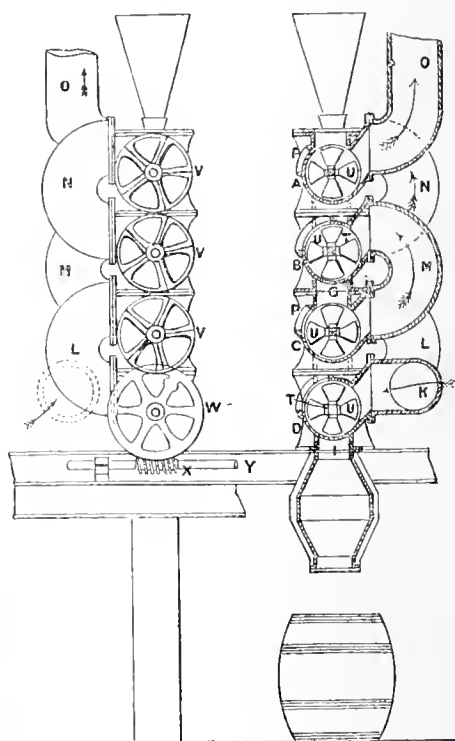


channels, and are each provided at one end with a spur wheel V, all of which are made to gear with each other. A worm wheel W, geared with the worm X on the driving shaft Y gives rotatory motion to the stirrers. The lime is charged through the hopper E and travels slowly to the other end of the channel A, where it falls through a branch F into the channel B. Here it is conveyed back to the other end, and so forth, until it is eventually discharged through the shoot I. The chlorine gas enters the lowest channel D through a lateral inlet K, and passing through the channel, is brought into intimate contact with the lime, as it is raised up by the stirrers. The gas then rises through the branch L, into the channel C, and so forth, until it gradually arrives at the top channel, where any unabsorbed residue escapes at O. The hopper E has a kind of throttle-valve, by means of which the discharge of lime into the hopper is regulated. On the side of the channels openings are left, which can be tightly closed by covers P, and allow of a ready inspection of the interior of the channel.—S. H.

Improved Apparatus for subjecting Pulverulent or Granular Materials to the Action of Gases. R. Hasenclever, Aachen, Germany. Eng. Pat. 17,012, November 22, 1888. 6d.

THE apparatus is designed for the manufacture of bleaching powder, or more especially for the absorption of chlorine by slaked lime. It mainly consists of a series of horizontal channels, each provided with stirring and propelling arrangement. These channels are made to communicate with each other and with a gas supply in such a manner that the lime fed into one end of the first channel passes consecutively through all the channels, while the gas travels at the same time in the contrary direction. Fig. 1 shows a sectional side view; Fig. 2 an end view and cross-section of the apparatus. A, B, C, D are a series of superposed channels. The stirring arrangement consists of a shaft T with a large number of oblique radial blades U. The ends of the shafts are carried in bearings in the end covers of the

Fig. 2.



VIII.—GLASS, POTTERY, AND EARTHENWARE.

Cryolite and its Substitutes in Glass Manufacture.

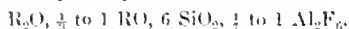
R. Zsigmondy. Dingl. Polyt. J. 271, 36—44 and 80—88.

CRYOLITE is used in the manufacture of milk or opal glass, and its price has risen so considerably within the last three years that it is most desirable to find a substitute for it. Attempts have been made to use a mixture of felspar and fluorspar for this purpose, with more or less success, while Weinreb has employed alkaline fluorides prepared from fluorspar by fusion with sand and an alkali. The objection to this process is the cost of the alkali if potash be used, and the outlay needed for fuel if soda be selected, as sodium fluoride requires 23 parts of water for its solution, all of which has to be evaporated to obtain it from the aqueous extract of the melt. Before describing his own modification of this process the author discusses the various

explanations of the action of cryolite in producing a milk glass that have been advanced. In 1869 *Benrath* attributed it to the expulsion of the fluorine as silicon fluoride and the liberation of the alumina which was distributed in suspension throughout the glass, while *Williams*, in the same year, postulated the formation of sodium fluosilicate from the fluorides of silicon and sodium produced by the action of the cryolite on the silica of the glass, and considered the opacity of the product due to it.

Ebell, in 1877 (*Dingl. Polyt. J.* **225**, 77), demolished both these theories by showing the presence of fluorine to be essential to the formation of a milk glass, while sodium fluosilicate was unable to effect it in the absence of alumina. He was followed by *Weinreb* in 1885 (*Dingl. Polyt. J.* **256**, 362), who demonstrated the necessity for both sodium fluoride and alumina. Finally *Schwarz* (*Dingl. Polyt. J.* **267**, 223) repeats *Williams'* statement that sodium fluosilicate is the cause of the opacity.

The author considers aluminium fluoride to be the essential constituent, and upholds his view by showing that the work of the previous observers can be interpreted in accordance with it. He confirms *Weinreb's* statement that sodium fluoride, alone, is ineffective, and points out that a great economy of fluorine may be attained by providing sufficient basic material to combine with the silica and prevent it expelling the fluorine as silicon fluoride. A good cryolite glass may be represented thus:—



The author succeeded in producing opaque glasses by the use of kaolin and fluorspar, which were little inferior to those containing cryolite, but in preparing them the bottom of the pots became deeply pitted, owing to the fluorspar melting first, trickling down through the mass of the other constituents and attacking them; pots were thus sometimes perforated in a couple of days.

Further attempts to use fluorspar instead of cryolite, being unsuccessful, attention was directed to the *partial* replacement of the latter, and with better results. For example, the following mixture yields a good milk glass:—

	Parts.
Sand	100
Potash	7.1
Soda	12.2
Fluorspar	7.4
Cryolite	7.4
Orthoclase	7.1
Kaolin	1.9

Eleven parts of felspar may be substituted for the last two constituents, in which case somewhat less sand and potash should be used.

Schwarz gives the analysis of a similar glass, which is, however, free from alumina, but contains zinc. The author contends that this does not invalidate his statement as to the cause of the opacity of cryolite glass, as zinc fluoride, like aluminium fluoride, lead fluoride, calcium phosphate, and stannic oxide, remains suspended and undissolved in the glass mixture when solidified, and thus communicates to it its peculiar property. A "French opal" glass examined by *Huck* (*Dingl. Polyt. J.* **224**, 624) contained:—

	Per Cent.
SiO ₂	63.7
PbO	16.5
FeO	0.3
Al ₂ O ₃	16.8
K ₂ O	2.3
	99.6

As it is free from fluorine, the author considers its opacity due to the presence of lead, as in lead glasses (perhaps on account of the low temperature at which they fuse), alumina is less soluble than in those not containing that metal.

In spite of the difficulties attending their manufacture, especially the outlay in melting-pots, glasses containing fluorspar instead of cryolite are a commercial success, on account of the high price of the latter body. Such a glass, giving satisfactory results, is represented by the formula $\frac{3}{4} \text{K}_2\text{O}, \frac{1}{4} \text{CaO}, \frac{1}{4} \text{ZnO}, 6 \text{SiO}_2, \frac{1}{4} \text{Al}_2\text{F}_6$. But even the best

of these glasses is not equal to good cryolite glass, as they are apt to lack homogeneity, and are not of such an opaque white colour as the latter. Moreover, they make much waste, which, in some manufacturers' opinion, eats up all profit arising from the use of the cheaper material. The conclusion arrived at is, that a fluorine compound free from lime and of low price can be the only formidable competitor to cryolite.

The details of the author's proposed process are as follows:—

Fluorspar is fused with potash and silica, the melt extracted with water, and the hot concentrated solution of potassium fluoride obtained, precipitated with a solution of soda saturated at about 38° C. Sodium fluoride is thrown down, while potassium carbonate remains in solution, and may be recovered and used over again. In order to discover the best proportions for obtaining a high yield of potassium fluoride, it was necessary to make many trials of different mixtures, and to estimate the quantity of soluble fluoride they yielded, and for this purpose a quick and fairly accurate method of determining fluorine was requisite. The principle made use of by *Knöfler* for the determination of combined sulphuric acid (*Annalen*, 1885) was employed, standard calcium chloride solution being substituted for barium chloride. The solution containing the fluoride, together with potassium silicate and carbonate, was neutralised with hydrochloric acid in the hot, using phenolphthalein as an indicator; 1 cc. of $\frac{N}{10}$ sodium carbonate solution was added, and then an excess of $\frac{N}{10}$ calcium chloride solution. (The use of the single cc. of sodium carbonate solution is to indicate when all the fluoride has been precipitated as CaF_2 , as then, and not till then does the sodium carbonate react with calcium chloride, precipitating calcium carbonate, which is neutral to phenolphthalein.) The excess of calcium chloride was determined by adding $\frac{N}{10}$ sodium carbonate solution until the liquid became alkaline, indicating the presence of excess of sodium carbonate consequent on the complete precipitation of the calcium chloride, then filtering and titrating back with hydrochloric acid, using methyl-orange as an indicator. Of course the 1 cc. of sodium carbonate must be added to the main quantity used when calculating the results. Obviously, only the first and last neutralisations need be effected accurately, the other two being merely devices to indicate that an excess of the reagent has been added.

To demonstrate the value of this method it was necessary to ascertain:—

(1.) How HF comported itself towards indicators when titrated. (2.) How water glass behaved towards indicators when titrated with HCl. (3.) Whether water glass, neutralised with HCl, had any action on CaCl_2 .

It was found with regard to (1) that litmus and phenolphthalein changed colour at a point corresponding to the formation of normal fluorides. Methyl-orange showed a tendency to change when enough alkali had been added to form acid fluorides like KHF_2 , but was far from distinct. For (2) it was proved that water glass behaves like pure carbonated alkali; the separated silica had no action even on phenolphthalein. In respect of (3), experiment answered it in the negative.

This being so, the method was tried on mixtures, like those that would have to be dealt with, containing known quantities of fluorine. It was found to give a maximum error of 1.5 per cent. of the quantity of fluorine estimated, which was sufficiently near for the purpose in hand. Thus a solution of hydrofluoric acid, which indicated 0.1022 grms. HF by titration with caustic soda, and 0.1021 grms. by weighing the CaF_2 , it could form, gave by titration 0.1016, 0.1005, and 0.1020 grm. in three trials.

A convenient modification of the process, if the quantity of alkaline carbonate and silicate present be wholly unknown, is to divide the extract from the melt into two parts, titrate one with standard hydrochloric acid, using cochineal or litmus as an indicator, and then run a little more than the quantity of acid thus found into the other half, boil, and titrate back with caustic soda, using phenolphthalein as an indicator until the red colour appears, which is then

removed by a single drop of hydrochloric acid. By this means the difficulty of titrating a solution containing a carbonate, with phenolphthalein as an indicator, is got over.

Armed with this method, the author proceeded to determine by numerous experiments the conditions under which the best yield of alkaline fluoride was obtained. He found that if less than 2 mol. of K_2CO_3 to 1 mol. of CaF_2 were used, as much as 1 mol. of SiO_2 was necessary to get 70–80 per cent. of the CaF_2 decomposed. Besides this, the degree of intimacy of the mixture, the temperature employed, and time occupied, were important factors in the yield. The portion of the melt left on extraction with water consists of calcium silicate, carbonate, and fluoride, together with small quantities of potassium salts which it is difficult to remove completely. Such a mixture could be used in glass making, and therefore no part of the process yields an absolutely waste product.

To prove the practicability of the other half of the process, potassium fluoride was precipitated with the equivalent quantity of sodium carbonate in the hot. The sodium fluoride, being somewhat soluble, prevented so good a yield as could be wished being obtained.

On considering the cost of the process it is seen that the potash is used repeatedly, the soda corresponding to the sodium fluoride, replacing that which would otherwise have to be added to the glass as carbonate, while the silica can be used in the form in which it is left, viz., calcium silicate, to replace the sand generally necessary. This leaves only the fluorspar and the fuel to be bought each time, and they are both cheap compared with cryolite. The process promises to be lucrative, unless mechanical difficulties are encountered. One of these, namely, the need of a material to form the floor of the furnace in which the fluorspar, sand and potash are to be melted, capable of withstanding their action, might be met by the use of basic bricks like those now obtainable at iron works.—B. B.

PATENTS.

Improved Machine for making Scorifiers, Cupels, and Crucibles. T. P. Sims, Swansea. Eng. Pat. 445, January 11, 1888. 8d.

See under I, page 186.

Improvements in the Production of Pictures and Designs on China, Earthenware and Glass. J. B. G. Bonnard, London. Eng. Pat. 1751, February 6, 1888. 6d.

A SHEET of glass is sensitised with a mixture of water, uracil, potassium bichromate, and borax, and exposed under an ordinary photographic transparency. The design is then brought out by dusting on the necessary colours, which are fixed by means of a fatty composition consisting of essence of lavender, fatty essence of Venice, and powdered resin. The picture is coated with a similar mixture containing collodion instead of essence of lavender, and placed in an alkaline bath of borax and sugar after previously soaking in warm water. The film can be then transferred to the china, or other material placed in the bath, which is afterwards fired in the usual way.—O. H.

Improvements in the Manufacture of Glass. E. Story and R. Punshon, London. Eng. Pat. 2184, February 14 1888. 6d.

THE inventors manufacture glass from "granite, granulite, syenite, elvan, &c." silicate of soda, sulphate of soda, carbonate of soda, and asbestos being among the other substances used.—E. G. C.

Improvements in the Silvering of Glass. J. Syer, Manchester. Eng. Pat. 16,453, November 13, 1888. 4d.

THIS process consists in the deposition of silver on glass from one or two solutions containing silver salts, without the application of heat. The solutions contain nitrate of silver, ammonia, and Rochelle salt.—E. G. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

On Saccharine Matter in Mortar and on Building in Frost. S. Crompton. Engineer, 1889, 110.

A CASE is quoted in the experience of the author of some building done in sharp frost. The courses of brickwork set in the wall with sugared mortar were perfectly sound and were untouched by the frost and by the thaw which followed it, whilst the work below it, and the work done on the same day that the sugared work was done, but done with unsugared mortar, suffered severely.

He further points out that the reason that Roman mortar was so good and stood so well, is, that the lime was slaked in pits and allowed to remain there for two or three years before use. He quotes Pliny (A.D. 77) in proof of this.

—W. S.

X.—METALLURGY, MINING, Etc.

On Corles' Method for Reducing difficultly Reducible Oxides. E. v. Sommaruga. Chem. Zeit. 12, 1728–1729.

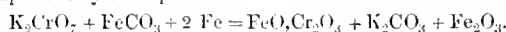
THE author believes that the method for reducing oxides of aluminium, silicon, and other elements, by means of an electric current in the presence of carbon, is simply a true reduction by carbon at a very high temperature, and not an electrolytic process. (Compare this Journal, 1886, 206–210.)—A. L.

Huntington's Centrifugal Roller Mill. Engineer, 1888, 519.

THIS new type of crushing mill possesses several important advantages over the ordinary stamp battery. A ten-stamp battery, with 850 lb. heads, weighs, in all, from 12 to 14 tons, and costs 650*l.*, while a 5-ft. Huntington mill weighs 5½ tons in all, the cost, including erection, being 350*l.* Omitting the great advantage in transport, the latter can be erected in 15 working hours by two men, the former by four men in 30 days, while frequently a considerable time is required before it can be got in action. Further, with one-half the power, the output of the centrifugal mill is 10–50 per cent. higher than the stamp battery. It consists chiefly of a vertical spindle, on which is keyed a circular frame, and from the latter, suitably hung in bearings permitting of a radial motion, with regard to the vertical spindle, are yokes carrying the steel rollers, while between the rollers, and attached to the frames, are scrapers. When the machine is in action these steel rollers are pressed by centrifugal force against a steel ring forming the sides of the pan. The quartz is fed with water into a hopper, and, being carried by the scrapers and the water against the sides of the ring, is pulverised by the rollers; the precious metal amalgamates with the mercury run in the bottom of the pan, while the fine grit, without slime, is discharged through a perforated grating extending along half the circumference of the mill, and passes on to the concentrators in the usual manner. About 75 per cent. of the precious metal is retained by the amalgam.—O. H.

The Artificial Production of Chrome Iron. S. Mennier. Compt. Rend. 107, 1153–1154.

THE author has succeeded in obtaining chrome iron artificially by very strongly heating an intimate mixture of 148 grms. of potassium bichromate, 58 grms. of ferrous carbonate, and 56 grms. of iron filings, the reaction being expressed by the equation—



The mixture is contained in an earthen crucible previously dusted with finely powdered cryolite. On breaking the fused mass distinct zones are visible, one of which is finely grained and steel grey, almost entirely composed of small

regular octohedrons, sometimes passing even into the cube, and yields, on analysis, the numbers for chrome iron.

—G. H. B.

Improvements in Metallurgical Processes. Dingl. Polyt. J. 271, 17—25 and 109—118.

At Freiberg lead is extracted in a very crude state, owing to the number and variety of residues from the working of ores of other metals that are added to it during smelting. The following table shows how complex a mixture it is:—

	I.	II.	III.	IV.	V.
Silver.....	1.790	0.470	0.131	0.830	0.516
Copper.....	0.662	0.225	0.121	0.328	0.660
Bismuth.....	0.034	0.019	0.022	0.017	0.032
Cadmium.....	..	..	0.002	..	0.003
Tin.....	1.490	1.354	0.078	0.650	0.871
Arsenic.....	1.159	1.826	0.131	0.540	0.388
Antimony.....	6.215	0.958	0.180	0.976	0.358
Nickel and cobalt ..	..	..	..	0.010	0.011
Iron.....	0.005	0.007	..	..	..
Zinc.....	0.003	0.002	0.008	..	..
Sulphur.....	..	0.051	0.015	..	..

Of these—

I. is from the rich (in silver) lead ore from the Muldner works.

II. is from the ordinary lead ore from the Muldner works.

III. is from the working up of the slag from the Muldner works.

IV. is from the lead ore from the Halsbrückner Works.

V. is from the working up of the slag from the Halsbrückner works.

The process of purification is as follows:—

About 90 per cent. of the copper is first separated by liquation, which gets rid of the nickel, cobalt and iron at the same time; with these latter remains a part of the sulphur and arsenic. The tin, arsenic, and antimony are separated as lead stannate, arseniate, and antimoniate respectively, by means of the "improving" process, a jet of air being allowed to play on the surface of the fused lead. The yield of metal in this case is 74—82 per cent. in the case of the lead from lead ore, and 78—90 per cent. in that of the product obtained by working up the slag. The silver is then extracted by the Pattinson or Parkes process, or by a combination of the two. The composition of the zinc-containing layer, skimmed off and removed, if the Parkes process be used, is shown by the following analysis of three samples of it:—

	I.	II.	III.
Gold.....	6.024	0.006	0.003
Silver.....	3.82	3.33	1.69
Copper.....	3.28	0.49	0.36
Bismuth.....	0.01	0.01	0.01
Lead.....	56.45	44.54	44.52
Zinc.....	34.02	49.69	50.77
Iron.....	1.31	0.57	0.85
Antimony.....	Trace.	Trace.	..
Sulphur.....	Trace.	..	..
Oxygen, &c.....	1.09	1.37	1.80
	100.00	100.00	100.00

An experiment on the way in which the impurities in crude lead disposed themselves when the metal was kept fused, was made by A. Schertel, to whom all the above analyses are also due. An iron cylinder one metre in height was filled with the fused lead and allowed to remain in a chamber kept at a temperature above the solidifying point for 24 hours. It was then allowed to cool, and samples taken from the top and bottom. They gave on analysis the following impurities:—

	Top.	Bottom.
Silver.....	0.121	0.103
Copper.....	1.324	0.031
Bismuth.....	0.132	0.042
Tin.....	0.911	?
Arsenic.....	2.161	1.980
Antimony.....	0.700	0.719
Iron.....	0.103	0.009
Nickel.....	0.029	..
Zinc.....	0.016	0.003
Sulphur.....	0.500	..
Specific Gravity.....	10.321	10.824

An analysis of the Freiberg blue vitriol is given, showing a percentage of 99.801 of $\text{CuSO}_4 + 5\text{H}_2\text{O}$, the balance being made up of traces of ferrous, zinc, nickel, and lead sulphates. The white arsenic produced contains 99.70 to 99.88 per cent. of As_2O_3 . The vitriol, which is one of the by-products at Freiberg, contains 0.175 per cent. of arsenic; after treatment of the chamber acid with sulphuretted hydrogen, the acid of 66° B. contains only 0.0002 per cent. The quantity of lead in the strong acid amounts to 0.058 per cent.

C. Schnabel considers (*Zeits. Ver. deutsch. Ing.* 1888, 758) that the electric method for the deposition of lead fine is not reliable.

C. H. T. Havemann has devised a process for the extraction of lead and silver from their sulphides without the necessity for a preliminary roasting. It consists in the fusion of the ore with caustic or carbonated alkali, which combines with the sulphur and liberates the metal. If the ore be free from iron it is advisable to add 5 to 10 per cent. of iron or its sulphide in order to form a double sulphide of iron and sodium, which facilitates the subsequent disintegration of the slag, which is extracted with water, and at the same time treated with CO_2 from a kiln or other suitable source, whereby the alkaline carbonate is regenerated; it may then be causticised and used over again. In working the process, charcoal and litharge may be added to the melt, and thus a larger yield of lead obtained for the same quantity of soda. A mixture of sodium chloride, litharge, and water may also be used with the view of obtaining caustic soda *in situ*. If silica be present in the ore to be smelted, it will not cause loss of soda, as the silicate of soda formed will be recovered as carbonate by the treatment with CO_2 mentioned above. The furnace used, if lined with siliceous bricks, will be strongly attacked by the alkaline melt, but can be made capable of resisting corrosion by previous treatment with a small quantity of soda at a much higher temperature than that needed in the process, thus transforming its surface into a refractory one of mixed silicates.

It is found that a galena containing about 70 per cent. of lead, together with silica and sulphides of copper, zinc, antimony, and iron, requires about 25 per cent. of soda.

The inventor reckons the cost of the recovered soda at 40s. per ton, *i.e.*, 10s. per ton of ore. The conditions under which the process is most likely to be commercially successful are those obtaining in a country where fuel is scarce, as it promises to be economical in that respect.

OUTPUT OF LEAD in GERMANY for 1886.

	Lead.	Litharge.
	Tons.	Tons.
<i>Stolberger Gesellschaft</i>	14,390	83
<i>Rheinisch-Nassauische Gesellschaft</i>	1,790	..
<i>Mechanischer Bergwerksverein</i>	22,800	..
<i>Commerzieller Bergwerksverein</i>.....	..	..
<i>A. Pönsgen und Söhne</i>	3,650	..
<i>Reiny und Hoffmann</i>	4,226	..
<i>S. B. Goldschmidt</i>	4,351	..
<i>Rothensbacher Hütte</i>	39	222
<i>Walther-Cronschmitt</i>	5,817	792
<i>Oberbergamt Clausthal</i>	8,427	..
<i>Unterharzer Hütten</i>	3,194	205
<i>Oberhüttenamt Freiberg</i>	4,359	479
Total.....	76,752	1,781

In 1886 North America produced 127,008 tons of lead.

At the Muldner works, Freiberg, the lead is desilverised by a combination of the Pattinson and Parkes processes; this is necessary on account of its impurity, particularly in respect of bismuth. The crude lead has first to be freed from copper, nickel, cobalt, tin, arsenic, and antimony, because the first three would cause more zinc to be used in the Parkes process than would otherwise be needed, while the others would remain in the desilverised lead and require to be removed by subsequent refining. The lead thus purified is also suitable for treatment by the Pattinson method. But for the presence of bismuth the Parkes process would be used exclusively, but as it does not eliminate this metal, recourse must be had to the other method, it being desirable to extract the bismuth, both on account of its deleterious influence on lead and its intrinsic value. Accordingly the Pattinson process is used until the percentage of silver is reduced from 0.8 or 0.4 to 0.1 per cent., at which stage the bismuth is all present in the concentrated lead, and then the desilverising completed by the Parkes method. *A. Junge (Jahrb. f. Berg. und Hüttenwesen, 1888, 1—12)* deals with the question of the best way of combining the two processes. He shows that working with a battery of 16 pots, of which No. 1 contains more than 0.81 per cent. of silver, and No. 16, 0.001 per cent. of silver, the cost of working crude lead containing so much silver as to be put into any one of the pots from No. 2 to No. 6, is greater than that of working a lead of any other degree of richness. (The cost for these particular pots is about 120 pfennige per cub. metre, that of the others being about 80 pfennige for the same quantity.) Further, the cost of the Parkes process, reckoning the expenditure for zinc not recovered by distillation, wages, fuel, repairs, royalty, and carriage, comes to an average of about 90 pfennige per cub. m. (1 pfennig = $\frac{1}{100}$ th shilling), for the same class of lead that would be put into pots 2—6 in the Pattinson process. It also appears that the expense increases less rapidly than the percentage of silver in the lead dealt with. On the other hand, as all qualities of lead take up the same quantity of zinc (viz., 0.7 per cent.), which can only be recovered by refining, poor leads are best treated by the Pattinson process.

The question of the bismuth has, however, to be considered, and as it collects in the silver-rich pot (No. 1) in the Pattinson process, it is found best to use this process *before* the Parkes process instead of *after*, as one would expect from the statements above. Consequently at Freiberg a battery of eight or seven pots, according as the lead goes into No. 2 or No. 3 at the beginning of the operation, is used, by which means a lead containing 2 per cent. of silver is obtained in No. 2, and one with 0.1 per cent. in the last. The poor lead is then desilverised by the zinc process in cast-iron pots, the resulting zinc-lead-silver alloy removed and liquated

in cast-iron liquation pots, the desilverised lead freed from zinc by partial oxidation (refining), and the liquated zinc-lead-silver alloy distilled in plumbago crucibles to recover the zinc.

The percentages of the products calculated on the crude lead are:—

(1.) 0.35 per cent. of “schlicker” that separates spontaneously from the crude lead on its first being melted; it contains 0.0004 per cent. of gold and 0.1 per cent. of silver, and goes to be melted down with a new batch of lead ore.

(2.) 2.25 per cent. of rich zinc-lead-silver alloy with 0.0153 per cent. of gold, 4.051 of silver, 53.2 of lead, 2.68 of copper, and 39.7 of zinc.

(3.) 98.95 per cent. of desilverised lead, containing 0.75 per cent. of zinc, and 0.0007 per cent. of silver.

(4.) 1.5 per cent. of lead recovered by liquation from the zinc-lead-silver alloy before it is distilled. It contains 1.3 per cent. of zinc, and 0.032 per cent. of silver, and is returned to the desilverising pots.

The process lasts 20 hours altogether, five hours being occupied in melting and skimming the lead, and five hours for each desilverising after the addition of the zinc, which is made in three portions.

The liquation of the zinc-lead-silver alloy cannot be pushed to its extreme possible limit with advantage, as the product is bulky and much loss is incurred in the distillation, which is carried out as follows: the alloy mixed with 1 per cent. of coarsely-powdered wood charcoal is put into plumbago crucibles as mentioned above (the bottoms of which are covered with a thin layer of charcoal), and heated in a furnace for eight or nine hours; 100 parts yield 57.17 parts of rich lead, containing 0.0186 per cent. of gold and 7.35 per cent. of silver; 5.85 parts of slag left in the crucible containing 0.112 per cent. of gold and 3.5 per cent. of copper; 29.54 parts of reguline zinc; and 7.22 parts of zinc dust containing 6.35 parts of zinc; 90.4 per cent. of the zinc present is recovered, corresponding to 50 per cent. of the whole quantity used for desilverising.

The respective merits of Schnabel's ammonia process and the method described above, are still the subject of dispute; the former is said to be preferable where the output is large.

Roessler has devised a process (Ger. Pat. 45,195 of 1888) by which the distillation can be effected at a sufficiently low temperature to permit of iron vessels being used. It consists in driving hydrogen, carbonic oxide, gaseous hydrocarbons, nitrogen, or carbon dioxide, through the fused alloy. The first four expel the zinc in the metallic state, the last as oxide, for which purpose it is preferable to steam, which, in presence of air, oxidises a portion of the lead.

(To be continued.) —B. B.

PATENTS.

Improvements in the Extraction of Gold and Silver from Ores or Compounds containing the same, and in Solvents for such Metals. A. Parkes, Dulwich. Eng. Pat. 17,033, December 10, 1887. 6d.

This patent, in which there are 11 claims, consists in submitting the crushed ore to the action of any one of the following mixtures, preferably with the assistance of steam under pressure:—(1) bromine, cyanide of potassium, and dilute chromic acid; (2) fluorine, cyanide of potassium, and dilute chromic acid; (3) bromine, chlorocyanide of potassium, and water; (4) bromine and dilute hydrochloric, nitric, sulphuric, or chlorochromic acid; (5) bromine, chlorine, and water; and (6) bromine (or fluorine), alcohol, and water. The precious metals are afterwards obtained from solution by any known method.—A. W.

Improvements in the Manufacture of Aluminium, and Apparatus therefor. H. H. Lake, London. From C. Netto, Dresden, Germany. Eng. Pat. 17,532, December 20, 1887. 11d.

The claims are various improvements in the methods of submitting aluminium compounds to the action of sodium,

for the purpose of obtaining aluminium. The first plan is to introduce sodium into the melted mixture contained in a crucible with a tight-fitting lid, repeatedly turning over the whole. The next is the use of a revolving cylinder with a flue through its centre, in which gas is burnt to supply the heat. The mixture is melted in this cylinder, sodium run in, the vessel closed, the flue disconnected from the gas-supply pipe, and the whole revolved. Again, the sodium can be brought to bear on the mixture by means of a "diver." Also, the operation can be conducted on the principle of Heaton's process for steel making, using sodium in place of the nitre and an aluminium grid in lieu of iron.

Finally, two forms of apparatus are described for introducing the sodium at the bottom of the molten aluminium compounds on the Bessemer converter plan. The materials are melted, run into the hot converter, and melted sodium is forced in by pumps, either through the bottom or through a pipe which leads down the centre of the converter to the bottom, where it is distributed through a perforated plate. The molten aluminium mixture may also be poured on to the melted sodium, preferably by first dividing it by pouring through a kind of sieve. Drawings of the inverting crucible, the revolving cylinder, and the converters are given.—A. W.

Improvements in the Manufacture of Bronze. W. H. Beck, London. From A. Sentex, C. Maréchal, and A. Saunier, Paris, France. Eng. Pat. 1886, February 8, 1888. 6d.

This is a process for producing "malleable and ductile bronze" bars or plates which are free from cracks and blowholes, are "inexhaustible," and which may be "rolled and drawn with the greatest ease." Moreover, the metal has the appearance and "sonorosity of gold." One and a half kilos. of tin are purified by melting under nitre. Ten kilos. of copper are melted and 50 grms. of equal parts of nitrate and cyanide of potassium are added for the double purpose of reducing the oxides and "fattening" the metal. Then 25 grms. of bitartrate of potassium, with the same quantity of cyanide, are added, and after polishing, the tin is introduced; 25 grms. each of sal-ammoniac and cyanide are thrown on, 1 gm. of "phosphuret of copper" introduced to "impart mildness," and 20 grms. of "Marseilles soap" added, which still further "fattens" the metal. Finally, 1 gm. of sodium is added at the moment of casting. The metal, if cast in sand, may contain more tin, and if the proportion of tin be reduced, the quantity of phosphorus and sodium may be increased.—A. W.

Improvements in Apparatus suitable for Separating Gold from its Ores. J. Hornsby and G. E. Coupe, Grantham. Eng. Pat. 1914, February 8, 1888. 8d.

This improvement is intended to ensure the intimate contact with amalgamated silver plates of sludge containing gold, especially when a large amount of water has to be used with the ore. The sludge is introduced into a box, preferably lined with amalgamated plates, and having inside it an axis or drum provided with easily removable tangential or other arms carrying amalgamated plates. These plates are caused to revolve in the casing, being either driven from the outside or made to revolve like a water-wheel by the sludge itself, the latter method being especially suitable for ores which require to be mixed with a large quantity of water. At the bottom of one of the sides of the casing is a slit, closed by a plate which dips into a trough of mercury. Other plates are provided at the bottom of the casing to break the flow of sludge, so as to prevent a too violent flow carrying the mercury out of the trough.—F. W. T. K.

A Mode of Treating Manganese Ore for Convenience and Economy in Transportation and Shipment. H. Morris, Manchester. From A. W. de Leuse Lenczewsky, Koutaïss, Russia. Eng. Pat. 1939, February 9, 1888. 4d.

The manganese ore is pulverised, worked up into a paste with water, made into bricks, and calcined sufficiently to remove the moisture and "a good portion of the foreign substances without melting out the metallic manganese." In some cases it may be found convenient to calcine the powdered ore directly and ship the powder.—F. W. T. K.

A New Non-Magnetic Metallic Alloy. H. Ostermann and A. Prip, Geneva, Switzerland. Eng. Pat. 11,939, February 16, 1888. 4d.

The alloy is composed of a mixture of platinum, nickel, copper, wolfram (tungsten), cobalt, and cadmium in certain proportions. The alloy is very suitable for replacing steel in the works of watches and in watch escapements, for it is both non-magnetic and its coefficient of linear expansion is almost the same as that of steel. By varying the proportions the alloy can be made harder or softer, more or less ductile and malleable, &c. (See next page).—S. G. R.

Improvements in the Extraction of Gold, Silver, and Platinum from Auriferous and Argentiferous Materials. F. Trickett and J. Noad, London. Eng. Pat. 2778, February 24, 1888. 6d.

The patentees make a saturated "solution of chloride of sodium and oxide of manganese," by dissolving 12 parts of the former and 1 part of the latter in 24 parts of water, and pass through it an electric current "until the whole of the chlorine is liberated and taken up by the solution, leaving a residue of sodium oxide." The ore is heated with the chlorine solution so obtained, whereby gold, silver, and platinum are converted into "soluble chlorides." Pyrites is first "mixed with the said residue of sodium oxide" to remove sulphur previous to the treatment with the chlorine solution. The metals can be obtained from solution by any known method.—A. W.

Improved Economic Treatment of Certain By-Products of Gas and Tin-Plate Manufactures. E. Bowen, Pontardulais. Eng. Pat. 3,179, March 2, 1888. 4d.

See under VII. page 193.

Improvements in Alloys containing Iron or Steel. J. F. Hall, Sheffield. Eng. Pat. 3410, March 6, 1888. 4d.

The inventor adds metallic nickel to iron in proportions of from 2.5 per cent. up to 50 per cent. of the whole, the greatest amount previously used being not more than 3 per cent. The alloy, which can be cast, forged, or rolled, is said to be particularly adapted for cannon, gun barrels, shot and shell, armour plates, engravers' plates, and other purposes.—S. G. R.

Improvements in Plating Iron and other Metals with Aluminium. L. Q. Brin, Paris, France. Eng. Pat. 3548, March 7, 1888. 6d.

The plate or piece of metal to be coated with aluminium is placed in a muffle furnace, which can be heated to 1,000°—1,500° C., and covered with a flux formed of clay, or other earth rich in alumina, mixed with sodium chloride, fluor-spar, and borax. In the muffle itself, or preferably in another vessel, aluminiferous vapours are produced by heating aluminium chloride or a mixture producing the chloride, and, in the latter case, passed into the muffle furnace. The vapours are mixed with a strongly heated inert gas to prevent condensation and deposition of the aluminium chloride before reaching the muffle; nitrogen obtained by passing air over incandescent coke answers well for the purpose. The aluminium formed permeates the other metal to a greater or lesser extent according to the temperature and time employed. If the outer layer of aluminium be removed it is found that the mass is still so impregnated with aluminium as to possess practically all the properties of an alloy of that metal.—S. G. R.

Improvements in the Process and Apparatus for obtaining Alloys of Aluminium and particularly Aluminium Bronze. L. Q. Brin, Paris, France. Eng. Pat. 3549, March 7, 1888. 8d.

Iron, steel, or other metal can be alloyed with aluminium, which has been reduced directly from its ore, in the following manner. The metal is coated over with a mixture of clay

or ore rich in aluminium, chloride of sodium, borax, and fluorspar, and then placed in a blast furnace with alternate layers of fuel. The aluminium is readily reduced and combines with the other metal or metals. The alloy formed in the case of iron and aluminium has a low melting point, and can be also produced in an ordinary reverberatory furnace without the use of a blast. The gases issuing from the throat of the furnace are passed through water to retain any products carried off by them.

—S. G. R.

Improvements relating to the Separation or Extraction of Metals from their Ores by Amalgamation, and to Apparatus therefor. T. R. Jordan, London. Eng. Pat. 3965, March 14, 1888. 11d.

This patent is for a new amalgamator, and is accompanied with drawings. The apparatus consists of a series of inverted conical plates placed one above the other on a spindle. Round these cones is a casing with a series of annular shelves sloping downwards towards the centre, and so arranged that a shelf is situated above and below each central cone. The cone plates and the shelves are amalgamated. The pulp is fed in at the top, the spindle carrying the cones made to revolve, and the amalgam collected in a suitable box at the bottom of the machine. Fresh mercury is also fed in at times at the top of the apparatus. It is maintained that the centrifugal force of the revolving inverted cones is sufficient to carry the pulp up and over the inclined surface on to the shelves of the casing, down which it is washed on to the next inverted cone underneath, and so on, the ore by this means being subjected to an extensive rubbing action against the amalgamating surfaces.

—A. W.

Improvements in the Manufacture of Metallic Alloys or Compounds. J. C. Bull, Erith. Eng. Pat. 4086, March 16, 1888. 6d.

THE improvements relate especially to zinc alloyed with other metals. In order to obtain an alloy with iron, manganese, chromium, tungsten, &c., which have much higher melting points than zinc, the inventor adds to the zinc-bath either varying proportions of arsenic and phosphorus, or preferably the former alone. With a bath containing 5 per cent. of arsenic, an alloy containing 18 per cent. of iron can be obtained, the highest result previously obtained being 10 per cent. of iron, and then only with a large loss of zinc. The melting point of the zinc varies with the amount of arsenic added. The surface of the molten zinc should be covered with fine coke in order to prevent free access of air.—S. G. R.

Improvements in the Treatment of Metallic Ores, and in Apparatus employed therein. G. J. Atkins, London. Eng. Pat. 4430, March 22, 1888. 8d.

THE finely-crushed gold or silver ore is fed through a hopper into a pipe, through which a jet of steam mixed with chlorine or bromine, &c., or mixtures to produce these bodies, is passing. The ore by this means is thoroughly disintegrated, the fine particles of metal being attacked by the chlorine and the whole carried forward by the force of the steam into a receiving chamber, where setting and condensation take place. The gold is in solution, and the silver may be extracted by lixiviation with hyposulphite or cyanide. The gold solution is passed through a carbon filter through which a current of electricity is passing, whereby, it is maintained, the gold is more completely precipitated than when the carbon filter alone is used. A diagrammatic sketch of the plant is given.—A. W.

Improvements in or relating to the Manufacture of Sodium and Potassium. G. A. Jarvis, St. Georges. Eng. Pat. 4842, March 31, 1888. 6d.

IN order to prevent the large amount of corrosion which takes place when iron crucibles or tubes are used, the inventor proposes the use of fire-clay apparatus. The

crucibles or retorts must be lined with some refractory basic material impermeable to the metallic vapour. The most suitable is that made from strongly-burned magnesia, with the addition of 10 per cent. of fluorspar; this is rammed in tightly, forming a firm coherent lining. If desired, sheet-iron may be enclosed between the crucible and this lining. The carbon necessary for reduction is prepared from a mixture of small charcoal, coke, or coal, made up with pitch, and then moulded and burned on iron bars, as supports, forming coherent carbon rods. These are placed in the retorts. If iron crucibles or other apparatus are to be employed, as is usually the case, they should be surrounded with salt, or some other suitable fusible material, by which the external corrosion of the iron is almost completely prevented.

—S. G. R.

A New Metallic Alloy. H. Ostermann and C. Lacroix, Geneva, Switzerland. Eng. Pat. 11,940, April 19, 1888. 4d.

THE alloy is to be used in place of steel, especially in the manufacture of springs, balance-wheels, and the other parts of watches, &c., which are liable to be affected by magnetism or oxidation. The following is the mixture:—Gold, 30 to 40 parts; palladium, 30 to 40 parts; rhodium, $\frac{1}{10}$ to 5 parts; copper, 10 to 20 parts; manganese, $\frac{1}{10}$ to 5 parts; silver, $\frac{1}{10}$ to 5 parts; and platinum, $\frac{1}{10}$ to 5 parts.—A. W.

A New Non-Magnetic Alloy. H. Ostermann and C. Lacroix, Geneva, Switzerland. Eng. Pat. 11,941, April 25, 1888. 4d.

THE proportions in this case are:—Gold, 30 to 40 parts; palladium, 30 to 40 parts; copper, 10 to 20 parts; silver, $\frac{1}{10}$ to 5 parts; cobalt, $\frac{1}{10}$ to $2\frac{1}{2}$ parts; wolfram, $\frac{1}{10}$ to 5 parts; rhodium, $\frac{1}{10}$ to 5 parts; and platinum, $\frac{1}{10}$ to 5 parts. This alloy is specially suited for watch escape-ments, and it secures the compensation of the balance-wheel and hair spring in different temperatures.—A. W.

An Improved Method of Calcining Pyrites and other Gold-bearing Ores. D. Hutton, Adelaide, South Australia. Eng. Pat. 12,683, September 3, 1888. 6d.

THE improvement consists in injecting steam, or solutions to produce the same, through the bed of the furnace into the pyrites during the process of calcination, whereby the resulting mass is rendered more friable and capable of being finely crushed with greater facility and less expense.

—A. W.

Improvements in the Process of, and Apparatus for extracting Iron from its Ores, and in obtaining By-Products. H. H. Eames, Baltimore City, U.S.A. Eng. Pat. 14,837, October 16, 1888. 8d.

THE apparatus consists of a raised cylindrical vertical chamber heated by the products of combustion of a furnace, and in which are vertically placed a number of narrow cylindrical retorts which protrude through the top and the bottom of the said chamber. The tops of these retorts are provided with hoppers, and to the lower extremities may be attached movable receptacles. The retorts may be of iron lined with fire-clay, and inside of each are placed two rods of carbon at the opposite sides of the interior throughout the entire length. These carbons are connected with the two extremities of a dynamo. The charge—consisting of oxide of iron, carbon, and lime—is introduced into the retorts, which are then closed and rendered air-tight. The whole is heated to about 550° C. and a current of electricity passed through each retort. The iron oxide is reduced to metal, the gases escape through suitable traps, and the sulphur and phosphorus are said to be eliminated in the following manner:—Part of the oxygen of the ore combines with the sulphur of the ore and produces sulphurous acid, which, in turn, combines with the lime and produces sulphate of lime, and the phosphorus is likewise liberated with the production of phosphate of lime. This "liberation continues until all

the said combined matter is carried off, when the refined ore may be discharged into the vessels" underneath each retort.

It is maintained that "sulphide ores of iron" may be used in these furnaces. In this case it is not necessary to mix in carbon and limestone, but simply to submit the ore itself to the continued action of heat and electricity. By this means "pure sulphur" is produced, which runs down into the underlying receptacle, and the iron is left in the "pure state."—A. W.

An Improved Process of Separating Metals and other Substances from Molten Slag and the like. H. H. Lake, London. From O. B. Peck, Chicago, U.S.A. Eng. Pat. 17,068, November 23, 1888. 8d.

This is a process for separating shots of metal, matte, and metallic compounds, from slags by means of a centrifugal machine. A wide-neck squat bottle-shaped vessel lined with cast iron is supported on a spindle and made to revolve rapidly. The molten slag is poured in at the top, preferably in a continuous stream; the metal, &c. is driven to and accumulated at the wall of the machine, which is kept cool by an external stream of water, and the freed slag rises to the neck of the vessel up the centre, through which it passes, and is then thrown off. The operation, of course, may be stopped at any time, but it is preferable to work it continuously until a large accumulation of metal has taken place. The latter solidifies, and the machine, which can be made up of parts clamped together, is taken to pieces and the metal removed. A drawing of the apparatus is given.—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Accumulators. Duneau. Electricien, 1889, 13, 32.

To avoid the deterioration of the lead plates in accumulators, the author covers them with a conducting deposit which is not attacked in any way by sulphuric acid. To effect this, the lead plate is placed as the anode in an alkaline bath of a lead salt, a second piece of lead serving as the cathode; by passing a weak current through the solution, the anode becomes covered with a dense and even deposit of the black oxide of lead, which protects the metal most effectually. Lighter and harder metals than lead might be employed by this method.—C. A. K.

PATENTS.

Process for Recovering Zinc and Alkali from Spent Liquors of Lalande Voltaic Batteries. H. A. Fergusson, London. Eng. Pat. 1707, February 4, 1888. 6d.

In the Lalande battery, zinc is used as one electrode, with a caustic alkali solution as electrolyte. The inventor places the spent liquor in a bath with iron and zinc alternately as electrodes, and, by passing an electric current, causes pure zinc to be deposited from the liquor on to the zinc plates in flocculent masses, which can be collected and separated from the liquor by filter-pressing, and afterwards be formed into blocks or ingots by pressure or fusion; the liquor being returned to the bath for further treatment.

Instead of zinc, other metals, if amalgamated, may be used as the negative electrodes.—E. T.

An Improved Method of Manufacturing Woven Plates for Secondary Batteries. M. Bailey and I. Warner, London. Eng. Pat. 2368, February 16, 1888. 8d.

THESE plates consist of lead strips or wires interwoven, preferably at right angles, with threads or strands of cotton, twine, silica cotton, or spun asbestos fibre, and are formed according to the Planté method.—B. T.

Improvements in Secondary Batteries. W. Kingsland, London. Eng. Pat. 3223, March 2, 1888. 6d.

THE inventor's object is to produce an accumulator which, by absence of local action, may remain in working condition for a considerable time, and so be used for electric bells, telegraph working, &c. An electrode is employed, therefore, consisting mainly of dense peroxide of lead, not in contact with any oxidisable materials. These electrodes are preferably made in accordance with Eng. Pat. 5867 of 1887. (This Journal, 1888, 328.)

For the other electrode the patentee employs amalgamated zinc, or a deposit of pure zinc on some such metal as lead. The electrolyte is preferably dilute sulphuric acid, and the cell may be sealed if desired.—E. T.

Improvements in the Elements for Secondary Batteries. J. A. Timmis, London. Eng. Pat. 10,064, July 21, 1888. 6d.

In order to cheapen, lessen the weight, and perfect the action of the positive elements or cathodes, they are made of litharge combined with a suitable solution, preferably sulphate of ammonia, supports of lead or an inoxidisable material being used.—B. T.

An Improved Apparatus for Pickling or Cleaning the Surface of Iron and other Metals to Prepare the same for Coating with Tin or other Metal. A. Gutensohn and J. M. James, Old Ford. Eng. Pat. 16,848, November 20, 1888. 6d.

THIS is an improvement on Eng. Pat. 8324 of 1886 (this Journal, 1887, 517), and is intended to obviate the gradual slowing off of the pickling process noticeable in the arrangement previously employed. The method is an electrical one, and the apparatus is constructed in a similar manner to and on the principle of the ordinary secondary battery. The bath is made water-tight and of wood or some other non-conducting material. It is divided off into several compartments by means of non-conducting partitions which fit into grooves in the sides of the bath. These partitions do not quite reach to the top of the sides of the bath, so that when the pickling solution (which may be either acid or alkaline) is run into the bath they are submerged. On the inner side of one end of the bath, and on the corresponding side of each partition, are fixed sheets of metal (preferably lead) which, however, do not reach to the bottom. Two strips of non-conducting material are fixed to the bottom of the bath so that their ends touch the partitions. The upper surface of these strips is faced with metal (preferably lead strips). Alternate strips on the bottom of each compartment are connected with the metal sheet on the side of the next compartment by means of an insulated wire. The current enters by a conductor which is attached to the end plate, and is led away by an insulated wire connected with one of the strips in the last compartment. The desired number of plates to be pickled are placed in the compartments so that their lower edges touch the strips on the bottom. To prevent their touching the vertical sheets, these latter are protected by vertical non-conducting laths which are fixed over them. The iron plates thus form part of one pole and the sheets the other poles. The sheets and strips may similarly be fitted to a crate and the latter can then be immersed in a bath. If other shaped pieces or articles of iron are to be cleaned, the shape of the bath and of the compartments has to be altered accordingly.—F. W. T. K.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

On the Production of Machine Oils, Vaseline, &c. from Mineral Oils. Chem. Zeit. 12, 1727.

THE oils which are to be purified have first to be dried, either by letting the water settle or by means of calcium chloride, sodium chloride, or sometimes by small quantities of glycerin, according to the nature of the oil; the oil, thus perfectly dried, is brought into an iron cylinder, which is coated inside with lead, and forms a cone at the lower end, at the lowest point of which is a tap. The oil is at first mixed, by means of compressed air, with 2 per cent. of sulphuric acid of 66° B. After mixing for two hours the air is shut off and the liquid allowed to settle for three hours. Then the acid is run off, the last traces being removed after another half hour. This treatment is repeated with 8 per cent. of sulphuric acid of 66° B. for four hours, or so long as sulphurous acid escapes. The sulphuric acid has to be gradually added, in intervals of half an hour. The whole operation is repeated with 10 per cent. of acid. Special care has to be taken that the oil does not get warm; in such a case the addition of sulphuric acid must be stopped until the mass is again cool. It may be advisable to add to the last charge of acid $\frac{1}{2}$ per cent. of dry zinc chloride. The oil is pumped, after all acid has been removed, into a second vessel of similar shape, and 20 per cent. of warm water is added, but without mixing it with the oil. After one hour's standing the water is removed and the operation repeated. The oil is now mixed by compressed air twice with 15 per cent. of warm water till no longer acid, and finally with 5 per cent. of caustic soda of 6°—8° B.

Very thick oils are mixed with petroleum naphtha. The mixing with sulphuric acid has, of course, to be done in such case in closed vessels. After the purification the naphtha is removed by distillation with superheated steam.

Tar oils containing creosote require a preparation with dilute caustic soda. Steaming very often removes from the oils any remaining odour. Treatment of the perfectly dry oil with animal charcoal has a more or less bleaching effect.

—A. L.

Olive Oil. K. Hazura and A. Grüssner. Monatsh. Chem. 9, 944—946. (Compare this Journal 1888, 506—507 and 680—682.)

OLIVE oil is generally considered to contain 72 per cent. of tri-olein and 28 per cent. of palmitin, stearin, and arachidin, but the iodine equivalent of the oil, as determined by Hübl's reagent, is higher than that accounted for by the olein contained (83 instead of 62.1), whence it is probable that either a lower acid of the oleic series or a more unsaturated acid than oleic acid, having a minimum iodine equivalent of 90.1, is present. In order to ascertain the presence of such an acid, the authors saponified pure olive oil (iodine equivalent 83) with caustic potash of sp. gr. 1.27, and then oxidised the aqueous solution of the potassium salts obtained with a $\frac{1}{2}$ per cent. solution of potassium permanganate. The oxidation was stopped after 10 minutes by the addition of an excess of sulphurous acid, and the separated acids dried on a porous plate, and extracted with ether. The residue from the ethereal extract consisted of a thick oil, and probably contained the unoxidised portion of the oil, together with lower fatty acids and azelaic acid. The portion insoluble in ether, which amounted to 80 per cent. of the weight of olive oil taken, was extracted with water, when a small portion (4 per cent. on the original weight of oil) dissolved, which crystallised out on cooling in crystals, melting at 162°, and which gave numbers on analysis agreeing well with the formula $C_{18}H_{36}O_6$. The acid is, therefore, sativic acid. The portion insoluble in

water proved to be dihydroxystearic acid; it crystallised from alcohol in microscopic tablets, and melted at 136°—137°. Sativic acid is tetra-hydroxystearic acid, $C_{18}H_{32}O_8(OH)_4$, and the fact that it is obtained together with dihydroxystearic acid by the oxidation of olive oil, points to the presence of a second acid in the oil, having the formula $C_{18}H_{32}O_2$; this is linolic acid (stearoleic acid), and judging from the relative quantities of the two acids obtained in the oxidation, the olive oil will contain about 7 per cent. of linolic acid to 93 per cent. of oleic acid.

The authors are of opinion that most of the non-drying oils contain linolic acid as well as oleic acid, and have proved this to be the case with earth-nut oil. They are engaged in examining other oils from this standpoint.

—C. A. K.

Uculuba Fat. E. Valenta. Zeits. f. angew. Chem. 1889, 3.

THIS fat, according to Schädler, obtained from the seeds of *Myristica beenhiba*, Humb., and according to Tschirch, from those of *M. Surinamensis*, is of a deep brown colour, and is tolerably firm; it possesses a peculiar aromatic odour, due to the ethereal oils it contains. On heating to 39° it melts, and at higher temperatures it possesses a somewhat disagreeable acid smell. Treatment with steam removes the ethereal oil and small quantities of volatile acids.

A sample, after treatment with steam, contained 93.4 per cent. of total fatty acids, 8.8 per cent. of free fatty acids. A quantity of the fat was saponified, and the soap decomposed with sulphuric acid. The fatty acids so obtained melted at 46°, and possessed a saponification equivalent of 219—220, and an iodine equivalent of 9.5. Treated with hot alcohol of 96 per cent., and after a time filtered, they left a resinous mass, having somewhat the odour of Peru balsam.

The crystals which separated from the clear liquid melted at 53°—53.5°, their saponification equivalent was 245—245.4, and their iodine equivalent 0. They thus consisted of myristic acid. Fractional precipitation with magnesium acetate showed that no other acid was present, with the exception of oleic acid. From the iodine equivalent the author concludes that the fatty acids consist of 89.46 per cent. of myristic acid and 10.54 per cent. of oleic acid.

This is, at all events, favourable to the use of the fat for making candles.—T. L. B.

The Rancidity of Fats. M. Gröger. Zeits. f. angew. Chem. 1889, 62—64.

THE tendency of fats to develop free fatty acids by keeping, and thereby to acquire a rancid smell, due to the volatility of a portion of these, is well known (for facts pointing to some other cause for rancidity, see this Journal, 1889, 54), but no precise knowledge exists as to the conditions governing this change.

The author accordingly investigated it in the case of six kinds of fat, viz., tallow, cocoa-nut oil, palm oil, cotton-seed oil, olive-kernel oil, and bone fat, in the following way: A portion of the clarified fat was placed in a flask of about 50 cc. capacity, which was then securely closed; another part was mixed with 4 per cent. of a concentrated solution of albumen (white of egg), and similarly secured; a third was soaked up by strips of dry filter-paper, previously extracted with water and ether, pleated and placed in large glass dishes, allowing free access of air; a fourth was similarly dealt with, save that the filter-paper was first saturated with a 10 per cent. solution of albumen, and dried. After the lapse of four years, the percentages of free fatty acid in all the samples were determined, and compared with their values before treatment. In the case of the fats enclosed in flasks, the portion for analysis could, of course, be taken direct; while in that of the strips of filter-paper, the plan adopted was to exhaust them with ether, evaporate the ethereal solution to dryness, and wash the residue repeatedly with boiling water, leaving a mixture of neutral fat and insoluble fatty acids which could be titrated in the ordinary way.

The results thus obtained are recorded in the following table :—

Percentage of Free Fatty Acid.

Kind of Fat.	Original.	After four Years.			
		With Exclusion of Air.		With Exposure to Air.	
		Alone.	In presence of Albumen.	Alone.	In presence of Albumen.
Cotton-seed oil.	0.33	0.36	0.52	39.34	39.18
Cocoa-nut oil...	2.51	5.34	4.75	5.45	5.88
Tallow.....	4.49	7.02	8.99	21.82	16.73
Bone fat	51.26	51.57	61.79	49.93	53.95
Palm oil	71.86	84.03	85.67	69.20	65.31
Olive-kernel oil	71.99	71.18	71.64	54.32	56.75

From this it appears that, with the exception of palm oil, the fats by themselves suffer little change if air be excluded; the presence of albumen somewhat favours the formation of free fatty acid, though only in the case of bone fat is the increase considerable. Exposure to air causes an increase in the first three, but with the remainder a decrease occurs; this is probably due to the formation of products volatile, or soluble in water. On the whole, the presence of albumen seems to hinder the change, possibly because of the diminished porosity of the paper saturated with it. One thing is plain however, viz., that the presence of air is the most important condition in the production of rancidity.

The mean combining weights of the fatty acids (free and combined) isolated from the ethereal extract of the filter-paper saturated with the fats under investigation (without the addition of albumen) were determined, and found to be, without exception, lower than those for the fats before exposure. This points to the splitting up of the fatty acids, during the period for which they were exposed, into simpler oxidation products, instead of their undergoing change by mere additive absorption of oxygen. Further evidence in this direction was afforded by the isolation of azelaic acid ($C_9H_{16}O_4$) mixed with a little suberic acid ($C_8H_{14}O_4$) from that portion of the rancid fats that was soluble in water. No free glycerol appeared to be present, and therefore the author concludes that it must suffer oxidation as well as the fatty acids.—B. B.

PATENTS.

Improvements in the Purification of Cotton-seed Oil, and in Apparatus therefor. R. Hunt, Liverpool. Eng. Pat. 550, January 13, 1888. 6d.

NEITHER drawings nor detailed explanations are given, but the patentee claims the use of "high speed minutely acting mixing apparatus" for promoting the action of the alkaline purifying agent upon the oil, and of centrifugal separators for removing the soap formed in the process, such as a hydro-extractor with the basket unperforated. The purifying solution and the oil are employed in approximately equal bulks, and at temperatures between 100° and 120° F.—W. L. C.

A Process for the Manufacture of a Soap soluble in Sea-water. O. H. von Wilke, Charlottenberg, Germany. Eng. Pat. 2306, February 15, 1888. 6d.

"EXPERIMENTS have proved that the separation of soap from its solution does not follow from the addition of dissolved borate of potash through solutions of common salt the strength of which corresponds to or exceeds that

of sea-water." Hence the patentee incorporates with hard commercial soaps about 0.2 per cent. of the potassium salt of boracic acid.—W. L. C.

A Composition for Cleaning Wall Papers, Papered Ceilings, and the like. E. Johnson, London. Eng. Pat. 2650, February 22, 1888. 4d.

FLOUR, bran, fuller's earth, and "Sanitas" powder are incorporated with each other, and with as much water as will bring the mass to the consistency of soft india-rubber.—W. L. C.

An Improved Compound for Washing and Laundry purposes. W. T. Lawson, Manchester. Eng. Pat. 2971, February 28, 1888. 4d.

PARAFFIN oil is incorporated with what is essentially a vegetable oil soap mixed with silicate of potash.—W. L. C.

Improved Preparation for Cleansing purposes. L. Grave, London. Eng. Pat. 13,673, September 21, 1888. 6d.

THE bark of any tree of the Sapindus family (e.g., Saponaria) is extracted with water, or the powdered bark is mixed with mucilage, oils, &c. to form a tablet or block as a substitute for soap.—W. L. C.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Red Lead. R. Frühling. Zeits. f. angew. Chem. 1889, 67-68.

THE many purposes for which red lead is used fall naturally into two classes; in the first, comprising its employment for joint-making, and as a pigment, purity is not essential, while in the other, covering such uses as in pharmacy and glass-making, it is imperative. The commonest adulterants met with are insoluble substances such as barium sulphate, clay, and brickdust, which are found to the extent of even 10 per cent. in so-called "best" red lead.

The following table shows the proportion of insoluble matter present in various commercial samples:—

Number of Sample.	Percentage.
1	7.75
2	27.19
3	9.59
4	8.46
5	25.39
6	17.66
7	9.60
8	2.08
9 (from a druggist's)	1.25

THE wholesale price is found to decrease with the increase in impurity, but not proportionately, while the retail price is much the same for all qualities. Of the samples in the table, Nos. 1, 3, 4, 7, 8, 9, contained fine sand and clay, while in Nos. 2, 5, 6, barium sulphate was present; the first-named impurities may have been derived from the use of inferior raw material, or carelessness in manufacture, but the last is evidently an intentional addition.—B. B.

PATENTS.

Improvements in and connected with Varnishes. F. Crane, London. From W. D. Field, Short Hills, U.S.A. Eng. Pat. 15,771, November 17, 1887. 6d.

THIS inventor uses a solution of cleared, purified, and bleached shellac, prepared according to Eng. Pat. 15,772 of 1887 (following abstract), in combination with a solution of pyroxilin in a practically non-hygroscopic menstruum miscible with the shellac solution.—E. G. C.

Process for Purifying and Clarifying Shellac or Solutions of Shellac. F. Crane, London. From W. D. Field, Short Hills, U.S.A. Eng. Pat. 15,772, November 17, 1887. 6d.

THE shellac is dissolved in methyl-alcohol, benzine added, and the mixture agitated. The benzine is drawn off, and a clear solution of shellac left in the vessel.—E. G. C.

Improvements in Dyeing and otherwise Treating India-rubber and India-rubber Compositions, Farina, Starch, and French Chalk, and Fabrics producing a Bronzed appearance. J. F. Kelly, London. Eng. Pat. 17,260, December 15, 1887. 6d.

THE inventor dissolves "aniline dyes in a strong solution of alcohol spirits, wood naphtha, nitric acid, and turpentine spirits," and passes the fabric over a roller partly immersed in a trough containing this solution: a bronzed appearance is thus produced on fabrics coated with india-rubber and compositions containing india-rubber. To dye india-rubber goods and compositions containing india-rubber, farina, starch, and French chalk, the quantity of nitric acid is reduced.—E. G. C.

Improvements in Forming Solutions and Compounds of Nitro-Cellulose. A. Orr, Glasgow. Eng. Pat. 487, January 12, 1888. 6d.

THE solvent employed is "a chlor-acetate of chlor-amyl," prepared by the action of chlorine on fusel oil "and other chemicals," and may be diluted with from 2—5 parts of fusel oil. A solution of nitro-cellulose in this solvent mixed with castor-oil and "wood pitch" is said to give, by suitable treatment, a very good insulating material.

—E. G. C.

Improved Process for Fired Painting on Metal Plates. C. J. Leroux and J. H. Fischbach, Paris, France. Eng. Pat. 12,892, September 6, 1888. 6d.

THE metal plate is fixed to a piece of canvas by rye-flour paste; when dry it is cleaned with "essence of turpentine," and the desired colours, mixed with turpentine and varnish, put on; the whole fired at 50°—100° C. and the painting and firing repeated until the desired effect is obtained, when it is varnished and again fired.

When used for mural decoration these plates can be fastened to the wall with a mixture of rye-paste and Flemish glue, if it be dry, or with one of white lead, linseed oil, and turpentine if it be damp.

The process can also be used for preparing letters for signs.—B. B.

Improvements relating to the Manufacture of Lead Pigments, and to Apparatus therefor. J. W. Hall, Bristol. From G. T. Lewis, Philadelphia, U.S.A. Eng. Pat. 14,107, October 1, 1888. 6d.

A ELAST of intimately admixed gas or liquid hydrocarbon, air, and finely-divided galena, is introduced into a combustion chamber, and inflamed at the entrance thereof. The resultant salts are forced into receptacles of textile fabric.

—E. G. C.

Improvements in the Manufacture of Paint. A. J. Boulton, London. From C. H. Eichler, Dresden, Germany. Eng. Pat. 15,997, November 5, 1888. 4d.

THE constituents used are:—pulverised slate, 50 per cent.; oil tar, 40 per cent.; sicative, 4 per cent.; sal-ammoniac,

3 per cent.; water-glass or siliceous varnish, 3 per cent. Paint so prepared is said to protect wood and other material against weather, fire, and rot.—E. G. C.

Improvements in Vulcanised Plastic Compounds. A. J. Boulton, London. From W. Kiel, New Jersey, U.S.A. Eng. Pat. 17,679, December 4, 1888. 6d.

INDIA-RUBBER, sulphur, punice stone, oil, and beeswax in proportions varying with the use to which the product is to be put, are thoroughly incorporated, moulded into any desired form, and vulcanised for 10—14 hours at a pressure of 50—60 lbs. The articles thus made are said to answer the purposes of hard rubber, while being stronger, cheaper, and easier to manufacture. The punice stone is regarded as an essential and novel ingredient.—B. B.

Improvements in Filling for use by Painters and others. S. Downs and W. Greenwood, Leeds. Eng. Pat. 17,799, December 6, 1888. 4d.

EQUAL parts by weight of "lead" and "patent driers" are mixed with equal parts by measure of japaners' gold size and turpentine, the whole made into a stiff paste by the addition of pounded "whitening" (preferably previously heated), and the resulting mixture applied to the surface to be treated with a knife or spatula.—B. B.

XV.—AGRICULTURE, MANURES, Etc.

Rare Constituents of Beet-root Ash. E. O. von Lippmann. Ber. 21, 3492—3493.

THE author finds boric acid in the roots and leaves of the beet. Vanadium is also found in the carbonaceous residue after distillation of the molasses. Among other elements manganese, caesium, and copper are occasionally found.

—J. B. C.

Cultivation Experiments with Different Varieties of Potatoes on Light Sandy Soil. Vibraus. Zeits. f. Spiritus Ind. 1888, 80.

THE land was in good agricultural condition; the potatoes were sown by drill in May and subsequently cultivated in the usual manner. The weather, at first fine and warm, became cold and dry towards the end of summer. The plants grew well, with the following results:—

Variety.	Condition on 1st September.	Yield.	
		Centners of Tubers.	Starch per Cent.
Imperator	Drooping slightly	130·0	19·2
Odin	Drooping very much	102·5	17·9
Sutton's Magnum ? Bonum	(Leaves half yellow with spots	8·5	18·4
Matador	Slightly drooping	102·5	14·1
Hortensia	Leaves completely yellow ..	87·5	15·4
Reichskansler	Leaves mostly dark green with few spots and few yellow leaves	62·5	21·4
Rosalie	Yellow and spotted	78·75	16·6
Juno	Almost entirely yellow and spotted	52·5	16·5

THE "Imperator" potatoes are the best for dry, especially sandy soils, for they not only yield well but the tubers are of good quality and keep well; this is not the case when they are grown on wet soils. The percentage of starch in potatoes of 1887 was from 2 to 4 per cent. lower than in 1886, owing to drought and cold.—D. A. L.

Destruction of Moss by Ferrous Sulphate. P. M. Delacharlonny. J. de l'Agricult. 1888, 737—739. L. Destreux. *Ibid.* 747.

THE former author concludes from numerous experiments that properly applied to meadow-land ferrous sulphate destroys moss and so facilitates the development of grasses. It is best applied in March, but may be sown later, even in autumn, without acting injuriously; the quantities employed vary with the condition of the meadow, when new 300 kilos. per hectare is sufficient, 600 should be used on old pastures, and 2,000 when the moss is very (8—10 cm.) thick. The sulphate may be used solid or in solution. The latter author has made observations which confirm the above.

—D. A. L.

Action of Ferrous Sulphate on Different Soils. P. M. Delacharlonny. Jour. de l'Agricult. 1888, 787—790.

IN the author's experiments various soils were analysed, and subsequently crops of wheat, lucerne, and potatoes were grown on them, with and without dressings of ferrous sulphate. The results indicate that ferrous sulphate is beneficial to these crops, being more so when the soil is poor in iron, as will be seen from the following data. On meadow-land the following results in kilos. per hectare were obtained:—

Percentage of Iron Oxide in Soil.	Yield without Ferrous Sulphate.	Yield with Ferrous Sulphate.	Quantity of Ferrous Sulphate used.
2.920	2,000	4,785	65
2.531	1,838	3,952	350
1.340	1,807	2,864	200
3.573	4,316	1,663	200
4.321	3,614	3,500	125

With lucerne the crop was increased 25 per cent. by dressing with ferrous sulphate, although the soil already contained 4.32 per cent. of ferric oxide, whilst the potato crop was also much benefited by the application of ferrous sulphate on a soil poor in iron; lime manuring also produced a good effect, as that constituent was also deficient in this soil.—D. A. L.

Value of the Nitrogen in Chili Saltpetre and Ammonium Sulphate for Potatoes and Oats. Baessler. Wochenbl. d. pommerseh. akons. Gesell. 1888, 163—164, 270—271.

POTATOES were grown on a sandy soil of the following composition, with superphosphate and with varying quantities of nitrogen, in some cases as Chili saltpetre, in others as ammonium sulphate or a mixture of the two salts. The dry soil contained per cent.: water, 1.18; organic matter, 5.36 (containing nitrogen, 0.21); ash, 93.46; insoluble in hot HCl, 88.02; Fe_2O_3 and Al_2O_3 , 2.32; CaO, 1.23; MgO, 1.33; K_2O , 0.11; P_2O_5 , 0.30. The mean results obtained were, numbers being kilos. per hectare:—

Manuring.	Yield.
Without manure	10,213
100 of Chili saltpetre	11,569
200 " 	11,867
75 of ammonium sulphate	10,250
100 " 	10,475
150 " 	10,800
200 " 	11,575
37.5 of ammonium sulphate, 50 of Chili saltpetre	10,577
50 " 50 " 	10,530

IN no instance did the ammonium sulphate cover its cost by the increase of crop produced by it; the nitrate, on the other hand, was remunerative in small quantities.

Ammonium sulphate proved better with oats on a humous sandy soil which had received a dressing of superphosphate, the results being as follows, numbers as before:—

Manuring.	Yield.	
	Straw and Chaff.	Grain.
Unmanured	2,812	1,562
100 of Chili saltpetre	4,127	2,631
200 " 	4,700	2,517
75 of ammonium sulphate	3,883	2,692
150 " 	4,160	2,473
37.5 " 	3,720	2,618
50 of Chili saltpetre		

The beneficial action of the ammonium sulphate is attributed to the wetness of the season.

In both series of experiments the saltpetre contained 16 per cent. of nitrogen, the ammonium sulphate 20.1 per cent.—D. A. L.

Experimental Cultivations with German and Russian Reproductions of the Sugar Beet (Fimbrin blanche améliorée). F. Kudełka. Deutsche Zucker-Ind. 1888, 423—424.

IN Germany the plants for seed are grown with artificial manures, but in Russia this is not the case. Three samples of Russian seed and two of German were all cultivated in five different places: four of these soils were deep black earth, and had grown wheat or buckwheat as previous crops, the fifth soil had grown clover. In all cases the beet were drilled in rows 14 inches apart, and the plants 10 inches from one another. The crops obtained from the Russian seed were nearly as good as those from the German seed.

—D. A. L.

Dry-decay of Potato Stems. P. Sorauer. Oesterr. landw. Wochenbl. 1888, 264.

THE author draws attention to a comparatively new and little known potato disease. When attacked by "wet-rot" potato stems become brown, the leaves black, and the plant putrid, whereas in the new disease individual stalks and tubers sicken, in the midst of healthy ones, on the same plant, the former becoming dry and decayed. It originates from a fungus hailing from the uppermost layers of the soil; the stems are attacked at a point in contact with the soil, and the disease spreads upwards and downwards, intercepting the sap and preventing its upward progress with consequent starvation of the affected stem. If the roots or tubers be attacked all further green growth ceases. Luxuriant haulms and loose cell tissues are favourable for the penetration of the fungus into the rind of the stem. In wet weather white warts appear on the stems; these loosen the cell tissue and prepare the way for the fungus. Increased aeration is the natural means of combating this fungus, and when practicable the potatoes should be pulled.—D. A. L.

On the Soils of Algeria. A. Ladureau. Compt. Rend. 107, 1154—1155.

AFTER a course of travels in Algeria for the purpose of examining the composition of the soils, the author concludes that the inferiority of cereal crops in the colony is due to insufficiency of phosphoric acid in the soil. The following figures in grms. per kilo. of dry earth are indicative of the

result of numerous careful estimations which were made in duplicate.

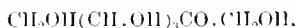
	Highest.	Lowest	Mean.
Department of Alger	1.97	0.26	0.76
„ „ Oran	1.37	0.23	0.54
„ „ Constantine ..	1.25	0.30	0.69
General average for Algeria ..	0.68		..

—G. H. B.

XVI.—SUGAR, STARCH, GUM, Etc.

The Constitution of Sorbinose. H. Kiliani and C. Scheibler. Ber. 21, 3276—3281.

SORBINOSE, like levulose, is inactivated upon when treated with bromine and water at the ordinary temperature; hence it does not contain the aldehyde group. With hydrocyanic acid, sorbinose combines readily, but the compound could not be obtained in a crystalline form, and it decomposes very readily into its components. Oxidised with nitric acid (sp. gr. 1.39) at 35 for 40 hours, a small quantity of a dibasic acid results; this acid possesses no reducing properties, and, therefore, contains neither a ketone group nor two hydroxyl groups attached to one carbon atom. An analysis of the potassium salt of the acid agrees with the formula $C_8H_6K_2O_7$, and the crystalline form of this salt is identical with that of the potassium salt of trihydroxyglutaric acid obtained by Kiliani as an oxidation product of arabinose (Ber. 21, 3006). The constitutional formula of this acid is $CO.OH(CH.OH)_3.CO.OH$, and hence sorbinose is a ketone alcohol of the formula—



Dessaigues previously obtained a dibasic acid ($C_8H_6O_7$), called by him aposorbic acid, by the oxidation of sorbinose with nitric acid. Its melting point (110°) differs from that of the acid obtained by the authors (127°). Sodium amalgam acts on sorbinose, forming an amorphous product; with red phosphorus and hydriodic acid a hexyl iodide results.—C. A. K.

The Pectins of the Sugar Beet. J. Weisberg. Chem. Zeit. 13, 2.

UNDER this heading reference was made in the Chem. Zeit. Rep. 1888, 335, to a communication by the author which appeared in *La Sucrerie Belge*, 1888, 17, 109, in which he believes to have shown that the dextro-rotary substances extracted by water from beets previously exhausted by alcohol, give on hydrolysis, as chief product, arabinose. On this formation of arabinose, the author based his views as to the nature of these bodies extracted by water. In the present communication, the author brings forward further arguments to prove the correctness of his conclusions. Although unable to separate the arabinose in a state of purity, the author considers its formation to be sufficiently proved by means of the special reactions mentioned in the original memoir.

When exhausted beets are boiled with milk of lime, levo-rotary calcium metapectate (arabinates) is obtained; this was first shown to be the case by Scheibler. Metapectic acid when boiled with sulphuric acid yields chiefly arabinose, which was also proved by Scheibler. Beets previously exhausted with alcohol, when simply heated with water, yield at first a neutral solution, which gradually becomes acid. On boiling this with milk of lime for a considerable period, a portion of the dissolved dextro-rotary substance is precipitated, the rest remaining in solution as calcium salt. This solution is levo-rotary, and contains calcium metapectate, i.e., the calcium salt of the acid which must

give arabinose on hydrolysis. This metapectic acid, however, can only have been formed from bodies of the same class. These are pectin and metapectin, which dissolve when exhausted beets are treated with water, and as such, are completely precipitated by milk of lime and basic acetate of lead. On prolonged heating they are converted into metapectic acid, which is not precipitated by basic acetate of lead in excess, and after filtration the solution is slightly levo-rotary.

On these grounds it follows that the views put forward by the author, as regards the nature of the dextro-rotary substances contained in exhausted beets, are correct.

—H. T. P.

PATENT.

Improvements in or relating to the Manufacture or Purification of Gums and Gum Resins. W. H. Stead, Liverpool. Eng. Pat. 245, January 6, 1888. 6d.

Dextrine, or some other cheap adhesive material, is dissolved in sufficient water to form a not too viscous liquid, shaken up with, or filtered through, animal charcoal or similar clarifying material, and concentrated to a suitable consistency either at the atmospheric pressure or in a vacuum pan; the charcoal is preferably dried by exposure to a temperature of about $300^\circ F$. immediately before use. The gum may be rendered transparent by the addition of a little nitric acid.

It is claimed that the product is free from offensive taste and smell, while its adhesiveness is unimpaired.—B. B.

XVII.—BREWING, WINES, SPIRITS, Etc.

Copper in Wine. Frühauf and Ursié. Le Staz. Speriment. Agr. Ital. 1888, 704. Sestini and Tobler. *Ibid.* 379.

WINES obtained from vines which have been treated with copper salts to prevent attacks of the peronospora contain, according to Frühauf and Ursié, at the most 0.25 to 0.28 mgrm., and at the least 0.01 to 0.02 mgrm. per litre; in only one instance did they find such a wine free from copper. In these determinations the copper was separated electrolytically. Sestini and Tobler point out that such wine does not contain more than 0.25 mgrm. of copper per litre, and is, therefore, harmless even if consumed every day.

—D. A. L.

PATENTS.

Improvements relating to the Treatment of Beer Wort, and to Apparatus therefor. C. Hoffmann and L. Ebert, Thuringen, Germany. Eng. Pat. 2059, February 19, 1888. 8d.

This invention relates to apparatus for sterilising and cooling beer wort, whereby it is kept completely protected from any injurious action of the micro-organisms of the air during the whole cooling process, from the time it leaves the copper until it enters the fermenting vat.

The apparatus consists of (A) a wort sterilising and filtering vessel in combination with (B), a circular wort refrigerator enclosed in a casing which can be hermetically closed, and also with (C) an air-cooling, drying, and filtering apparatus.

The wort after boiling in the copper is run direct, hops and all, into the sterilising vessel containing only sterilised air; here it is again boiled for a short time, and left to rest for about an hour so as to allow the hops to settle out at the bottom of the vessel, and serve as a filtering medium for the supernatant liquor; from here it is run into the cooling vessel, sterilised air under pressure at the same time being introduced. The wort by this means becoming thoroughly

aerated and cooled to the necessary degree, is run free from turbidity and micro-organisms into the fermenting vessels. Descriptive drawings of the apparatus are given.—J. H.

Improvements in the Manufacture of Brewers' Finings, and in Machinery and Apparatus therefor. E. Thatcher, Nailsea. Eng. Pat. 3193, March 2, 1888. 8d.

According to this invention, the isinglass or other material from which the finings are extracted is, with the proper quantity of water, placed in a barrel or tub. In this is immersed a perforated cylindrical vessel, to which rotary motion is imparted, the vessel being supported in a frame, which is clamped or otherwise secured to the barrel or tub. Through orifices in the cover of the cylindrical vessel the contents of the barrel are admitted thereto, and as the vessel rotates the contents are expelled by centrifugal force through the perforations in the sides. The finings are thus strained in passing out of the cylindrical vessel back into the barrel or tub.—J. H.

An Improvement in Brewing. B. W. Valentin, Birmingham. Eng. Pat. 3754, March 10, 1888. 4d.

When wort is drawn off from the mash tun it holds in solution certain nitrogenous substances, which, under some circumstances, tend to make the finished beer turbid. This invention relates to a simple means of preventing this, by getting rid of the objectionable portions of such nitrogenous substances in the following manner: the whole of the wort is drawn off from the mash tun, and heated to 180° F.; by this means a change is effected in the nitrogenous matter, such that when the wort is again cooled to 150° F., this matter becomes separable from the wort, which is then passed through the grains from which it was obtained. These, acting as a filter, allow the pure wort to pass through, but retain the most objectionable of the nitrogenous substances.—J. H.

Improvements in the Manufacture of Saccharine Liquors for Brewing and other Purposes. J. Grass, G. C. Heilmann, and O. Olme, London. Eng. Pat. 13,531, September 19, 1888. 4d.

This invention consists in the manufacture of ordinary glucose from rice, maize, sago, &c., the sulphuric acid usually employed being replaced by nitric acid in similar proportions (2 per cent.). As soon as the conversion is complete, the nitric acid is removed by the addition of a certain quantity of "disulphide of lime," the mass then boiled for 15 minutes, and neutralised by carbonate of lime, when every trace of nitric acid is said to be removed. It is claimed that a purer and cheaper production results from this process, containing "neither dextrin nor other impurity."—J. H.

Improved Filtering Apparatus. H. H. Leigh, London. From B. E. Gasquet and H. E. Gaulne, Bordeaux, France. Eng. Pat. 13,625, September 20, 1888. 8d.

This apparatus, adapted to the filtration of wines, &c., consists of filtering cloths placed between corrugated metallic gratings, and held apart by perforated rings, the said cloths, gratings, and rings being built upon layers about a central cylinder consisting of a perforated and winged chamber.—E. G. C.

Improvements in Apparatus for the Manufacture of Malt. H. H. Lake, London. From J. W. Tree, Boston, U.S.A. Eng. Pat. 16,885, November 20, 1888. 1s. 1d.

This invention relates to a malt-growing and drying apparatus having a series of stirring buckets or rotary lifting devices arranged upon a horizontal shaft carried parallel to the floor, upon which the grain or malt rests, and which stirring buckets may be varied as to the degree or extent of their lifting capacity. The invention further relates to the

employment of a scraper for removing the malt from the malting floor through a trap door in the floor, and to various details of organisation and construction, all of which are fully illustrated by means of several drawings.

"The operation of the machine is as follows:—The grain or malt is introduced into the malting chamber, which is cylindrical in shape, covering the floor thereof to the depth of a number of inches, and when desired for the purpose of assisting in the malting process, the mass of grain or malt is stirred, broken up, and separated by the movement of the buckets through the mass; the buckets advancing in a line and rotating lift the grain or malt from the floor of the chamber in comparatively small quantities, and by lifting blades which deposit in a broken, separate condition, and in a new relation to the rest of the malt, and to the floor of the machine."

"This changing of the mass continues as long as may be desired," and "may be used in connexion with all the various stages of the treatment of the grain."

The apparatus can also be applied to an oblong floor by altering its construction somewhat.—J. H.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A)—CHEMISTRY OF FOOD.

PATENTS.

An Improved Method of Preparing Ferment of Rennet. F. Graeff, Alkmaar, Holland. Eng. Pat. 16,652, December 3, 1887. 4d.

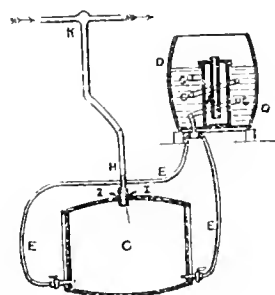
"A pure and clear solution of the ferment, not containing above 10 per cent. of table salt, is evaporated to dryness in vacuo at a temperature not exceeding 40° C. The residue is reduced to powder, which is thereupon washed with concentrated solution of table salt in view of removing the colouring matter present." The product is dried again and mixed "with an innocuous soluble salt—for instance, with table salt."—E. G. C.

An Improved Process of Preserving Eggs. H. H. Lake, London. From F. Tiedemann, Copenhagen, Denmark. Eng. Pat. 1653, February 3, 1888. 8d.

Carbon dioxide, dried by calcium chloride and sulphuric acid, is introduced into the receptacle containing the eggs. The carbon dioxide is said to penetrate through the pores in the shell of the eggs, and when the eggs are removed keeps the eggs fresh.—E. G. C.

Apparatus to be Employed in Effecting the Preservation of Fruit, Vegetables, Meat, Fish, and other Perishable Articles of Food. W. Peacock, South Melbourne, Australia. Eng. Pat. 2426, February 17, 1888. 8d.

The apparatus described is intended to carry into effect the process of preserving perishable articles of food described in Eng. Pat. 11,233 of 1885. (This Journal, 1886, 104.)



A is a leaden vessel in which sulphur is burned for the production of sulphurous acid; C a cooling worm immersed in water in tank D; G is the receptacle for the fruit or other material, into the lower part of which the sulphurous acid is conducted by flexible pipes E; H is a pipe sealed by the rubber-flap I, passing from G to an exhaustor K, which, when the apparatus is in work, removes the air from G and draws in the sulphurous acid formed in A.

—C. C. H.

An Improved Process for Manufacturing Conserved Meats.

H. Stachelhaus, Ruhrort-on-Rhine, Germany. Eng. Pat. 16,335, November 10, 1888. 4d.

THE object of the inventor is the production of a preserved meat in which the meat fibre, jelly, and fat are all present in their normal proportions and without separation. Meat from an animal recently slaughtered and still warm is beaten thoroughly until pliable, minced finely, and allowed to cool for two days at a temperature of 5° to 8° C. It is again minced, mixed intimately with any other flesh similarly treated,—e.g., beef may be mixed with pork,—put into tins, hermetically sealed, and immersed in a water-bath having a temperature of 87° to 93° C. Thus prepared the meat retains its normal proportions of fibre, jelly, and fat.

—C. C. H.

(B)—SANITARY CHEMISTRY.

The Supply of Water from Wells, and its Hygienic Aspect. F. Hueppe. Journ. f. Gasbel. 1889, 15—23.

UNTIL quite recently, when examining a water for hygienic purposes, it has been the custom to ask: Is the water deleterious to health, and how may its impurity be detected?

from the prevention standpoint only. This plan demands a water supply and a method of distribution which absolutely negatives pollution or infection at any stage. Underground water is the best on all accounts, since Nature provides for its purification and disinfection. To obtain a pure supply the well should be built in a proper manner, and the author indicates the following plan of construction:—(1.) The ground surrounding the well should be paved, and should slope gently downwards on all sides, so that all dirty water, &c. may be carried away from the well. The pavement may consist of cement Pl¹, or of slabs of stone, St. (See drawing.) (2.) The water-tight inner wall, pl, of the well should project above the ground to a height of at least 15 cm. (3.) The well should be securely closed by means of a stone cover, Pl, laid in cement, on the crown of the well pl; a cast-iron lid might also be used. The cover should gently slope downwards, and ought to project over the edge, pl, of the well. The cover must be provided with a hole, L, for the purposes of ventilation. To prevent contamination entering through this opening, the (4.) body of the pump Brll must be tightly fitted over it, so that communication with the outer air can only take place through the ventilator V, which is covered with wire gauze. (5.) The excess water flowing from the spout BrA must be carried away from the pump through b, on to the slanting pavement Pl. (6.) The inner wall of the well must be water-tight to a depth of at least 6 metres; for the author has shown that below this depth no micro-organisms capable of development exist in soil. Preferably, however, the well is made water-tight right down to the water-bearing strata, so that water can enter the well only at the bottom. The whole of the wall may be built of cement or Beton; or quarry stones M¹ or well-burnt bricks M² laid in mortar may be used, the whole of the inside being smoothed over with cement. The space between the soil E¹ and E², and the well-shaft M¹ and M², is finally filled up with clay or loam, or even cement, thus making the well perfectly water-tight.

—H. T. P.

PATENTS.

Improvements in Apparatus for Treating Sewage and other Impure Liquids by Electrolysis. W. Webster, junior, Blackheath. Eng. Pat. 472, January 11, 1888. 8d.

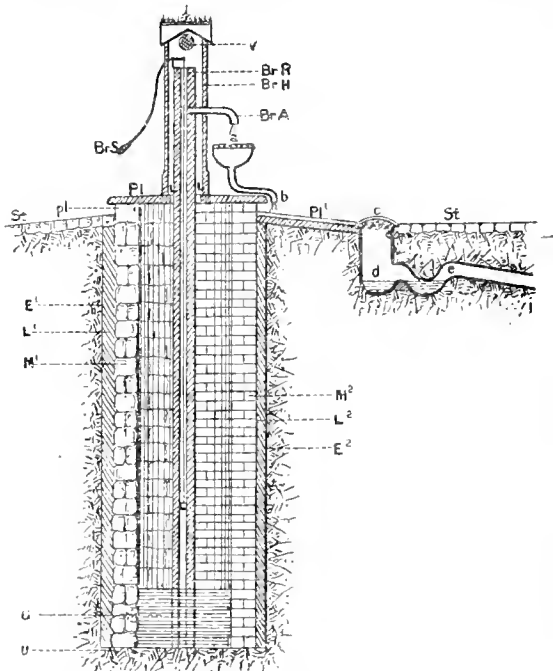
IMPROVEMENTS ON Eng. Pat. 1333 of 1887 (this Journal, 1888 441), which consist (1) in arranging a number of separate tanks with their electrodes connected in series with the main conductor; and (2) in arranging the electrodes in groups, the electrodes of each group being arranged in parallel circuit, while the several groups are connected in series, the objects being to diminish resistance and economise the electricity.—O. H.

Improvements in the Means or Appliances for Treating Sewage by Electrolytic Action and for Disposing of the Deposits thereof. W. Webster, junior, Blackheath. Eng. Pat. 1105, January 24, 1888. 8d.

FOR the iron plates described in Eng. Pat. 1333 (this Journal, 1888, 441) the inventor now substitutes aluminium wholly or in part, or "cast-iron plates in which pieces of graphite or other carbon are embedded by throwing them in just before cooling." The effluent is sometimes sent through a filtering chamber containing carbon electrodes. The walls and partitions of the tanks and sewers are made of ironstone, or of red or brown hematite. The sludge is mixed with lime refuse, for making land. (See also this Journal, 1888, 764; and 1889, 58.)—O. H.

Improved Construction and Arrangement of Apparatus for the Separation of Liquids and Semi-Liquids from Solids, especially applicable to Sewage, Sludge, Slip, Slurry, and other like Bodies. R. Muirhead, Maidstone. Eng. Pat. 1884, February 8, 1888. 11d.

THE improved apparatus used for the separation of liquid from solid matters consists of a rectangular box with two or more sides removable. One of these sides is used as



This question is exceedingly difficult to answer. The principal expeditions bacteriological methods in use have many faults. The micro-organisms which are at the bottom of many diseases are yet unknown, and many other organisms, though known, are not developed, and are therefore not discovered under the conditions employed in these bacteriological methods. The author is therefore of opinion that "prevention is better than cure;" and he strongly insists that the question of water supply shall be considered

a tube plate, and carries a number of tubes of cylindrical or other shape in cross-section, the sides perforated or otherwise constructed with filtering passages or slits, and sometimes covered with a stocking or bag of textile material, or the interior packed with porous or fibrous filtering substance. The sides of the box are forcibly held in position by a variety of devices illustrated, and in some cases the whole box may be swung on trunnions. The substance treated is forced into the interior of the box; the solid matter becomes compacted into a mass forming on the exterior of the tubes, and the liquid filtering into the interior of the tubes is conveyed to the outside of the machine by a suitably formed channel. Appropriate devices for the removal of the solid block, formed as described, from the interior of the tank, are shown.

—C. C. H.

Improvements in Treating Decomposed Organic Substances for rendering them Innocuous, and Apparatus therefor. G. F. Redfern, London. From E. Senorans, Paris, France. Eng. Pat. 4215, March 19, 1888. *8d.*

THE faecal or organic matter is placed in a receiver and reduced to a thin pulp by the action of steam. After being run into a second vessel it is mixed with an absorbent material, *e.g.*, burnt bones, ashes, or earth; the liquid portion may be drained off and evaporated, the more solid material being dried in the receiver by steam coils.—C. C. H.

Improvements in the Means Employed for Purifying Sewage and other Water. B. Jagger, Leeds. Eng. Pat. 9312, June 26, 1888. *6d.*

ASH-RTT refuse, road scrapings, or refuse containing animal or vegetable matter, is carbonised in a kiln, and used either as a deodorant for mixing with faecal matter or as a defecating agent for sewage.—C. C. H.

Improved Methods and Apparatus for the Treatment of Human Excrement and other Feculent Matter. H. H. Lake, London. From J. Hirshfield, Philadelphia, U.S.A. Eng. Pat. 17,793, December 5, 1888. *8d.*

THE apparatus consists of an improved closet or vessel for the reception of faeces. The interior is provided with a perforated receiver which retains the solid matter, the liquid from which, together with the urine, is filtered and partially absorbed by a bed of filtering media in the lower part of the apparatus, and from thence by a pipe to the sewer. This consists of a mixture of clay and alum. Mechanism is also shown which, after each use of the closet, projects on to the faeces deposited a charge of deodorant, consisting of a mixture of pulverised slag, coke, and sulphate of lime and magnesia or the like.—C. C. H.

(C)—DISINFECTANTS, &c.

PATENT.

Improvements in Mixtures or Curatives applicable for the Destruction of the Bacilli or Microbes of Consumption and other Diseases or Virulent Ailments, and in Apparatus for producing and applying said Curatives. W. H. Davies and G. Brighthouse, Liverpool. Eng. Pat. 3511, March 7, 1888. *8d.*

THE authors find that the combined use of phenol or its homologues and ozone will destroy the bacillus of consumption, &c., as well as of blood poisoning. This is applied either by ejecting phenol into the atmosphere breathed by the patient in the form of a spray by means of ozone, similarly to an ordinary scent spray, or a current of ozone may be passed through phenol in a receiver, and inhaled therefrom.—C. C. H.

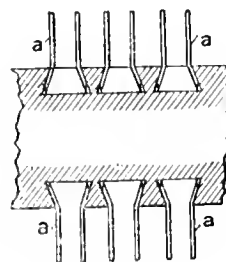
XIX.—PAPER, PASTEBOARD, Etc.

PATENTS.

Improvements in Machines for the Production of Wood Fibre. P. A. Newton, London. From R. Steinmig, Grossbolkau, Germany. Eng. Pat. 2046, February 10, 1888. *11d.*

INSTEAD of using grindstones for the production of mechanical wood pulp, as hitherto, the inventor uses a specially prepared grinding machine, consisting of a wooden or metal disc, the peripheries or sides of which are covered with a number of cutting edges made from steel or other hard metal, securely fastened by means of wooden wedges (Fig. 1).

Fig. 1.



The cutting edges may be of different forms, as shown by the sections (Fig. 2), and they should project from the

Fig. 2.



surface of the disc to about one inch, and at such a distance from each other that they do not touch when bent by the pressure of the wood against them.

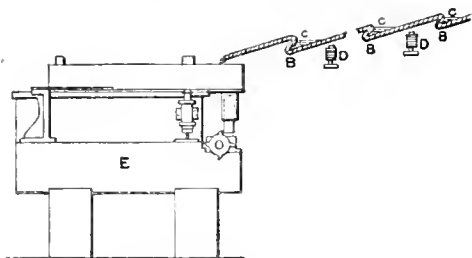
Such an arrangement is said to give a long soft flexible fibre at small cost for labour.—E. J. B.

Improvements in or relating to Aseptic or Antiseptic Paper and the like, applicable for Use as Bandages for Wounds, or for Hygienic or Preservative Purposes. W. P. Thompson, Liverpool. From P. Matcovitch and A. Grossich, Fiume, Hungary. Eng. Pat. 7854, May 29, 1888. *6d.*

THIS specification relates to the manufacture of aseptic paper from 75 per cent. of linen and 25 per cent. of cotton, the pulp being washed in an alkaline solution, and subsequently treated with chlorine water, alcohol, "phenic acid," &c. The antiseptics used are iodoform, corrosive sublimate, thymol, carbolic acid, salol, picric acid, salicylic acid, and the like.—E. G. C.

Apparatus for removing Metallic Particles from Paper Pulp. H. H. Lake, London. From C. H. Atkins, Boston, U.S.A. Eng. Pat. 17,227, November 27, 1888. *8d.*

THE pulp is made to flow, on its way to the pulp vat E, along a copper trough A, the recesses, B, of which are filled with mercury. Below the trough are placed a number of electro-magnets, D. The latter remove from the



pulp any magnetic particles, such as fragments of steel or iron, while the mercury retains any particle of brass, copper, or bronze.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Ammonium Bromide. K. Thümmel. Arch. Pharm. 1888, 26, 1124.

ACCORDING to the German Pharmacopœia (H.), ammonium bromide should not redden litmus paper. The author finds, however, that ammonium bromide, prepared in a variety of ways, invariably reddens litmus paper, either when simply placed upon the paper, or when tested in a 1:5 solution. He further finds that by the action of bromine upon ammonia, nitrogen is evolved and ammonium bromide alone formed, as long as ammonia is in excess, a statement which is contradictory to the observation of E. Schmidt (Pharm. Chem. 1, 484) that by this means a small quantity of an oxygenated product results.—C. A. K.

Basic Bismuth Nitrate (Bismuthum subnitricum, B.P.). F. Belliogròdt. Apoth. Zeit. 1889, 4, 29.

THIS product, as obtained from the best German manufacturers, has been found to contain so much lead, that the presence of the latter is rendered evident by the taste.

—C. A. K.

Iodoform. B. Fischer. Pharm. Zeit. 1889, 34, 31.

THE author has examined into the cause of the pink colouration acquired by iodoform when dissolved in ether, &c., and finds that the ethereal solution of perfectly pure iodoform acquires a dark tint under ordinary conditions. But if the iodoform and the solvent be freed from air, the solution is of a pale yellow colour as long as air is completely excluded; this solution darkens immediately it is exposed to air, owing to the separation of free iodine. Certain impurities, either in the iodoform or in the solvent, appear to hinder this decomposition; in samples of iodoform containing amylalcohol, pyridine bases, and acetamide respectively, the darkening of the ethereal solution was not observed, so that in all probability these substances either take up the oxygen (from the air) in the solvent, or else the separated iodine.—C. A. K.

The Alkaloids of the Areca Nut. E. Jahus. Ber. 21, 3404—3409.

THE areca or betel nut is the fruit of the areca palm (*Areca catechu*), and is an important article of commerce. It contains tannin, fat, and alkaloid substances. The latter are extracted as follows:—The powdered seeds are extracted three times in the cold with water to which 2 grms. of concentrated sulphuric acid are added for every 1 kilo. of seed.

The filtrate is evaporated, and after filtration, potassium bismuth iodide, and sulphuric acid added. The red crystalline precipitate is decomposed with barium carbonate and water. The alkaloids dissolve, whilst bismuth oxyiodide, colouring matter, &c., remain undissolved. The filtrate is evaporated, baryta solution added, and extracted with ether. The latter extracts an oily substance called *arecoline*. The residue is neutralised with sulphuric acid, and the remaining alkaloids extracted by treating successively with silver sulphate, baryta, and carbonic acid, and extracting the dry residue with absolute alcohol or chloroform. A second alkaloid goes into solution, and a third, *arecaine*, remains undissolved. The yield of *arecoline* is '07 to 1 per cent., of *arecaine*, '1 per cent.

Arecoline is a colourless oily liquid with a strongly alkaline reaction soluble in the usual solvents. It is volatile, and distils at about 220°. The hydrobromide has the formula $C_8H_{13}NO_2 \cdot HBr$. The hydrochloride forms double salts with auric and platonic chlorides.

It acts as a strong poison. *Arecaine* forms colourless crystals soluble in dilute alcohol and water. It contains one molecule of water of crystallisation which it loses at 100°. Its formula is $C_7H_{11}NO_2 + H_2O$. Like *arecoline* it forms double salts with platonic and auric chlorides.

—J. B. C.

Preparation of Concentrated Formic Acid. M. Maquenne. Bull. Soc. Chim. 1888, 662—664.

THE author finds that, although formic acid is decomposed by sulphuric acid into carbon monoxide, the reaction only occurs when both acids are concentrated, and that dilute formic acid may be distilled, under diminished pressure, over concentrated sulphuric acid without decomposition. For instance, commercial formic acid containing 45—50 per cent. of water, on distilling on the water-bath with an equal weight of strong sulphuric at 66° B., yields formic acid of 84—85 per cent., and a second distillation yields an acid of 98 per cent. strength. The lower the temperature at which the acid is distilled the better, and the less the acid carried away by the exhauster. A certain quantity of more dilute formic acid remains behind in the retort, and may be further concentrated.—J. B. C.

The Manufacture of Iodoform. H. Suilliot and H. Raynaud. Bull. Soc. Chim. 51, 3—4.

THE authors base their process on the reaction between acetone and iodine, and by the use of hydrochlorite at a later stage, practically recover the whole of the iodine in the final product. One molecule of acetone and six of iodine in presence of sodium hydrate yield one molecule of iodoform, one-half of the iodine forming sodium iodide. If sodium hypochlorite be then added, a further molecule of acetone is attacked, yielding iodoform. There is no formation of chloroform or iodate. The mode of procedure is to dissolve 50 parts of potassium iodide, six parts of acetone, and two parts of sodium hydrate, in one or two litres of cold water. On adding to this a dilute solution of sodium hypochlorite, drop by drop, with agitation, a precipitation of iodoform ensues, which agglomerates rapidly. The hypochlorite is added until all acetone or iodine has disappeared. The results are close on the calculated quantities. As the presence of neutral salts of the alkalis do not interfere with the reaction, crude caustic liquors may be used, if previously freed from sulphides, sulphites, &c. The liquor decanted from the precipitate contains only traces of iodine.

—G. H. B.

On the Employment of Low Temperature in the Preparation of Pharmaceutical Extracts. L. A. Adrian. Bull. Soc. Chim. 1889, 234—240.

THE advantage of employing methods of freezing for the concentration of solutions of organic substances has long been recognised by many investigators whose views are cited in this article, and the author is engaged in working out a method for operating on an industrial scale in the

production of extracts sufficiently concentrated to be suitable for further evaporation in the vacuum apparatus described and illustrated on pages 184–185. The extracts as obtained by the usual methods (maceration, infusion, &c.) in dilute aqueous solution are submitted to a low temperature until the greater part of the water separates in the form of ice, leaving the dissolved substances in that portion which remains liquid; but the separation is always more or less imperfect, as the ice in the process of formation occludes much of the mother-liquor. The author has aimed at improving the means of separating the ice from the liquid portion, and uses a machine on the ammonia system for operating on 200 kilos. of liquid at one time. The filtered solution is placed in moulds and submitted to cold until the frozen blocks have a temperature of -10°C ., and are then very hard. The blocks are then removed and placed in a crushing machine of special construction which, in less than a minute, reduces them to the condition of snow. This snow is transferred to an apparatus which, in about 20 minutes, separates 75 per cent. of the water in the solid state and almost free from dissolved matters, whilst the liquid portion is again treated as before but at a still lower temperature. (No description is given of the apparatus employed.) Two congelations yield 12 to 15 per cent. of the original solution in the form of a syrupy extract, which is concentrated to the desired degree in the vacuum apparatus. The avoidance of high temperatures and of loss of time in all the operations tends to preserve the original potency of the organic principles in the extract, and the author believes that, should the process become generally employed, it will become necessary to verify experimentally the activity of many extracts so obtained; for example, of belladonna, hyoscyamus, hemlock, &c.

—G. H. B.

On the Active Principle of *Strophantus glabre*.

M. Arnaud. *Compt. Rend.* **107**, 1162–1164.

The author described recently two crystallised substances, ouabaine, $\text{C}_{20}\text{H}_{36}\text{O}_{12}$, obtained from the wood of *Acokanthera Ouabaïto*, and strophantine, $\text{C}_{31}\text{H}_{44}\text{O}_{12}$, from the seeds of *Strophantus Kombé*. (This Journal, 1888, 586.) He has since examined the crystallised substance contained in the seeds of *Strophantus glabre* of Gabon, which furnish the arrow poison of the Pahouin tribe. This principle appears to be identical with ouabaine, which exhibits toxic effects almost identical with strophantine. Hardy and Gallois have also described a crystallised substance from *Strophantus glabre*, but imperfectly for want of material. These substances are glucosides, and low temperatures must be adhered to in the extraction in order to avoid decomposition. The crystals of glucoside from the seeds of *Strophantus glabre* (which gave the remarkably high yield of $\frac{1}{2}$ –7 per cent.) are transparent, very slender, and of rectangular form; by slow crystallisation they are thicker and become opaque. The melting point is about 185°C ., but a pasty condition obscures the exact point of fusion. The crystals dissolve in 150 parts of water at 8°C .. The aqueous solution exhibits left-handed polarisation, and a solution containing 6.5 per cent. at 50°C ., gave the coefficient $\alpha_D = -33.8$. Under the influence of dilute acids and heat the substance splits up into a reducing sugar and a peculiar insoluble resin. The crystals of ouabaine have the formula $\text{C}_{20}\text{H}_{36}\text{O}_{12} \cdot 7\text{H}_2\text{O}$, of which only six molecules of water are given off at 100°C .—G. H. B.

Ouabaine. M. Arnaud. *Bull. Soc. Chim.* **51**, 10–11.

THIS paper is substantially a shortened report of the above, with the additional information that ouabaine is an ether of isodulcite, whilst strophantine yields glucose on splitting up the glucoside.—G. H. B.

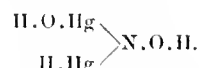
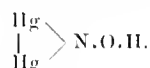
Notes on Mercury-Ammonium Compounds. C. Rammelsberg. *J. Prakt. Chem.* **38**, 1888, 558–569.

1. *Mercuric Oxide and Ammonia*.—Yellow amorphous mercuric oxide was employed for the experiments. If gaseous ammonia be allowed to act upon it at common

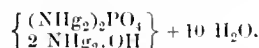
temperatures, a pale yellow product is obtained, the analysis of which corresponds with the formula $2\text{HgO} + \text{NH}_3$. This compound is very stable, and does not lose any ammonia in the air or on boiling with water. Even strong bases, like sodium hydrate, liberate, on continued boiling, only 0.23 per cent. of ammonia. Kept over time, concentrated sulphuric acid or phosphorus pentoxide, the loss in weight becomes constant after some time, and the substance assumes a light-brown colour. The weight lost indicates that $2\text{HgO} + \text{NH}_3$ liberates one molecule of water on drying, and is thereby converted into Hg_2ONH . It is very probable that $2\text{HgO} + \text{NH}_3$ is the hydrate of mercuric-ammonium hydroxide, thus: $\text{NH}_2\text{Hg}_2\text{OH} + \text{H}_2\text{O}$. It presents all the properties of a base, as will be seen further on. If mercuric oxide be treated with ammonia-liquor in the heat or in the cold, a pale yellow product is obtained, which is usually called "Millon's base." According to Millon it has the formula $2\text{HgO} + \text{NH}_3 + \text{H}_2\text{O}$, whereas the analysis of the author points to the formula $3(2\text{HgO} + \text{NH}_3) + 2\text{H}_2\text{O}$. Dried over sulphuric acid, it loses its water and becomes identical with the base obtained by the dry method. But whereas the latter loses its water, if dried at common temperatures, Millon's base loses under similar conditions, at first only $\frac{2}{3}$ ths of its water, and the rest on warming only. Millon's base, therefore, retains a portion of its water more firmly than the base produced by the dry method. However, both bases yield with acids identical salts. The two compounds may have a different constitution; thus—

Base by dry method.

Millon's base.

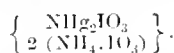


2. *Mercury-Ammonium Chloride*.—Dilute hydrochloric acid changes the two bases into an insoluble yellow chloride. It is also obtained by boiling the so called "white precipitate" with water or sodium hydrate. It has the formula $\text{NH}_2\text{Hg}_2\text{Cl} + \text{H}_2\text{O}$. Its water is only completely given off at 200°C . 3. *Double Salts of Mercury-Ammonium Chloride and Ammonium Chloride (White Precipitate)*.—Mercury-ammonium chloride combines with ammonium chloride in two proportions. Both compounds are called white precipitate. They are decomposed by warm water, ammonium chloride going into solution and mercuric-ammonium chloride being left behind. The compound of the latter with one molecule of ammonium chloride does not fuse on heating, and is called "infusible precipitate," whereas the compound containing three molecules of ammonium chloride fuses on heating, and is termed "fusible precipitate." The latter can be made from the former by boiling with ammonium chloride solution. Amorphous mercuric oxide and Millon's base are converted into fusible precipitate by boiling with ammonium chloride. 4. *Mercury-Ammonium Sulphate*.—Millon's base changes on boiling with dilute sulphuric acid into an insoluble pale yellow sulphate, which turns grey in the light. Its formula is $(\text{NH}_2\text{Hg}_2)_2\text{SO}_4 + 2\text{H}_2\text{O}$. 5. *Mercury-Ammonium Nitrate*.—If the mercury-ammonium base be heated with dilute nitric acid, it forms a yellow insoluble nitrate of the formula $\text{NH}_2\text{Hg}_2\text{NO}_3$. It appears to be identical with the product obtained by treating mercuric oxide with a solution of ammonium nitrate. 6. *Mercury-Ammonium Carbonate*.—The base boiled with a solution of sodium carbonate forms a white carbonate (normal), $(\text{NH}_2\text{Hg}_2)_2\text{CO}_3 + 2\text{H}_2\text{O}$. It is also obtained from mercuric oxide and ammonium carbonate. 7. *Mercury-Ammonium Phosphate*.—Boiled with an excess of phosphoric acid, the base is converted into a yellow phosphate, which becomes grey in the light. It is a basic salt and has the formula—

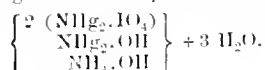


8. *Mercury-Ammonium Bromate*.—If ammonia be added to a solution of mercuric bromate, a yellow precipitate is obtained which has the formula $2(\text{NH}_2\text{Hg}_2\text{BrO}_3) + 3\text{H}_2\text{O}$. On heating it is decomposed with a loud detonation. 9. *Mercury-Ammonium Iodate*.—Amorphous mercuric oxide, digested with aqueous iodic acid, is rapidly converted into a white iodate, HgI_2O_6 . If the latter be heated with ammonia-

liquor it turns yellow. The analysis of this yellow product presents great difficulties and the figures obtained point to the formula—



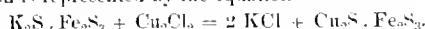
10. *Mercury-Ammonium Periodate*.—Mercuric oxide treated with periodic acid in excess, is changed into pentamercurey periodate $\text{Hg}_5\text{I}_2\text{O}_{12}$. The latter, digested with ammonia, yields a light yellow substance, the analysis of which is very difficult. The figures obtained point to the formula—



—S. H.

On the Action of Cuprous Chloride on Iron Potassium Sulphide and the Preparation of Artificial Copper Pyrites. R. Schneider. J. Prakt. Chem. 33, 1888, 569–582.

AN ammoniacal solution of cuprous chloride is allowed to act in the cold on crystals of iron-potassium sulphide, both substances being taken in equivalent proportions. The reaction proceeds at once, but drags towards the end and requires nearly 30 hours before it is finished. The crystals obtained correspond with the empirical formula Cu_2FeS_3 . They present the same chemical properties as natural copper pyrites, with which they are, in fact, identical. The reaction is represented by the equation—



The author is of opinion that the formula of natural copper pyrites should be written $\text{Cu}_2\text{S} \cdot \text{FeS}_3$ instead of $\text{CuS} \cdot \text{FeS}$.

—S. H.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Salts of Gold used in Photography. A. Lainer. Dingl. Polyt. J. 271, 30–35.

THE salts of gold generally in use among photographers are auric chloride, potassium auric chloride, and sodium auric chloride. If it be desired to substitute one for the other in the toning solution, it is customary to assume that the quantity of gold they contain will correspond to their equivalent weights. That such an assumption may be fallacious is shown by the fact that many preparations have a considerable residue when treated with ether-alcohol, consisting of alkaline chlorides. The subject presents three aspects: (1) analytical, as to the purity of the salts; (2) pecuniary, as to their money value; (3) photographic, as to their toning power.

With regard to (1): Auric chloride often contains free gold, actually, or potentially as aurous chloride; this is due to overheating in its preparation. On the other hand, by insufficient evaporation, hydrochloric acid may be left in, as hydrogen auric chloride, $\text{AuCl}_3\text{HCl} \cdot 3 \text{H}_2\text{O}$.

Two samples of commercial "gold chloride" were found to contain 42.11 and 51.75 per cent., respectively, of Au, instead of 57.96 per cent., which is the proportion present in $\text{AuCl}_3 \cdot 2 \text{H}_2\text{O}$. The former contained a notable quantity of potassium chloride, while the latter was contaminated with no foreign metal except copper, of which the chloride was present to the extent of 0.5 per cent. A sample of potassium auric chloride was adulterated with 10.4 per cent. of added potassium chloride, which was easily detected on shaking with ether. Two samples of sodium auric chloride contained 17.73 and 20.55 per cent. of Au respectively, in place of 49.43 per cent., which is the quantity present in $\text{AuCl}_3\text{NaCl} \cdot 2 \text{H}_2\text{O}$; these numbers correspond to the presence of 64 and 58 per cent. of added sodium chloride respectively. In the latter specimen a trace of copper was found.

(2.) In respect of the money value of the commercial gold salts, it was found that the price was fairly close to the actual quantity of gold they contained, as the following table shows:—

Sample.	Weight of Gold.	Value.	Price.
Grm.	Grm.	Fl. kr.	Fl. kr.
Auric chloride	1	0.4211	1 15
" "	1	0.5175	1 46
Sodium auric chloride ..	1	0.1773	0 48
" " " ..	1	0.2055	0 55

The weight of salt in the nominally 2-grm. bottles was generally nearly correct, though usually inclined to be a little low.

(3.) From the above facts it appears that the photographer cannot make up his toning solution of the right strength by taking equivalent weights of the commercial gold salts. This is in itself objectionable, but what is worse is the presence of such excessive quantities of sodium chloride as were found in the samples examined, as they have a tendency to produce a reddish tone on the prints. Hydrochloric acid is also most deleterious, delaying the toning and causing the formation of blisters; even after neutralisation it is injurious on account of its forming so much more alkaline chloride. The presence of cupric chloride mentioned above is found to be distinctly advantageous to the toning properties of the bath. The large variations in the proportion of gold in different preparations sold under the same name go far to explain how the almost innumerable receipts for toning solutions now extant, have arisen.

Photographers who are in the habit of preparing their own gold salts are of course free from these inconveniences, but for those who buy them, the best plan is to purchase only definitely crystallised samples.—B. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

Bellite Experiments. Engineer, 1889, 116.

ON Tuesday last, February 5th, a programme of experiments with this explosive was carried out at Wangey Hall Farm, Chadwell Heath, in the presence of Sir I. Lowthian Bell, and other scientific visitors, including many of the attachés of foreign Powers. Bellite in its character and composition closely resembles roborite, but it is claimed for it that it possesses special advantages in the total absence of sulphur and chlorine, and consequently the property of being flameless, and thus specially for being adapted for work in "fiery" mines. Bellite consists of a mixture of five parts by weight of nitrate of ammonium and one of dinitrobenzene. The trials were conducted under the direction of Mr. C. Napier Blake, the arrangements being made by Mr. Preece Williams.

The inventor, Mr. Carl Lamm, claims for bellite the following advantages:—(1) That bellite is one of the most powerful explosives known; (2) that it is more powerful than either gun-cotton, dynamite, or gunpowder; (3) that it possesses qualities of safety entirely foreign to explosive substances generally; (4) that bellite presents no danger whatever in manufacture; (5) that it cannot be made to explode by friction; (6) that it cannot be made to explode by shock or by pressure; (7) that it cannot be made to explode by electricity or by lightning; (8) that bellite cannot be made to explode by fire; (9) that it cannot be made to explode by any means except by the aid of a detonating cap, and is therefore absolutely safe; (10) that on bellite being exploded no noxious gases are given off, as is the case with dynamite and all nitroglycerin compounds; (11) that bellite made expressly for coal or rock blasting does not shatter like dynamite, but forces the coal or rock out in larger blocks, making but a very small percentage of dust; (12) that it does not undergo any chemical

change from time nor from atmospheric influences, always retaining its non-explosive character until the fulminating cap is applied to it; (13) that it can be used in shells that would prove of a terribly destructive character. Dynamite cannot be so applied, as the concussion produced by ignition of the gun charge would be liable to explode the shell and burst the gun. Bellite shells, however, may be fired without any such risk, thus solving the problem of firing high explosives from ordinary guns, hitherto an impossibility. (14) That bellite can be manufactured in tropical climates, which is not possible with dynamite; (15) that it can be transported by land or sea with perfect safety, being carried in Sweden as ordinary merchandise; (16) that it requires no thawing in the coldest weather, like dynamite, consequently much time is saved; (17) that it can be profitably sold at a lower price than dynamite or any other nitroglycerin compound. At present there are about 60 factories in Europe making dynamite and similar compositions, producing annually 40,000,000 lbs.

The programme was commenced by firing a charge of 1½ lb. of bellite in a can under water. As the bellite was enclosed in a water-tight case there was nothing in this test to notice.

(2.) A bellite 4-oz. charge—which somewhat resembles a stick of sulphur with a perforation at one end—was broken in two, the solid end being thrown into a coal fire, where it melted and burnt without attracting notice, and the perforated end being exploded by means of a fuse and detonator, on a ½-in. boiler plate, which it bulged. This illustrated the fact that bellite will not explode by ordinary combustion, while its action on ignition by a detonator is very powerful.

(3.) An iron 120-lb. weight was dropped from a height of about 16 ft. on five charges of bellite laid on an iron plate. The first blow not being quite end on, this was repeated, when the bellite was crushed to powder without explosion.

(4.) The crushed bellite thus produced was then placed in a tin which held 5 oz., and fired by a detonator in contact with an old S.E.R. iron steel-faced rail, which was fractured. This illustrated the power of bellite to resist explosion under a blow when in contact with iron.

(5.) In a hole 3 ft. deep was buried 1 lb. of blasting powder mixed up with naked bellite cartridges or charges, and the powder fired by a plain powder fuse, when the bellite was thrown about and blackened, and the surface burnt in places, but apparently none of it was exploded.

(6.) A charge of bellite was fired like a bullet from a small-arm, "No. 8"—½-in.—bore, against a ½-in. boiler plate. Bellite was found in small pieces adhering to the face of the plate unexploded.

(7.) The propelling power of bellite was next shown by the following experiment:—A 32-lb. shot was discharged from a short mortar, first by a charge of ½ lb. of powder—Curtis and Harvey's—and then by ½ lb. of bellite. In the former case the shot fell at 40½ yards from the mortar, and in the second at about 95 yards, illustrating the great superiority of bellite over the double weight of powder fired under these conditions, for propulsion.

(8.) Charges of dynamite and bellite 4 oz. each were placed on similar ½-in. boiler plates, and after being covered with clay, which was pressed over them, was fired. The effects were very nearly identical in this case. It is, however, said that experience has shown that the injury effected by dynamite is generally more local, and that of bellite more distributed.

(9.) The fuses of mines in the earth charged with gunpowder and bellite were now ignited. The powder exploded, but the bellite fuses failed.

(10.) A charge of 8 lb. (10s. worth) of bellite, which had been buried 3 ft. beneath a length of 60 ft. of railway line, laid on chairs fixed on cross sleepers, with fishes, &c., complete, was now exploded by the usual detonating fuse. The entire structure for many feet was lifted high in the air, the rails being both broken through in one place, while one rail was bent at some feet distance from the point of fracture, the fishes of the other rail being broken through at a nearly equal distance. The sleepers were torn and split, and one chair broken. A crater was opened in the ground about 12 ft. in diameter.

Some of its properties were necessarily not tested; for example, its freedom from all flame, and the harmless character claimed for its products of combustion. Then, again, its power to explode when in contact with water was not exhibited. It may be noticed in addition to what has been mentioned above with regard to the 13th claim put forward by the inventor, namely, its suitability for bursting charges of gun shells, that a delay action arrangement has been devised to enable steel shells to perforate armour before explosion takes place.—W. S.

Blasting Gelatin and Bellite. J. Guthrie Kerr. Glasgow Herald, March 6, 1889.

IN a lecture by the above-named, before the Philosophical Society of Kilmarnock, the following comparison was made between the powerful explosives "bellite" and "blasting gelatin." Nitroglycerin exudes from dynamite immersed in water, and Nobel's next effort was so to fix the nitroglycerin that the danger arising from this—the cause of several accidents—might be averted. Further, it seemed desirable that the fixing compound should not be inert like "Kieselguhr." This was effected by utilising Pelouze's discovery of gun-cotton (trinitrocellulose) in 1838. This substance, itself an explosive, but with slight defect of oxygen, was found to dissolve in nitroglycerin, which contains for explosion slight excess of oxygen, and with these two was formed the theoretically perfect explosive—"blasting gelatin." The parts are 3 per cent. of gun-cotton to 97 per cent. of nitroglycerin. In explosive effect blasting gelatin is 50 per cent. better than dynamite, and is described by Sir Frederick Abel, our greatest authority on explosives, as the cheapest, the safest, and most perfect. It is entirely unaffected by water, and cartridges which have been immersed for seven years in water have at the end of that time developed their full power when detonated. Gelatin-dynamite is a modification of blasting gelatin, somewhat cheaper in manufacture, and having in use more of a heaving action. It is made of 80 per cent. of blasting gelatin, not quite gelatinous, wood meal and saltpetre forming the other 20 per cent., and is largely used in the fiery mines in England, as the cartridge is Settle's patent. This invention consists of a water-tight bag, in which the cartridge is kept in position in the middle of the water in the bag by tin supports. The charge is exploded by a detonator set off by a current of electricity. No flame follows the explosion, and accordingly the risk from fire-damp is minimised. Within the last two years attempts have been made to meet the disadvantages of forming such large bore-holes as this invention requires, and to diminish the trouble which the miner has in manipulating the apparatus. The explosives for which is claimed at least equal power but entire absence of flame are known as roborite, carbonite, and bellite. These compounds are nitro-substitution derivatives of benzene associated with nitrate of ammonium. In bellite, the discovery of Carl Launm in 1887, the proportions are five parts of the ammonium salt to one part of dinitrobenzene. This explosive is said to be 30 per cent. stronger than dynamite, absolutely safe for transport, and flameless. The experiments lately made in the Cleveland district pronouncedly show that bellite may be safely subjected to the roughest treatment. Regarding entire absence of flame in the explosion of those nitrobenzene compounds, there seemed to be want of evidence as to the effects of other than comparatively small charges under favourable conditions. In the meantime the claim could not be considered as made good, whatever the promise might be. Compared with blasting gelatin, bellite is inferior so far as concerns power of withstanding water, as might be inferred from the presence of such a large proportion of nitrate of ammonia. If, as a protection against water it be covered with a waterproof mixture, it becomes less adaptable for the completely filling up of bore-holes in blasting operations.—W. S.

PATENTS.

An Improved Apparatus for utilising an Explosive Compound for Blasting or other Purposes. R. Pamshon and R. R. Vizer, London. Eng. Pat. 2428, May 12, 1883. Amended November 13, 1888. 6d.

This invention relates to a cartridge in which nitric and picric acids can be separately contained, the object being to enable these two acids to be utilised for blasting purposes, &c.

The former two claims are withdrawn, and another substituted, which is explained by the foregoing.—C. N. H.

Improvements in the Manufacture of Explosives. A. V. Newton, London. From A. Nobel, Paris, France. Eng. Pat. 1,471, January 31, 1888. 6d.

"The object of this invention is to combine the substances, nitroglycerine and nitrated cellulose, with or without nitrated starch or nitro-dextrine, or both, so as to produce an explosive substance of a horny or semi-horny character, and capable of being reduced to grains suitable for use as a propeller of projectiles."

In carrying out the invention, varying proportions of the ingredients are taken according to the result desired. Camphor or other solvents, such as benzol, acetone, &c., are added with a view to facilitate the solvent action of the nitroglycerin on the nitrocellulose.

The limit of variation as regards the relative proportions of nitroglycerin and nitrocellulose, which permits of obtaining a compound consistent enough to be granulated, is very wide. But when the proportion of nitroglycerin exceeds two-thirds of the compound it is rather too soft, and when, on the contrary, nitrocellulose is in excess of two-thirds it becomes too tough and hard to be easily granulated.

For firearms "an excellent explosive is obtained by dissolving 20 to 30 parts of nitrated, soluble, pulped cotton in 100 parts of nitroglycerin and 20 parts of camphor, adding then 100 parts of nitrostarch, containing about 12 to 12½ per cent. of nitrogen, and 200 parts of nitro-dextrine of the same tenour of nitrogen. The material is easily formed by simply kneading it together at a temperature of, say, 60° C., or better still by malaxation between rollers, regulating the temperature so as not to have it too sticky. It is, after having become homogeneous, rolled out into thin sheets and cut up into grains, or moulded, if desired."

Oxygen yielding salts, such as nitrates and chlorates, or powdered explosives, such as picrates, are easily incorporated in the above mixture at a temperature of 60° C. The quantity of such salts to be added is limited to the capability of easy practical incorporation, and varies according to the necessity for more or less complete combustion on explosion.—C. N. H.

XXIII.—ANALYTICAL CHEMISTRY.

A New Method of Estimating Temperatures.
Engineering, 1889, 115.

An instrument has been recently made by Messrs. Dueretot, of Paris, to the designs of Messrs. Nouël and Mesuré, to utilise the colour of heated iron so as to determine its temperature. Could these colours, as they pass from red through orange to dazzling white, be reproduced with certainty on the retina, they would show that the corresponding temperature had been attained. Owing to physical defects, however, the eye is unable to properly distinguish these different shades. This pyrometer glass, in brief, consists of a telescope fitted with a couple of Nicol's prisms, one of which acts as analyser to the other; a plate of quartz also being placed between the two. The light from a heated object on passing through the first Nicol is polarised, and the plane of this polarisation is, as the light traverses the quartz plate, turned round through an angle proportional to the thickness of the quartz, and nearly inversely to the wave length of

the light—that is to say, its colour. Hence, assuming the Nicols were set so that if the quartz were removed, the polarised ray was quenched by the second, then on replacing the quartz the second Nicol would have to be rotated through a certain angle to again quench the light, this angle, of course, being equal to the rotation of the plane of polarisation by the quartz, and therefore dependent on the colour of the rays passing through. The second Nicol is carried by a tube fitted with a graduated head, so that this angle can readily be observed, and to every graduation corresponds one colour, and one only. In practice, complete extinction never occurs, but at a certain point the colour of the transmitted light changes from green to red, and this point is taken as the angle to be measured.—W. S.

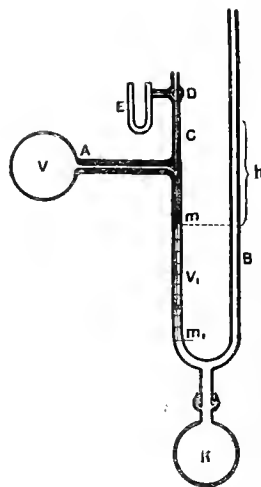
J. Wiborgh's Air Pyrometer. Dingl. Polyt. J. 271, 118—124.

Of all the materials by the expansion of which high temperatures are measured, air is probably the most suitable, as its coefficient of expansion is, as far as we know, very constant. Pyrometers in which it is used have often been devised, and fall naturally into two classes:—

- (1.) That in which the volume of the air is kept constant, and the increase of pressure measured.
- (2.) That in which the pressure of the air is kept constant, and its increase in volume measured.

The chief objection to the first is that, at comparatively low temperatures, the pressure has risen already to an inconvenient extent, a pressure of an additional atmosphere

Fig. 1.

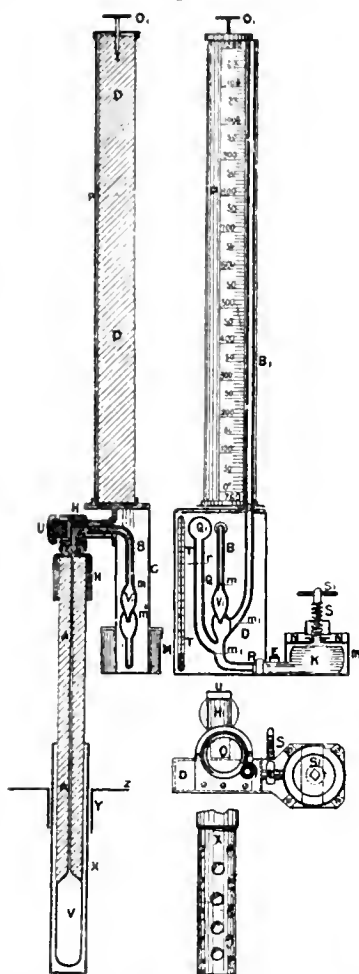


corresponding only to a temperature of 272° C.; while in the case of the second, there is the great disadvantage that, as the temperature rises, an increment of a given number of degrees corresponds to a continually diminishing increase in the volume of the air. Consequently, in order to get an accurate reading, it is not only imperative that the limb of the manometer be finely graduated, but also that precaution be taken to level the mercury very exactly.

To achieve this result, Petterson has devised an appendage marked E in Fig. 1, consisting of a small manometer containing water instead of mercury. When the level of the mercury in the large manometer B V has been adjusted as closely as possible, communication between it and E is made by means of the three-way cock D, and the adjustment continued until E shows it to be exact. Even with this addition, accuracy in the indications of the instrument can only be attained by surrounding that part of the manometer which measures the increase in volume by a water jacket, so as to keep it at a known temperature, thereby making it somewhat clumsy.

Wiborgh's pyrometer depends on a new principle, and is free from these defects.

Fig. 2.



In Figure 1, which represents the apparatus diagrammatically, V is the bulb, containing air, which is exposed to the temperature to be measured, A a capillary tube so small that its volume may be neglected, V₁ the near limb of the manometer, which has its volume between the marks *m* and *m*¹, known, B the other limb, and K a rubber reservoir of mercury. The action is as follows: V being raised to the temperature to be measured while the cock D is open to the air, and the level of the mercury is brought to *m*¹, the temperature of the air in the limb V₁ of the manometer is taken, the cock closed, and mercury forced into the manometer by the rubber ball K until it stands at *m* permanently, showing that the air added to the contents of V has attained its temperature.

The increased pressure requisite to effect this is read off, and the temperature can then be calculated from the following considerations: If T be the temperature to be measured, and *t* that of the portion of air forced into the bulb, V the volume of the bulb, and V₁ that of the air forced in, then as V is raised through T-*t* degrees, its volume under atmospheric pressure would be V [1 + α (T-*t*)] where α is the coefficient of expansion of air. Therefore the total air in the bulb would measure, under atmospheric pressure, V + V₁ [1 + α (T-*t*)]. But as it is constrained to occupy a volume V₁, being under the additional pressure of the mercury in the manometer, which we will call *h*, we have, taking H as the height of the barometer at the time, the equation:—

$$\frac{V + V_1 [1 + \alpha (T - t)]}{H + h} H = V$$

Sprung points out (*Oesterr. Zeits. f. Berg. u. Huttenwesen*, 1889, 2) that this is erroneous, inasmuch as α is the increase in volume of a unit volume of air when raised from 0° C. to 1° C., and therefore the volume occupied by V₁, after being raised from *t* to T, is not V₁ + V₁ α (T-*t*), but V₁ + V₁ α (T-*t*). Where V₁ is the volume, V₁ would occupy when cooled from T to 0° C. It is far simpler to dispense with the use of the symbol α, and make the temperature absolute, in which case we have—

$$\frac{V + V_1 \left(\frac{T + 273}{t + 273} \right)}{H + h} H = V$$

(A correction for the expansibility of the material of which the bulb is composed can be inserted if thought necessary.)

This equation can be written—

$$h = H \frac{V_1}{V} \left(\frac{T + 273}{t + 273} \right)$$

which shows that a given increment of temperature at any part of the range of the pyrometer produces a constant increment in the reading (*h*) of the instrument. Further, the apparatus can be constructed of any required degree of delicacy by varying the relation between V and V₁. Its zero point is determined by making a determination in the manner described above, when T = *t*. It can be used for measuring temperatures lower than *t*, in which case *h* becomes negative.

The actual construction is shown in Fig. 2. The thermometer bulb V is of porcelain, and is in one piece with the capillary tube of the same material marked A. This tube has an external diameter of 1.0 mm. and a bore of 0.5 mm. It is connected by the metal cap II and tube II₁ with the manometer B V₁ B₁ which has an enlargement at *m*, which serves to contain the volume of air that is forced into V₁ and which is conveniently $\frac{1}{10}$ th of its volume. An air-trap below V₁ is provided, as shown in the figure. The india-rubber reservoir K is enclosed in a metal box fitted with a lid which can be raised and depressed by means of the screw S, and thus mercury forced evenly into the manometer tube.—B. B.

Detection of Antimony in Minerals. A. Johnstone.

Chem. News, 58, 296—297, and 59, 15.

By adding a drop of ammonium sulphide to the white incrustation of Sb₂O₃, obtained by heating an antimoniferous mineral with fusion mixture on charcoal in the inner flame of the blowpipe, the very characteristic reddish or orange sulphide of antimony is produced. With larger quantities the reaction may be obtained in an open tube.

—O. H.

The Testing of Reagents. L. L. de Koninck. Zeits. f. angew. Chem. 1889, 4.

Lead Peroxide often contains manganese, likewise as peroxide. Boiling with dilute nitric acid is not sufficient to distinguish this. If, however, the peroxide be warmed with excess of concentrated sulphuric acid, and then, on cooling, treated with water and an additional quantity of peroxide, and again heated, presence of manganese is denoted by a red colouration of the solution, due to permanganic acid.

Ether.—Presence of free sulphur and consequent probable presence of organic sulphur may easily be recognised by shaking with a drop of pure mercury. In presence of only a very small quantity of sulphur, the surface of the mercury becomes dull; if a relatively large quantity of sulphur be present, the whole liquid becomes grey or black.

Chloroform.—Pure chloroform does not reduce an alkaline solution of potassium permanganate in the cold; if alcohol be present, reduction takes place. Caustic soda and caustic potash, however, generally contain organic compounds, consequently it is best to use a solution of permanganate in saturated baryta water.

Such a solution, when added to chloroform containing alcohol, turns green, owing to formation of manganate.

—T. L. B.

The Action of Sulphuretted Hydrogen on Solutions of Sulphate of Zinc. H. Baubigny. *Compt. Rend.* **107**, 1148—1150.

It has been stated by Berzelius that a current of sulphuretted hydrogen will precipitate a portion of the metal from a saturated solution of zinc sulphate, but the action stops when the solution has developed a certain degree of acidity. The author has examined this reaction in the case of dilute solutions, and finds that a more qualified statement is required for a generalisation of the facts. A solution of sulphate or chloride of zinc (always in the state of neutral salt) containing 0.3 gm. of salt in 100 cc. will be completely precipitated after saturation with sulphuretted hydrogen, and on being left in a closed vessel for several hours at the ordinary temperature. If the quantity of dissolved salt be doubled the precipitation is less perfect; after five hours the solution contained from 0.004 to 0.006 gm. of the salt employed, which became reduced to 0.001 gm. in three days. With 0.3 gm. of salt in 100 cc. it is necessary to add thirty times the weight of the acid of the salt in order to prevent any precipitation under similar conditions, but if the temperature be raised, precipitation ensues, and at 100° C. it is necessary to have 90 or 100 parts of free acid present in order to prevent precipitation of the sulphide. The results vary with all the conditions, and it would be incorrect to define a limit depending on the acidity of the solution, since the decomposition is a function not only of the relation of the weight of free acid to the weight of the solution, but also of the acid to metal.

—G. H. B.

On the Estimation of Manganese by Hydrogen Peroxide. A. Carnot. *Compt. Rend.* **107**, 1159.

The author rectifies an error in a previous communication (this Journal, 1889, 138) by stating that the precipitates yielded by his method are of the composition Mn_2O_{11} (or $5 MnO_2 + MnO$) and not the binoxide. Consequently 5 equivalents of oxygen correspond exactly to 6 equivalents of manganese.—G. H. B.

The Volumetric Determination of Sulphates. H. Quantin. *Bull. Soc. Chim.* **51**, 21—24.

This method depends on the reaction of sulphuric acid on barium chromate, by which chromic acid is liberated in a condition available for titration with a ferrous salt. The standard reagent is prepared by dissolving 19.48 grms. of neutral potassium chromate in 200 cc. of water and adding 50 to 100 cc. of hydrochloric acid; 24.35 grms. of barium chloride in solution are then added slowly with continual agitation, so as to redissolve the precipitate, and the whole diluted to 1 litre and filtered. 50 cc. of this solution are required for 0.3 or 0.4 gm. of sulphuric acid. To standardise this solution 1 gm. of pure dry potassium sulphate is dissolved in about 600 cc. of water, and 100 cc. of the chromate solution are added and shaken up. When the mixture begins to become clear, an excess of ammonia is added, and the whole diluted to 1 litre. 100 cc. of the filtered solution are then acidified with 5 cc. of pure sulphuric acid, and titrated with a standard ferrous sulphate solution, using potassium ferricyanide as indicator. The ferrous sulphate solution is prepared by dissolving 20 grms. of ferrous ammonium sulphate and 10 cc. of pure sulphuric acid in 1 litre of water. The amount of chromic acid thus found is the equivalent of the sulphuric acid which was added to the barium chromate solution, plus a small correction, which is due to the necessity for having a slight excess of chromic acid over the barium in the standard reagent. This correction is ascertained by a blank experiment. If, in making up the original solution, the barium chloride were in excess of the chromate, some barium sulphate would be precipitated in the subsequent operations without leaving its equivalent of chromic acid. The method gives very exact results.—G. H. B.

Critical Examinations of the Methods for Analysing the Raw Material for producing Tartaric Acid. Chem. Zeit. **13**, 160—161.

The article contains some observations on the methods of Goldenberg, Scheurer-Kestner, Fresenius, and Goldenberg-Geromont; and recommends the method of Goldenberg-Geromont as the best and most reliable one.—A. L.

Test for Nitrobenzene in the presence of Bitter Almond Oil. K. List. *Chem. Zeit.* **12**, 172—178.

If crushed almonds become strongly odorous after mixing with water, the smell of prussic acid is easily removed by warming with some carbonate of soda solution and some drops of a ferrous salt solution. After addition of potassium permanganate the smell of benzaldehyde also disappears. This treatment, has, however, no effect on nitrobenzene, which can thus be easily identified.—A. L.

Selection of Benzoyl Sulphonic imide (Saccharine) by the Fluorescein Reaction. E. Bornstein. *Ber.* **21**, 3396—3397.

This is a reply, the objection raised to the test being that resorcinol heated alone with concentrated sulphuric acid gives a green fluorescent substance (this Journal, 1888, 458). The great difference in intensity makes the test, however, according to the author, perfectly reliable; 1 mg. of the substance imparts a distinct fluorescence to 1 litre of water. The sulphonic imide, or substance containing it, is heated in a test tube with sulphuric acid, diluted, and caustic soda added. On addition of the alkali the sudden change to green is very characteristic, and is only given by phthalic anhydride and phthalimide.—J. B. C.

Detection of Colours on Dyed Wool. G. Dommergue. *Monit. Scient.* **33**, 25—40.

No methods have been published for detecting the coal tar colours on dyed wool; with the exception of the tests given by Rénard, which deal with these colours fixed on cotton, most of the literature relates to the detection of the natural dyestuffs. The analytical tests of O. Witt and E. Weingartner refer to the dyes in the free state and are inapplicable to dyed tissues, since when fixed they are insoluble in the majority of solvents ordinarily used in testing, such as water, alcohol, alkalis, and dilute acids.

Only such reagents as are used in the dyehouse are employed in the following tests.

REAGENTS.

Alkalis.—Ammonium hydrate, 21° B., normal potash corresponding to 100 grms. sulphuric acid per litre.

Acids.—Hydrochloric acid, 21° B., sulphuric acid, 66° B.

The tests are made by spotting with the several reagents the dyed fabric placed on a porcelain surface, or, if the shade be dark, the fabric is examined by looking through it towards the light.

PART I.

TESTING OF PURE SHADES.

Violet Colours.

Dahlia Violet (Imperial or phenylated violet, red shade).—Hydrochloride of monophenylosaniline.

Parma Violet (Imperial or phenylated violet, blue shade).—Hydrochloride of diphenylosaniline.

These violets, soluble in spirit, have been replaced by the methylosaniline violets.

Their reactions are as follows: NH_4OH , completely decolourises; KOH , red colouration; HCl , brown colouration; H_2SO_4 , orange colouration.

Methylor Paris Violet R.—Hydrochloride of monomethyl-p-rosaniline.

Methyl or Paris Violet B.—Hydrochloride of trimethyl-p-rosaniline.

Paris Violet, very blue.—Hydrochloride of pentamethyl-*p*-rosaniline.

Paris Violet N, Benzyl Violet, or Methyl Violet 5 B.—Hydrochloride of dimethylbenzyl-*p*-rosaniline.

Crystal Violet.—Hydrochloride of hexamethyl-*p*-rosaniline.

The reactions of this group are: NH_4OH , slowly decolourises; KOH , as with NH_4OH ; HCl , completely decolourises, tissue is coloured purplish-grey; H_2SO_4 , turns yellowish-brown.

Gallein or anthracene violet.—Pyrogallolphthalein.

This is largely used for dyeing fast shades.

NH_4OH , colour becomes paler; KOH , as with NH_4OH ; HCl , brownish-red colouration; H_2SO_4 , orange colouration. The ash usually contains chrome.

Blue Colours.

1. Triphenylmethane Compounds.

Bleu de Lyon (Spirit Blue, Paris Blue, Light Blue, Opal Blue).—Hydrochloride of triphenylrosaniline.

NH_4OH , completely decolourises; KOH , colour destroyed, tissue coloured greyish-pink; HCl , completely decolourises; H_2SO_4 , brownish-red colouration.

Nicholson's or Alkali Blues.—Sodium salts of triphenylrosaniline-sulphonic acids.

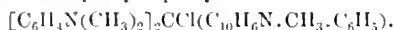
NH_4OH , completely decolourises; KOH , slowly decolourises, tissue coloured pink; HCl , colour becomes slightly green; H_2SO_4 , brownish-red colouration.

Victoria Blue B.—Hydrochloride of tetramethylphenyl-triamidodiphenyl-naphthylcarbinol—



NH_4OH , colour becomes slightly greyish; KOH , red colouration; HCl , orange-red colouration; H_2SO_4 , orange colouration.

Victoria Blue 4 R.—Hydrochloride of pentamethylphenyl-triamidodiphenyl-naphthylcarbinol—



NH_4OH , incompletely decolourises; KOH , decolourises, fibre coloured silver-grey; HCl , yellowish-brown colouration; H_2SO_4 , orange colouration.

II. Compound Blues.

The so-called indigo substitutes are mixtures of violets of more or less blue shade and of greens derived from triphenylmethane. The chief of these mixtures are: Acid green and acid violet R. or B, acid green and methyl violet, and methyl green and methyl violet.

Acid Green and Acid Violet R. or B.— NH_4OH or KOH , completely decolourises; HCl , brownish-red colouration; H_2SO_4 , brownish-yellow colouration.

Acid Green and Methyl Violet; Methyl Green and Methyl Violet.— NH_4OH or KOH , the green disappears entirely, the violet partly remains; HCl , brownish-yellow colouration; H_2SO_4 , as with HCl .

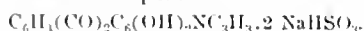
III. Indulines.

Fast Blue R. (B. A. S. F.).— NH_4OH , violet-grey colouration; KOH , violet-grey colouration; HCl and H_2SO_4 , little action.

New Blue (M. L. and P.).— NH_4OH or KOH , greyish-purple colouration; HCl or H_2SO_4 , bluish-violet colouration.

IV. Anthracene Colouring Matters.

Alizarin Blue S.—Sodium bisulphite compound of alizarin blue soluble in spirit.



NH_4OH , colour slowly becomes paler; KOH , colour paler and more green; HCl , little action; H_2SO_4 , little action.

The ash contains chrome.

V. Natural Colouring Matters.

Indigo.— NH_4OH , no action; KOH , no action; HCl , no action; H_2SO_4 , colour becomes very slightly greenish.

A small portion of the dyed tissue heated in a closed tube gives a violet vapour of indigotine.

The ash contains either iron or zinc according to the vat used.

Indigo Carmine and Sulphate.— NH_4OH , little action; KOH , yellow-brown colouration; HCl , little action; H_2SO_4 , violet-blue colouration.

A small portion of the dyed tissue heated in a closed tube does not evolve vapours of indigotine.

VI. Mineral Colouring Matters.

Prussian Blue. $\text{Fe}_4(\text{CN})_{12}$ deposited on the wool from an acid bath through the reducing action of the wool. NH_4OH , turns violet; KOH , fibre buff; HCl , colour rendered slightly paler; H_2SO_4 , yellow-brown colouration.

The ash contains iron, sometimes also alumina.

Green Colours.

1. Triphenylmethane Compounds.

Malachite Green (Victoria Green, Diamond Green).—Double chloride of zinc and tetramethyldiamidotriphenylcarbinol.

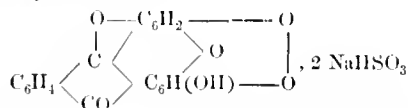
Light Green S. (Acid Green, Helvetia Green).—Sodium salt of tetramethyldiamidotriphenylcarbinol-sulphonic acid.

Brilliant Green (Solid or Fast Green, New Victoria Green).—Oxalate of tetramethyldiamidotriphenylcarbinol.

Methyl Green (Light Green).—Zinc double salt of methylhexamethylparosaniline. (Little used.)

NH_4OH , completely decolourised; KOH , as with NH_4OH ; HCl , yellow-brown colouration; H_2SO_4 , as with HCl .

Coccalein S.—Sodium bisulphite compound of coccalein soluble in spirit.



NH_4OH , becomes much paler; KOH , as with NH_4OH ; HCl , slowly becomes paler; H_2SO_4 , dull-red colouration.

The ash contains chrome.

Yellow and Orange Colours.

1. Nitro Compounds.

Picric Acid.—Trinitrophenol.

NH_4OH , little or no action; KOH , reddened slightly; HCl , slowly decolourised; H_2SO_4 , decolourised.

A small portion of the tissue moistened with potassium cyanide becomes coloured a rich reddish-brown, potassium isopurpurate being formed, tissues dyed with dinitroresol or naphthol yellow are decolourised by the same reagent.

Golden Yellow (Manchester Yellow).—Alkaline salt of dinitroresol.

NH_4OH , no action; KOH , slowly and imperfectly decolourised; HCl , decolourised; H_2SO_4 , decolourised.

Naphthol Yellow S.—Sodium salt of dinitro- α -naphthol sulphonic acid.

NH_4OH , no action; KOH , decolourised; HCl , slowly decolourised; H_2SO_4 , decolourised.

II. Azo-Compounds.

Orange 1 (Poirrier) (Tropacolin 000).—Sodium salt of α -naphtholazobenzenesulphonic acid.

NH_4OH , red colouration; KOH , violet colouration; HCl , violet colouration; H_2SO_4 , violet colouration.

Orange 2 (Poirrier) (Tropacolin 000 No. 2).—Sodium salt of β -naphtholazobenzenesulphonic acid.

Orange 3 (Poirrier) (Methyl Orange, Helianthine).—Sodium salt of dimethylanilineazobenzenesulphonic acid.

The reactions of these two dyes are the same.

NH_4OH , little or no action; KOH , red colouration; HCl , red colouration; H_2SO_4 , as with HCl .

Orange 4 (Poirrier) (Orange N., Diphenylamine Orange, Tropaeolin 00).—Sodium salt of diphenylaminazobenzene-sulphonic acid.

NH_4OH , little or no action; KOH , as with NH_4OH ; HCl , violet colouration; H_2SO_4 , as with HCl .

Indian Yellow (Monnet).—Nitro-compound of Orange 4. NH_4OH , little action; KOH , brown colouration; HCl , violet colouration; H_2SO_4 , as with HCl .

Fast Yellow R. (Badische).—Sodium salt of amidoazobenzene-disulphonic acid.

NH_4OH , little or no action; KOH , little or no action; HCl , red colouration; H_2SO_4 , yellow-brown colouration.

Chrysoin (Poirrier) (Resorcinol yellow, Tropaeoline R or O).—Sodium salt of resorcinolazobenzene-sulphonic acid.

NH_4OH , little or no action; KOH , red colouration; HCl , orange colouration; H_2SO_4 , as with HCl .

III. Anthracene Colouring Matters.

Alizarin Orange (Nitroalizarin).— β -nitroalizarin.

NH_4OH , becomes slightly paler; KOH , reddens slightly; HCl , becomes slightly paler; H_2SO_4 , almost decolourised.

The ash contains chrome.

IV. Natural Colouring Matters.

Fustic.— NH_4OH , little or no action; KOH , as with NH_4OH ; HCl , completely decolourised; H_2SO_4 , little action. The ash contains alumina.

Turmeric.—This dyestuff has almost disappeared from use. NH_4OH , orange colouration; KOH , as with NH_4OH ; HCl , brown-red colouration; H_2SO_4 , red, changing to dull grey. Ash contains alumina.

Red Colours.

1. Triphenylmethane Compounds.

Magenta.—Salt of triamidotriphenylcarbinol or of triamidodiphenyltolylcarbinol.

NH_4OH , slowly decolourised; KOH , completely decolourised; HCl , yellow-brown colouration; H_2SO_4 , as with HCl .

Acid Magenta (Magenta S.).—Sodium salt of rosaniline-trisulphonic acid.

NH_4OH , decolourised; KOH , decolourised; HCl , the shade becomes much more blue; H_2SO_4 , yellow-brown colouration.

II. Azo Compounds.

Bordeaux R or B (M. L. and B.).—Sodium salt of α -naphthylamine-azo- β -naphthol-disulphonic acid.

NH_4OH , little or no action; KOH , yellow-brown colouration; HCl , little or no action; H_2SO_4 , blue colouration.

Amaranth (M. L. and B.).—Sodium salt of α -naphthylamine-azo- β -naphthol-trisulphonic acid.

NH_4OH , little or no action; KOH , colour turned slightly grey; HCl , little or no action; H_2SO_4 , violet-blue colouration.

Ponceau 3 R (M. L. and B.).—Sodium salt of xylene-azo- β -naphthol-disulphonic acid.

NH_4OH , little or no action; KOH , brown colouration; HCl , little or no action; H_2SO_4 , crimson-red colouration.

Roccellin (Fast Red A).—Sodium salt of β -naphthol-azo-naphthalene sulphonic acid.

NH_4OH , becomes slightly paler; KOH , darkens and becomes rather more blue; HCl , as with KOH ; H_2SO_4 , violet colouration.

Orchil Substitute (Poirrier).—Sodium salt of nitraniline-azo- α -naphthylaminesulphonic acid.

NH_4OH , dirty-grey colouration; KOH , as with NH_4OH ; HCl , magenta-red colouration; H_2SO_4 , brown colouration. Useful colour for compound shades, largely used in France.

Eosin 1, Hortensia, Erythrosin, Phloxin B extra, Cyanosin, Rose Bengal.—All the resorcinol derivatives show the same reactions.

NH_4OH , little or no action; KOH , as with NH_4OH ; HCl , yellow-brown colouration; H_2SO_4 , as with HCl .

These dyes can be easily removed from the fibre by solvents, and exhibit a greenish-yellow fluorescence, particularly in alkaline solution.

III. Anthracene Colouring Matters.

Alizarin W. S. (B. A. S. F.).—Sodium salt of alizarin-sulphonic acid.

NH_4OH , violet colouration; KOH , as with NH_4OH ; HCl , becomes slightly paler; H_2SO_4 , little or no action.

The ash contains chrome or alumina.

IV. Natural Colouring Matters.

Of these the following are still used for dyeing red:—

Orchil (mainly used for maroons, &c.).

NH_4OH , violet colouration; KOH , as with NH_4OH ; HCl , little or no action; H_2SO_4 , darkens and becomes more blue; fibre is destroyed.

Ash contains alumina.

Ammoniacal Cochineal (very little used).

NH_4OH , slowly becomes violet; KOH , shade turns violet; HCl , decolourised; fibre coloured grey; H_2SO_4 , yellow-brown colouration.

The ash contains alumina.

Redwood (Brazilwood, &c.).—

NH_4OH , becomes slightly paler; KOH , as with NH_4OH ; HCl , as with NH_4OH , but to a less extent; H_2SO_4 , yellow-brown colouration.

The above colouring-matters represent those which are at the present time employed in dyeing, those colours which have been replaced or abandoned are omitted. All colours which will resist moistening with ammonia solution are considered as fast.

PART II.

TESTING OF COMPOUND SHADES.

Grenats.

Red is the predominating colour in grenat. Bright grenats test like a mixture of yellow and red; in examining the same, first moisten with hydrochloric acid and notice whether—

(1.) The shade turns yellow;

(2.) The shade becomes slightly bluer or violet.

In the first case the grenat is produced from magenta and golden yellow, this being the only yellow which is dyed in a neutral bath, and which does not precipitate the salts of rosaniline.

The second test may be produced by either—

(a.) Acid magenta and chrysoin or naphthol yellow, when the test is only rendered slightly blue by hydrochloric acid; or

(b.) Acid magenta and Orange 4 (or similar azo-orange or yellow), in which case hydrochloric acid turns the colour violet.

All bright grenats lose their red colour when moistened with ammonia, yellow remaining; the shades very rarely obtained with Bordeaux and Amaranth are not altered by ammonia, but become violet blue or blue when touched with sulphuric acid.

Maroons and Compound-red Shades.

The colour is moistened with ammonia, and it is observed whether—

(1.) The shade becomes green;

(2.) Only yellow remains;

(3.) The shade becomes paler.

In the first case acid magenta is present since it is soluble in alkalis; the blue (indigo) is fast. Test further by moistening with hydrochloric acid, the yellow becomes violet, indicating Orange 4 (or other azo-orange or yellow);

chrysoin and naphthol yellow are rendered slightly blue by this treatment.

The shades produced with Acid magenta, indigo, and Orange 4 are very commonly met with, the others more rarely.

In the second case where the yellow remains after testing with ammonia solution the presence of Acid green, Acid violet, and Acid magenta is shown; if Orange 4 is also present the shade becomes red-violet when moistened with hydrochloric acid.

In the third case the shade is fast, it may be either—

- (a.) Azo red, indigo, and Orange 4, when on moistening with hydrochloric acid it becomes slightly violet; if this acid does not change the shade chrysoin is present.
- (b.) Logwood, giving a red colouration to the acid when tested with hydrochloric acid, mixed with Orange 4 and 64 (M. L. and B.), the compound shade changing to violet-red or grenat.

Olives.

The tissue is moistened with ammonia when—

- (1.) Only yellow remains, acid green and acid violet are present, moisten with hydrochloric acid to test the yellow. The shade containing Orange 4 changes to grenat, if it contains chrysoin it becomes yellow-brown.
- (2.) The shade becomes slightly more blue, indigo present; test the yellow as in (1).

Dark Greens.

The tissue is moistened with ammonia—

- (1.) Only the yellow remains. Acid green and Acid violet, together with Naphthol yellow or picric acid, the yellow is not easily detected.
- (2.) The shade if changed becomes paler; moisten with hydrochloric acid and notice if—
 - (a.) The acid is coloured red, showing presence of logwood, and the shade becomes red or violet red; the yellow is fustic. The ash contains chrome.
 - (b.) The yellow is destroyed and blue remains, in which case indigo and Naphthol yellow or picric acid are present.

Dark Blues and Purples.

The fibre is moistened with ammonia, and it is noted whether—

- (1.) Complete decolourisation takes place;
- (2.) The red is removed leaving the blue;
- (3.) The shade becomes slightly paler.

In the first case Acid magenta, Acid green, and Acid violet are present.

The second reaction shows the presence of indigo, the red being Acid magenta.

The third reaction indicates an azo-red and indigo, when further tested by hydrochloric and sulphuric when the shade is not appreciably changed.

Shades obtained with logwood, indigo carmine, and Acid magenta or an azo-red are difficult to analyse; the logwood colours acid as previously mentioned, and the ash contains chrome.

Blacks.

All blacks on wool are dyed with logwood; on testing with acid the shade reddens. There are two kinds.

- (1.) Blacks dyed on iron or copper-iron mordants (the oxides of these metals being left in the ash), which rub off easily. This black is exceedingly rare.
- (2.) Blacks dyed on a chrome or copper chrome mordant (shown by the ash). This black is almost always employed.

Scarlets.

Cochineal scarlets are turned violet by potash whilst the artificial scarlets are turned yellow, moreover tin is found in the ash of the Cochineal scarlet.

Yellows, Oranges, &c.

See the first portion of this paper.

Mode Colours.

In testing for the very numerous range of colouring matters used in the production of these shades, the chief tests for orchil, Acid magenta, orchil substitute, azo-oranges, &c. must be carefully borne in mind.—E. B.

New Method of Examining Alcohol for Aldehyde.

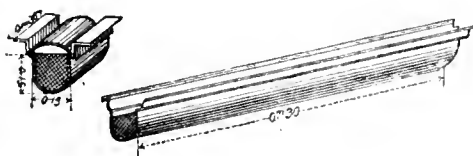
C. Girard and X. Rocques. *Compt. Rend.* **107**, 1158—1159.

THE previous methods of testing commercial alcohols for small quantities of aldehyde and amyl alcohol are only qualitative, and they also fail in distinguishing between these two impurities. The authors have succeeded in overcoming these defects by the following method:—3 grms. of the hydrochloride of *m*-phenylenediamine are dissolved in 200 cc. of alcohol of 50°, and the solution boiled for half an hour with an inverted condenser; the liquid acquires a yellow colour. After cooling for half an hour the solution is shaken. If aldehyde be present the colour gradually deepens and acquires a fine green fluorescence, due to the action of the air. The liquid is then rapidly distilled until 125 cc. have passed over, when the distillate will be of 75° strength. The distillate is examined for amyl alcohol by Savalle's method, which consists in heating to 66° with an equal volume of sulphuric acid, producing a brown colouration, the depth of which can be compared with that given by known percentages of pure amyl alcohol in alcohol of 75°. The aldehyde compound remains almost entirely in the residue of the distillation, whilst the amyl alcohol passes over completely with the 125 cc. The quantity of aldehyde is estimated by the depth of colouration of the residual liquid.—G. H. B.

Determination of Sulphur in Coal. Brullé. *Monit. Scient.* 1889, 230.

THE author having had very considerable experience of estimating sulphur in coals, by projecting little by little an intimate mixture of 1 gm. of coal to 20 grms. of a mixture of equal parts of sodium carbonate and nitre into a platinum crucible raised to a red heat, has found that his results were uniformly too low. He attributes this to a part of the sulphur passing away as SO₂.

Another method consists in operating on the entire bulk of the mixture in a combustion tube, heated progressively from front to back. In presence of organic matter not very rich in carbon, combustion takes place gently, and the process yields excellent results. But in the case of coals in which carbon is present to an extent up to and exceeding 90 per cent., the combustion is too active. It would be possible to correct this by increasing the proportion of sodium carbonate; but then the length of the tube must be much augmented, and the subsequent treatment of the solution obtained with barium chloride takes place in presence of too great a quantity of dissolved saline matter. A simple modification of the first mode of operating has given results which are all that could be desired. Instead of making the combustion in a platinum crucible, a long platinum boat was used, about 3 decimetres long, 15 mm. wide, and 15 mm. deep. A ledge or rim running along each side of the boat allows of a cover or lid being fitted almost hermetically upon the same.



The mixture of sodium carbonate, potassium nitrate, and coal is distributed along the bottom of the boat. The mixture is then again covered with a thin layer of carbonate and nitrate with which a little powdered chlorate of potassium

is mixed. A little of the mixture is also equally placed over the interstices of the long lid or cover.

The apparatus thus arranged is conveyed into a combustion furnace, and heated progressively from one extremity to the other, till the mixture is brought to complete fusion.

The tube is then washed out with warm water, the solution treated with hydrochloric acid, and evaporated to dryness, to render any silica insoluble which had been formerly contained in the coal. Treatment with dilute hydrochloric acid and filtration follow, and finally treatment with barium chloride.

This method of operating gives one-third more sulphur than that found by the first method in the same samples of coal.—W. S.

Estimation of Mustard-oil in the seed of Cruciferae.

O. Förster. Landw. Versuchsstat. 1888, 204—214.
(Compare this Journal 1888, 854.)

25 grms. of seed or cake prepared from it is rubbed to a thin magma with water and placed in a 250 cc. flask, connected with an inverted condenser, the upper end of which is bent so as to dip a few millimeters below the surface of 50 cc. of alcohol saturated with ammonia, contained in a flask. After half an hour, steam is passed into the magma until the liquid in the upper flask amounts to about 200 cc., and after 12 hours standing, in the closed flask, this is transferred to a beaker, boiled, treated with coarse floccy precipitated mercuric oxide, and boiled and stirred for a few minutes. Sufficient potassium cyanide is now added to dissolve the excess of mercuric oxide and the mercurio-ammonium hydroxide. The mercuric sulphide is then collected on a tared filter, washed, dried, and weighed, the weight multiplied by 0.4266 gives the amount of mustard-oil decomposed.—D. A. L.

Analysis of Wool Oils. A. Horwitz. Dingl. Polyt. J. 271, 29—30.

THE oily lubricating materials used in the manufacture of woollen goods are emulsions composed of liquid fats suspended in aqueous alkaline solutions. These coming under the author's notice were usually mixtures of olive and cotton-seed oils with solutions of ammonia and soda. As commercial olive oil is often sophisticated with mineral, rosin, and drying oils, all having an adverse influence on the subsequent manufacturing processes, it is necessary to look for them qualitatively before proceeding with the quantitative analysis, which is conducted as follows:—

1.5 to 2.0 grms. of the material are weighed in a closed vessel and extracted for some hours, with frequent shaking, with ether-alcohol. The soda remains undissolved, is collected on a weighed filter, dried, and weighed; the filtrate is divided into two parts, one of which is evaporated to dryness, giving the fat, while the other is supersaturated with hydrochloric acid and precipitated with platonic chloride, and the ammonia determined by weighing the ammonium platonic chloride formed, or the platinum left on igniting it. The water and ammonia together are determined by drying another portion of the substance at 100°—120° C.

As an example of the composition of this material and an instance of the precision of the method, this analysis may be quoted:—

	Per Cent.
Fat	13.16
Soda	0.91
Ammonia	0.32
Water	84.45
	99.84

The last two constituents represent a *liquor ammoniac* of sp. gr. 0.9983, which was probably used as such in the manufacture.—B. B.

On the Determination of Neutral Fat. M. Gröger. Zeits. f. angew. Chem. 1889, 61—62.

THE author has found that in saponifying cocoa-nut oil, olive-kernel oil, and palm oil for the determination of their saturation equivalents, it is necessary to have present an excess of alkali corresponding to at least 3 cc. of semi-normal acid, as otherwise they do not consume as much as they are capable of neutralising if this condition obtain.

For example a cocoa-nut oil which when saponified with so much alcoholic potash as to require the addition of 0.1 cc. of semi-normal hydrochloric acid to restore neutrality, gave figures corresponding to the presence of 91.9 per cent. of neutral fat, whereas when the excess of alkali was such as to use up 2.95 per cent. of the acid in backward titration, the true value 94.6 per cent. was obtained. That the higher value is correct is shown by the fact that when once the limit mentioned above has been exceeded, further excess of alkali is without effect on the results.—B. B.

Determination of the Quantity of Alkaloid in Zenbane Extract (Hyoscyamine). L. van Itallie. Nederl. Tijdschr. Pharm. Chem. en Toxikol. 1839, 1, 6.

ACIDIFY 5 grms. of the extract with 10 drops of dilute sulphuric acid (1:20), dilute with water to 50 cc., and macerate for 1—2 hours. Add 25 cc. of a 10 per cent solution of lead acetate, and allow to settle. Filter off 50 cc. of the solution through a dry filter paper, add 10 cc. of dilute sulphuric acid (1:10) to the filtrate and again filter off 50 cc. Transfer this second filtrate to a separating funnel, add ammonia to alkaline reaction and extract three times with an equal volume of chloroform. Separate the chloroform extract, distil off the chloroform, dissolve the residue in 5 cc. of dilute alcohol and titrate with centinormal acid. This method may also be applied for the quantitative examination of belladonna and aconite extracts.—C. A. K.

Red Lead. A. Kremel. Pharm. Pest. 1889, 22, 22.

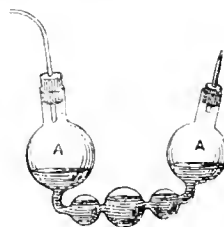
To test red lead for mineral impurities 5 grms. are dissolved in 50 grms. of dilute nitric acid and 1 gm. of oxalic acid added; the insoluble residue should not weigh more than 0.05 gm.—C. A. K.

Red Lead. R. Frühling. Zeits. f. angew. Chem. 1889, 67—78.

See under XIII. page 203.

Determination of Nitric-Nitrogen by Kjeldahl's Method. O. Foerster. Chem. Zeit. 13, 229.

THE author has found the following modification gives good results. The nitrate (about 0.5 gm.) is treated with 15 cc. of phenol-sulphuric acid (6 per cent.), and after it



is dissolved, 1—2 gm. of sodium thiosulphate is added; thereupon, after the decomposition has taken place, 10 cc. of sulphuric acid and the requisite quantity of mercury are added. Sodium thiosulphate is recommended because thereby nitrosylsulphuric acid is formed, from which a loss of nitrogen as nitric oxide need not be feared. Of 14 determinations with pure potassium nitrate, the highest result obtained was 13.91 per cent. of N, and the lowest 13.79 per cent. The author recommends the absorption tube shown in the accompanying sketch, in which the bulbs A have a capacity of about 200 cc.—J. W. L.

Estimation of Benzene in Coal Gas. M. Berthelot. Bull. Soc. Chim. 1888, 660—662.

THE author determines the quantity of benzene in coal gas by introducing into the gas measured over water about 1 cc. of fuming nitric acid contained in a small flask of 20 to 25 cc. and shaking up for about half a minute at the outside and reading off the loss of volume. The action of the nitric acid must not be protracted longer, as the other hydrocarbons, such as acetylene, the olefines, and carbon monoxide may also be attacked. Further details are given in a previous paper (Bull. Soc. Chim. 1888, 171). (See also this Journal, 1889, 61.)—J. B. C.

New Books.

DIE CHEMIE DES STEINKOULENTHEERS MIT BESONDERER BERÜCKSICHTIGUNG DER KÜNSTLICHEN ORGANISCHEN FARBSTOFFE. VON GUSTAV SCHULTZ. Zweite Vollständige Aufgearbeitete Auflage. Zweiter Band. Die Farbstoffe. Dritte Lieferung. 1889. Braunschweig: Druck und Verlag von Friedrich Vieweg und Sohn. London: H. Grevel and Co., 33, King Street, Covent Garden.

IS this Part (the Third), Chapter XXXII, is continued and completed. It deals with Magenta and its Sulphonic Acids. Chapter XXXIII, treats of the Alkyl- and Phenyl-derivatives of Magenta and their Sulphonic Acids, and also of the corresponding Naphthyl compounds. Of course, under these are comprised—(1.) Violet Colouring matters; (2.) Blue Colouring matters; and (3.) Green Colouring matters of the Pararosamine and Rosaniline series. In Chapter XXXIV, are to be found the Phenyl- and Toly-derivatives of the Rosanilines, also the Sulphonic Acids of Triphenylrosaniline, and, finally, Toluidine Blue. Aurin and Rosolic Acid and their derivatives find very complete treatment in Chapter XXXV, and when Chapter XXXVI, is reached, we find a most comprehensive monograph on the Phthaleins, Eosines and Substituted Eosines, under which the new colour Rhodamine appears. Owing to the singular beauty and unique tints produced by this dye, on silks more especially, the original compound has gone through such a series of metamorphoses through substitution, that the Rhodamines are now found to comprise quite a special class of compounds. The volume commences with page 355 and ends on page 576, and it contains three woodcuts.

THE CHEMICAL ANALYSIS OF IRON. A complete account of all the best known Methods for the Analysis of Iron, Steel, Pig-Iron, Iron-Ore, Limestone, Slag, Clay, Sand, Coal, Coke, and Furnace and Producer Gases. By ANDREW ALEXANDER BLAIR, Graduate United States Naval Academy, 1866; Chief Chemist United States Board, appointed to Test Iron, Steel, and other Metals, 1875; Chief Chemist United States Geological Survey and Tenth Census, 1880. London: Whitaker and Co., White Hart Street, Paternoster Square. Philadelphia: J. B. Lippincott, 1888.

THIS is an 8vo. volume bound in cloth, containing 274 pages of subject-matter and an alphabetical index. The text is embellished with 94 wood engravings, and the work terminates with some useful tables. In opening the subject it will be noticed that a few pages are devoted to a matter of which most works on Chemical Analysis are quite oblivious, and yet without due attention to which Commercial Analyses are of little or absolutely no value—this is the subject of Sampling and Apparatus for preparing the Samples. Next comes the subject of Reagents, and then Methods of Analysing Pig-Iron, Bar-Iron and Steel; Determinations of Silicon, Slag and Oxides; Phosphorus; Manganese; Carbon, graphitic and combined; Titanium; Copper; Nickel and Cobalt; Chromium and Aluminium; Arsenic; Antimony; Tin; Tungsten and Vanadium; Methods for the Analyses of Iron Ores, Limestones, Clays, Slags, Fire-sands, Coal and Coke, and Gases. The whole subject appears to receive very complete treatment, for under the principal headings we find, *e.g.*, (1.) Methods of Collecting the Samples; (2.) Preparation of Reagents; and (3.) Methods of Analysis. Further, the text is spaced off and rendered easy of reference by a kind of concurrent index of the various paragraphs in small type.

PRACTICAL ORGANIC CHEMISTRY. The Detection and Properties of some of the more Important Organic Compounds. By SAMUEL RIDEAL, D.Sc. (Lond.), F.C.S., F.I.C., Fellow of University College, London. London: H. K. Lewis, 136, Gower Street, 1889.

SMALL 8vo volume, bound in cloth, containing Preface, Table of Contents, Introduction, 155 pages of subject-matter, a couple of pages devoted to the "Order of Analysis," and an Alphabetical Index. The work is grouped as follows:—The Organic Acids; the Carbohydrates; the Organic Bases, and Neutral Substances. The work may be briefly defined as a small manual of Qualitative Organic Chemistry more especially suited for the Medical Student in his higher examinations, as well as for the student who reads for the London University B.Sc. and Int. M.B. Examinations.

Trade Report.

(From the Board of Trade Journal and other sources.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

THE NETHERLANDS.

Customs Classification of Antipyrine.

According to the *Moniteur Belge* for the 1st February last, the Netherlands Customs authorities have decided that antipyrine is free from import duty, whatever may be the nature of the package in which it is imported.

FRANCE.

Recent Customs Decisions.

Note.—Kilog. = 2·204 lbs. avoirdupois. Franc = 94 $\frac{1}{2}$ d.
Hectolitre = 22 imp. gallons.

A report, dated the 1st February last, has been received from Mr. J. A. Crowe, Her Majesty's Commercial Attaché at Paris, enclosing copies of circulars recently issued by the French Customs Department, respecting the classification of articles in the Customs Tariff and the application of the Customs law of France.

Circular No. 932 withdraws the privilege hitherto granted to importers of lard mixed with less than 25 per cent. of cotton oil to pay duty on the mixture in proportion only to the weight of the oil. From the 1st of May next, lard mixed with any quantity of cotton oil will be charged 6 francs per 100 kilos., like pure vegetable oils (*antres*).

Circular No. 934 reduces the number of volatile essences requiring certificates of origin to 10, viz.: Essences of bitter almonds, cinnamon, cloves, bergamot, lemon of Portugal, lavender, thyme, *bigarade*, mint, and marjoram.

Circular No. 1357 requires that importers should distinguish in their declarations between vinegar made from wine or pyrogenous acid and vinegar derived from an alcoholic base. The latter will not only be charged with the ordinary Excise and Customs due leviable on vinegar, but with a "duty of denaturation" of 37 francs per hectolitre.

SWITZERLAND.

Classification of Articles in Customs Tariff.

Compressed sulphurous acid, in cylinders of wrought iron.—Category 9a. Duty 7 frs. per quintal (220 $\frac{1}{2}$ lbs. avoirdupois).

GREECE.

Modifications in Customs Tariff.

Note.—Drachme = 94 $\frac{1}{2}$ d. Oke = 2·8 lbs. avoirdupois.

The following are extracted from a translation of a law sanctioned by the King of Greece on the 14th February, introducing modifications into the General Greek Tariff in accordance with the annexed table:—

No. in Tariff.	Classification of Articles.	General Import Duty.	
		Oke	Dr. Lep.
11c	Madder seed.....	Oke	0 10
88a	Varnish prepared with oil and boiled linseed oil.....	"	0 30
88b	Varnish prepared in alcohol.....	"	0 70
94	Starch.....	"	0 20
90	Kerosine, paraffin, or other artificial wax	"	1 00
103a	Potash, carbonate of soda, caustic soda used in soap making and glass making, as well as saltpetre for gunpowder making and carbonate of sulphur.....	Free.	
136	Molasses.....	Oke	0 25
137	Sugar, glucose, syrups, and honey.....	"	0 75

UNITED STATES.

Customs Decisions.

The following decisions affecting the classification of articles in the Customs Tariff have recently been given by the United States Customs authorities:—

An article designated as albumen-substitute or glue-paste, which is a compound of albumen, glue, and a hydrocarbon, resembling spirits of turpentine, is dutiable under section 2513 of the Revised Statutes as an unenumerated manufactured article, at the rate of 20 per cent. *ad valorem*.

So-called valerianic ether (valerianate of amyl) is dutiable as a fruit-ether under T. L. 114.

So-called soda-lime, which is a union of two compounds (caustic lime and caustic soda), and is prepared principally for laboratory purposes, is dutiable as a chemical compound under T. L. 92.

An article variously styled "parchment paper," "parchmentised paper," "vegetable parchment," "papyrine," &c., but which, it appears, is in reality paper which has been subjected to a process or treatment to fit it for use with machinery in a manner similar to that for which animal parchment is used, is held not to be a manufacture of paper, under T. L. 388, but to be dutiable as paper not otherwise enumerated under T. L. 392.

An importation of stearine, claimed to be free of duty as an "acid used for manufacturing purposes," was held to be dutiable, under the provisions of section 2513 of the Revised Statutes, as an unenumerated manufactured article, at the rate of 20 per cent. *ad valorem*.

A composition of glue and other substances adapted and intended for use in applying and fixing gold or bronze to paper-hangings, and which is commercially known as "gold-size," is held to be free of duty, under the provision in the free list, T. L. 711, for "gold-size."

An article claimed to be annatto extract, but found upon analysis to consist of water (81.31 per cent.), organic colouring matter, coal-tar colour (13.64 per cent.), and inorganic matter, alumina, &c. (2.02 per cent.), which combination constitutes a lake, is held to be dutiable at the rate prescribed by T. L. 87, for "colours and paints, including lakes."

Oils, cassia, orange, and attar of roses are held to be dutiable as expressed oils under T. L. 92.

"Liquor ammonia odoriferous" is held to be dutiable as a proprietary preparation under T. L. 96.

PERU.

Changes in the Customs Tariff.

The following articles are declared free of import duties:—

Tar; quicksilver; Roman cement; tanner's bark; crucibles; dynamite; gunpowder and other explosives for mining; matches; detonators; chemicals for purifying wine, excepting those of an injurious character; poison for tanning.

CUSTOMS TARIFF OF FIJI.

The following are extracted from a statement of the rates of import duty now levied under the Customs Tariff of Fiji:—

Classification of Articles.	Rates of Duty now levied.
Blue.....	Lb. £ s. d. 0 0 2
Blacking.....	10 % <i>ad val.</i>
Baking powder.....	10 % <i>ad val.</i>
Candles.....	Lb. 0 0 1
Cement.....	10 % <i>ad val.</i>
Dynamine and lithofracteur.....	Lb. 0 0 6
Drugs, including all articles of the kind and form used as medicines.....	15 % <i>ad val.</i>
Earthenware.....	10 % <i>ad val.</i>
Fuse.....	10 % <i>ad val.</i>
Glass and glassware.....	10 % <i>ad val.</i>
Gelatin.....	Lb. 0 0 3
Glue.....	10 % <i>ad val.</i>
Gutta-percha and india-rubber.....	10 % <i>ad val.</i>
Ink.....	10 % <i>ad val.</i>
Kerosene (of not less than 150° test).....	Gallon 0 0 9
Kerosene, all other tests.....	" 0 1 3
Leather.....	10 % <i>ad val.</i>
Methylated spirits.....	Gallon 0 2 0
Matches.....	10 % <i>ad val.</i>

Classification of Articles.

Rates of Duty now levied.

Opium and all preparations thereof.....	Lb. £ s. d. 0 15 0
Oils of all kinds (except medicinal).....	Gallon 0 0 9
Powder (sporting).....	Lb. 0 0 6
Paints, wet or dry.....	10 % <i>ad val.</i>
Perfumery.....	15 % <i>ad val.</i>
Soap (hard and soft).....	Lb. 0 0 1
Soap (fancy, scented, or medicated).....	15 % <i>ad val.</i>
Salt and saltpetre.....	Ton 1 0 0
Soda (crystals).....	" 1 0 0
Turpentine.....	Gallon 0 1 0
Varnish.....	" 0 2 0
Vinegar (in bulk or bottle).....	" 0 0 6

The following articles are free:—Mannres, pitch, powder (blasting), resin, sulphur, and tar.

A general duty of 5 per cent. *ad valorem* is charged on all articles not specified or not included in the free list.

An export duty of 5% per ton is charged on sandalwood, manufactured or unmanufactured.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

TRADE OF FRANCE WITH TUNIS IN 1888.

Mr. J. A. Crowe, Her Majesty's Commercial Attaché at Paris, states that imports from Tunis into France rose from 5,440,039 francs in 1887 to 7,247,754 francs in 1888, and that it is mainly due to an increase of 1,222,850 francs in the value of the trade in olive oil. More wool, too, has been sent to France as well as more wax.

In about the same ratio as the imports into France improved, those of France into Tunis declined, and among the chief decreases were spirits, chemicals, and soap.

FIJI ISLANDS.

Drug Imports.

Fiji imported, in 1887, 188,071l. worth of goods, nearly half of which came from New South Wales, and a considerable proportion from New Zealand and Victoria, which are gaining rapidly at the expense of New South Wales; the United Kingdom contributing about 12 per cent. to the direct trade. The imports include:—

	1884.	1885.	1886.	1887.
Drugs.....	£ 5,286	£ 3,840	£ 2,530	£ 2,088
Soap.....	2,463	2,344	1,765	1,715
Oils and oil stores.....	10,497	8,974	7,811	7,954
Paints.....	2,284	1,077	1,030	1,174

SPAIN.

Olive Oil in Malaga.

The cultivation of the olive in the Malaga district is declining, not so much owing to the failure of the last two crops as to the backward nature of the processes in use for extracting the oil. Improvements in this respect have been limited to the substitution of iron for stone rolls, and screw or hydraulic presses for the traditional wooden beam, which some of the farmers still continue to use. These improvements have had for their object merely an increase in the quantity of the oil by exercising greater pressure on the olive, but very little attention has been given to improving the quality. This is especially to be regretted, as the coarser kinds of olive oil are now being supplanted by seed oils and petroleum—the latter being used for lamps, the former for lubricating machinery and the manufacture of soap. Hence the oil trade of Malaga is undergoing a severe crisis, and the price of olive oil, which used to range between 9s. and 9s. 2½d. the "arobe" (25 lbs.), has now fallen to between 6s. and 7s. The trade in oils is likewise hampered by the exorbitant railway tariffs, which considerably impeded its transportation by land.—*Chemist and Druggist*.

TURKEY IN EUROPE.

Drugs in Constantinople.

Nearly all chemicals sold in Constantinople, says the Austrian Consul, are of German manufacture, a few specialties and also quinine being bought from Milan. In drugs, the principal trade is done by London, Marseilles, Genoa, and Hamburg. Pharmaceutical preparations are partly supplied by France, but some of the large German factories have been able lately to find a large share of the trade formerly done by the French.

Terms.—Drugs are always bought "c.i.f. Constantinople," chemicals, &c., delivered at Trieste or Marseilles. Great Britain sells almost exclusively on cash terms, France gives three to four months' credit, but German, Austrian, and Italian dealers must generally allow from four to five months' credit.

—*Chemist and Druggist.*

UNITED STATES OF COLOMBIA.

Coca.

Scarcely any plant cultivated in Colombia can be said to be confined exclusively to the temperate zone, except perhaps coca, which, however, is now little grown. It is only in general use as an article of daily consumption in the south of the department of Cauca, where it is the custom to hire labourers at so many reals a day and so much coca. But it is grown in small quantities in several parts of the country, and used mostly by Indians. It is also sold for medicinal purposes in the markets of most of the large towns. At the time of the Spanish conquest it was general all over the country, but the use of it gradually died out. The recent demand for coca for the extraction of cocaine does not seem to have stimulated its cultivation in any part of the country. About 1,000 lbs. were exported in 1887.

Eucalyptus.

Eucalyptus trees have been largely planted during the last 20 years in many parts of the country, especially on the savana of Bogotá. The *E. Globulus* is the species which has been most planted, though others, such as the *E. citriodora*, *E. rostrata*, and *E. saligna*, have been tried. Many attempts have been made to introduce some species of the tree into very hot districts, such as Carthagena and some parts of the Magdalena valley, but so far without success.—*Chemist and Druggist.*

EXTRACTS FROM THE REPORT OF THE UNITED STATES CONSUL AT BUENOS AYRES ON THE INDUSTRIES AND COMMERCE, &c. OF THE ARGENTINE REPUBLIC.

An increased impulse is noted in every department of trade and industry, and the Consul thinks that, in spite of the minor impediments of bad financial management and a persistent disregard of the laws of trade, the movement is not fictitious, but genuine.

New industries are cropping out in all directions, and all classes of the people are aroused to the possibilities of the new departure. On the other hand the constantly increasing volume of irredeemable currency and the continuance of the suspension of specie payments make it only too easy to float the most extravagant schemes, and many are being carried beyond the bounds of prudence into speculation. At the same time there is greater confidence in the stability of the institutions of the country, and accordingly both capital and labour are flowing into the country.

According to official returns, 128,797 immigrants arrived during 11 months of 1888, as against 137,426 for all 1887, and 93,116 for 1886. The Consul does not recommend it as a field for immigration for English-speaking peoples accustomed to a higher plane of civilisation, but considers it most suitable for immigrants from the shores of the Mediterranean, who are similar to the people of the country in language and habits, and soon assimilate with the native population.

The Consul, after treating of the railway and maritime facilities offered, proceeds to treat of the internal commerce and agriculture of the Republic. Under this last head he mentions that the shipments of crop products in 1887 were as follows, and gives the shipments for 1882 for the sake of comparison:—

Articles.	1882.	1887.
	Tons.	Tons.
Wheat.....	1,705	237,865
Flour	548	5,401
Indian corn.....	167,327	361,844
Linseed.....	23,351	81,208
Barley.....	1,100	4,194
Peanuts.....	422	3,367

He considers that, owing to bad weather, the exports for 1888 will show a decrease. Of the above exports the linseed nearly all goes to England, and the peanuts to France for the manufacture of olive oil.

The following are the shipments of metals and minerals for 1887 and first nine months of 1888:

Principal Articles.	1887.		First nine Months of 1888.	
	Kilos.	Value.	Kilos.	Value.
		Dollars.		Dollars.
Copper in bars..	143,287	57,315	115,770	46,308
Copper mineral .	4,110	1,644	262,622	48,250
Silver mineral ..	106,780	53,090	321,000	161,660
Lead ore.....	156,386	12,544	96,316	7,706
Silver, pure.....	1,630	61,753	12,837	447,969
Gold dust.....	..	..	325,524*	55,101
Bismuth .....	..	..	35,072	140,288
Tin .....	..	..	301,835	159,818
Silver metal ....	..	..	11,070	110,700
Total Value.	..	186,356	..	1,195,137

* The figures for gold dust must be erroneous.

The gold referred to above is believed to be the product of recent mining operations in Tierra del Fuego.

The Consul believes that there are immense deposits of other valuable metals besides gold in various parts of the Argentine Republic, but to develop them will, in his opinion, require careful scientific investigation into the geology of the country. Coal has been discovered, but, so far, has not been utilised; and enormous petroleum reservoirs occur in the provinces of Mendoza, Salta, and Jujuy, but thus far, notwithstanding a high protective duty, no oil has been placed upon the market.

Foreign Commerce of the Argentine Republic.

Commerce.	1886.	1887.	Increase.
	Dollars.	Dollars.	Dollars.
Imports	95,408,715	117,352,125	21,943,380
Exports	69,834,841	84,421,820	14,586,979
Total	165,243,586	201,773,945	36,530,359

Commerce is conducted mainly through the ports of Buenos Ayres and Rosario, and was distributed as follows in 1887:—

Countries.	Imports.	Exports.	Total.
	Dollars.	Dollars.	Dollars.
Germany	12,108,456	9,835,754	21,944,210
Belgium	10,947,955	12,111,531	23,059,486
United States....	11,004,553	5,938,808	16,943,361
France	22,743,550	24,871,354	47,614,904
Italy.....	7,937,741	3,167,113	10,144,854
Great Britain....	34,779,219	17,085,061	51,864,220

The imports for 1887 as compared with 1886 have increased from the following countries:—

Countries.	Increase.	Countries.	Increase.
	Dollars.		Dollars.
Germany	2,063,581	France	5,741,512
Belgium	3,226,038	Italy	2,390,501
United States	3,331,269	Great Britain	1,316,559

The exports in the same period have increased to:—

Countries.	Increase.	Countries.	Increase.
	Dollars.		Dollars.
Germany	3,884,846	France	2,520,171
Belgium	1,186,794	Italy	630,675
United States	2,358,402	Great Britain	7,013,152

Imports of Chemicals, Drugs, and Drysalteries of the Argentine Republic during 1887.

Articles.	Quantity.	Official Value.
		Dollars.
Groceries and comestibles:—		
Olive oil	Kilos. 5,616,026	1,976,107
Starch	" 890,700	148,072
Sugar, refined	" 22,912,687	4,353,497
Spices and condiments	" 1,386,889	396,355
Salt, table	" 954,717	57,283
Liquors:—		
Alcohol and other liquor	Litres 345,483	115,850
Syrups	" ..	6,336
Drugs and chemicals:—		
Sulphuric acid	Kilos. 954,392	47,720
Muriatic acid	" 38,147	11,442
Nitric acid	" 11,161	3,094
Other acids	" ..	28,409
Linseed oil	Kilos. 627,245	125,419
Palm oil	" 138,098	31,900
Oil of other kinds	" ..	94,115
White lead	Kilos. 11,150	2,013
Alcohol	Litres 140,135	22,690
Tar	Kilos. 313,476	20,373
Alum	" 62,232	3,171
Liquid ammonia	" 50,325	17,583
Indigo	" 4,210	10,947
Sulphur	" 305,335	19,832
Turpentine	" 772,584	123,611
Varnish	" 151,413	88,710
Bicarbonate of potassa	" 1,121	647
Bicarbonate of soda	" 58,259	6,220
Benzine	Litres 40,009	4,253

Articles.	Quantity.	Official Value.
		Dollars.
Blackening	Kilos. 154,664	43,763
Borax	" 62,640	9,396
Chloride of lime	" 123,956	6,198
Carbonate of magnesia	" 1,858	743
Carbonate of potassa	" 18,847	3,770
Carbonate of soda	" 115,270	5,764
Glue	" 159,766	33,113
Colours, in powder	" 1,060,526	163,314
Colours, prepared	" 3,341,812	313,103
Fire crackers	" 190,504	69,826
Dextrin	" 10,251	2,050
Stearin	" 34,535	10,360
Essences of all kinds	" ..	44,105
Specifics for curing sheep scab	" ..	190,261
Phosphorus	Kilos. 2,115	2,538
Glucose	" 71,936	7,193
Gelatin	" 11,556	6,885
Gum	" 165,134	78,808
Glycerin	" 8,323	3,101
Soap, common	" 43,933	12,836
Soap, perfumed	" 129,138	66,737
Malt	" 1,703,121	244,410
Medical preparations	" ..	6,89,971
Perfumery	" ..	428,563
Rosin	Kilos. 2,527,975	75,839
Potassa	" 15,078	3,015
Powder and other explosives	" 114,528	59,565
Various pharmaceutical products and substances	" ..	188,241
Various chemical products and substances	" ..	515,255
Common salt	Hectols. 348,981	216,368
Calcined soda	Kilos. 2,284,310	90,573
Caustic soda	" 267,842	18,749
Sulphate of iron	" 70,007	1,400
Sulphate of magnesia	" 4,145	290
Sulphate of quinine	" 40	2,200
Sulphate of lime	" 260,951	5,219
Printing ink	" 88,416	19,451
Writing ink	" 81,301	12,195
Tremintine	" 1,928	135
Vaseline, common	" 12,147	6,973
Total	" ..	4,188,968

The imports of drugs and chemicals in 1887 showed an increase of 481,983 dols. over those of 1886.

Speaking of imports generally the Consul considers them "out of all proportion to a healthy condition of trade." The country is persistently buying more than it sells, and meets the difference by sending abroad the gold which its Government borrows.

It is true that the trade returns do show a large increase of exports. In 1887 they were 14,586,979 dols. greater than 1886, or an increase of 20 per cent.; but until there is a very decided increase in them, or a decrease in the imports, the commerce of the country cannot be said to be in a safe condition.

Argentine Trade with Great Britain.

If the trade with France shows a remarkable progression, that with England presents a still more surprising increase. In the last eight years it has more than triplicated, since from 17,272,193 dol., in 1880 it has reached to 51,864,229 do's. in 1887. In 1880 the imports from Great Britain amounted to only 12,103,660 dol.; in 1887 they were 34,779,211 dol.; in 1880 the exports to Great Britain were 5,168,732 dol.; in 1887 they were 17,085,001 dol. The imports from Great Britain were as follows:—

Articles.	Value.
	Dollars.
Live stock.....	200,160
Groceries and comestibles	1,297,330
Liquors.....	476,556
Woven goods	12,505,481
Ready-made clothing.....	2,150,635
Chemicals and drugs	1,227,134
Furniture	227,587
Paper.....	328,800
Boots and shoes	304,518
Iron and iron utensils.....	10,088,224
Jewellery, &c.....	515,717
Glass and crockery ware	860,515
Stone coal.....	3,854,422
All other imports.....	762,620
Total Imports	34,779,219

The exports to Great Britain comprised the following articles:—

Articles.	Value.
	Dollars.
Sheep skins	590,366
Salted ox hides	1,081,990
Wool, unwashed	500,024
Linseed (62,974,984 kilos.)	3,148,749
Indian corn (177,769,044 kilos.)	3,555,382
Wheat (143,947,643 kilos.)	5,837,906
Bones and bone-ash	243,219
Salt beef	401,558
Frozen mutton	838,702
Flour	28,769
Grease and tallow	273,196
Precious woods	82,928
Copper and silver ore	97,572
All other exports	390,867
Total Exports.....	17,085,001

It will be seen, from this table, that the surplus agricultural products of the country are beginning to find a market in England in such quantities as to cause no inconsiderable increase in the amount of exports to that country.

Imports of Chemicals and Drugs from the United States into Argentine Republic in 1887.

Articles.	Quantity.	Official Value.
		Dollars.
Chemicals, drugs, &c. :—		
Acids .....	..	140
Oils.....	..	18,745
Alcohol	Litres 144	29
Indigo	Kilos. 1,700	18
Turpentine .....	.. 600,915	110,546
Varnish.....	.. 39,307	3,844
Blacking.....	.. 109,513	20,569
Carbonate of soda .....	.. 769	38
Paints, in powder .....	.. 25,500	2,063
Paints, prepared .....	.. 10,431	1,283
Fire crackers .....	.. 169,623	59,398
Essences.....	..	3,276
Specifics for sheep scab .....	..	26,702
Glycerin	Kilos. 15	15
Toilet soaps.....	.. 457	207
Patent medicines .....	..	99,077
Perfumery.....	..	3,581
Rosin.....	Kilos. 1,743,056	52,296
Potassa .....	.. 3,840	768
Pharmaceutical products .....	..	6,294
Chemical products .....	..	32,851
Calcined soda.....	Kilos. 14,396	576
Sulphate of lime .....	.. 47,167	943
Printing ink .....	.. 12,674	2,788
Writing ink .....	.. 2,382	357
Vaseline .....	.. 11,926	5,981

The Consul considers that the establishment of American sample houses has contributed not a little to swell the trade with the United States, but thinks that more could be done.

The trade returns for the first nine months of 1888 show an excess of imports over exports of 33,604,846 dol., which is more than the total excess of any previous year, but the excess consists almost entirely of liquors, fine clothing, and objects of luxury.

The Consul concludes with a detailed account of the finances and prospects of the country in which on the whole he takes a favourable view of the future.

MISCELLANEOUS TRADE NOTICES.

PRODUCTION OF QUICKSILVER IN RUSSIA.

La Nature points out that quicksilver was discovered in Russia in 1879, close to Nikitowka. In 1885 a company was established to work a mine, and this company began its labours in 1886. During the first year, 1887, the mine produced 3,911 pounds of mercury, that is to say, 64,966 kilos. It is estimated that the whole quantity of ore in the mine amounts to about 12 millions of pounds, of which 1·2 per cent. is mercury.

PRODUCTION OF METALS IN RUSSIA.

The *Gazette de Moscou* states that, according to a report recently issued by the Russian Administration of Mines to the Government, there were extracted in 1886 in Russia 1,720 pounds of fine gold, 263½ pounds of platinum, and 279,056 pounds of copper.

FOOD ANALYSIS IN ST. PETERSBURG.

The Russian *Nouveau Temps* states that two hygienic laboratories have been opened recently in the busiest parts of St. Petersburg, at which gratuitous analyses are made at any time of specimens of the following articles of consumption:—Drinking water, milk, flour, bread, meat, wine, beer, and kvass. What is offered in these laboratories is merely a general opinion as to whether foreign substances occur in the articles submitted, and whether the latter are fresh or not.

MANGANESE DEPOSITS IN TRANSCAUCASIA.

The *Revue Commerciale et Industrielle du Caucase* for the 15th (27th) January last, says that the persons working the deposits of manganese in Transcaucasia have for a long time solicited the aid of the Government for the construction of a branch railway between Kvirila and Tchihtoury. In the Chorapan district, and in the basin of the Kvirila, the beds occupy an area of 126 square versts (verste = 663 of a mile). The workings have been begun on both banks of the river in the neighbourhood of the villages of Rgami, Zéda-Rgami, Gvimevi, Perévissi, Choukrouty, and Itkhivissi. The manganese, carried with great difficulty on the backs of horses, mules, and by *arabes*, to the Kvirila station, is from there sent to Poti or Batoum.

Professor Kotsovsky, who was sent in 1886 by the Administration of Mines to Transcaucasia in order to examine the deposits of manganese there, has just published the results of his mission, and the following are his conclusions with respect to the projected railway:—

1. Notwithstanding the wealth of the Tchihtoury beds, they cannot be considered as being remarkable. In the Caucasus beds of manganese, having an area of 18 versts and containing more than 55 per cent. of metal, have been discovered.

2. As regards quality, the Tchihtoury ore is exposed to the competition of the ores of America, Spain, Caucasia, and deposits discovered in the Government of Catherineopol. According to analyses made, the Tchihtoury ore contains 55 per cent. of manganese; that of the environs of Tiflis, 60.34 per cent.; of Adjameti, 49.60 per cent.; of Novo-Souaki, 54 per cent.; of Tiflis, 48.72 per cent.; of Koukass, 49.48 per cent.; of Mexico and Chili, 55 per cent.; of Spain, 50.55 per cent.; and of Sweden, 47.20 per cent.

3. The manganese industry is profitable both for the owners of the deposits and for the contractors.

4. Although a brilliant future awaits the manganese industry, the construction of a railway with Government assistance does not appear to me at the present moment opportune.

5. A railway would not put a stop to the abuses committed by the contractors for the carrying of the ore.

6. A railway will not contribute to the improvement of the manganese industry until a better system for working the deposits is adopted.

7. The construction of a road is the only practicable means which may be recommended. With a good route, from 10 to 12 copecks per pound of ore will be saved in transport.

8. A system of control over the manganese industry in Transcaucasia and Caucasia should be organised.

9. The contractors and manufacturers who work the manganese deposits have a net profit of from 3 to 6 copecks per pound of ore, and the merchants who purchase the ore at the station of Kvirila gain in their turn 11 copecks per pound.

BRAZILIAN INDIA-RUBBER.

The journal *Le Brésil* states that during 1887 Brazil exported 15 million kilos. of india-rubber. The supply was abundant in 1888, but there is more than 15 million reis difference between the price obtained by sales last year and the year before. On account of the difficulties thus raised, the price of cocoa has also fallen, and that article now with difficulty fetches 400 reis, where last year it was sold for 500 reis. The amount of india-rubber produced in Brazil of late years may be seen from the following statement:—

Kilos.

1883-84	10,463,000
1884-85	11,885,000
1885-86	12,835,000
1886-87	13,395,000
1887-88	15,766,000

The largest quantity came from the province of Para.

COCOA NUT OIL IN CUBA.

We learn from *La Nature* that a special industry, and one which seems likely to enjoy a certain amount of success in the future, has been started at Baracoa in Cuba by a Frenchman. This is the manufacture of cocoa nut oil. According to a report which has been made by M. de Bérad, the French Consul at Santiago de Cuba, this factory has been fitted up with the latest inventions in the way of machinery for producing an oil of absolute purity. The cocoa oil, besides its medicinal properties, is useful as a lubricant, and as material for the manufacture of soap. It can also be employed for lighting. The refined cocoa oil is more economical than most other mineral and vegetable oils. It is very fluid and does not easily turn rancid.

EXPERIMENTAL CULTIVATION OF MYROBALANS IN SOUTH AUSTRALIA.

The *Adelaide Observer* for the 29th December last states that the South Australian Forest Department intend to plant seeds of myrobalans of commerce, which have been received from India, with a view of ascertaining whether they can be cultivated in the colony. The plant is used in dyeing cloth and leather.

THE AGRICULTURAL AND INDUSTRIAL CONDITION OF GUATEMALA.

See Board of Trade Journal for March, p. 333.

PRODUCTION OF WILD SILKS.

(From *L'Industrie Textile*.)

See Board of Trade Journal for March, p. 350.

THE TRADE OF BENGAL IN 1887—88.

See Board of Trade Journal for March, p. 355.

INDIA-RUBBER IN BURMAH.

The requirements for india-rubber being now so large, it is satisfactory to know that the india-rubber trade on the Chindwin, in Burma, although it has only existed for about a year, has increased to such an extent that the local government has placed a large export duty on all rubber passing Kendat, the first revenue station on the way to the seaports, besides imposing a licence costing ten rupees per annum on all brokers or buyers of the article. According to a recent report, rubber is extracted from the *ficus elastica*, which is similar in appearance to the banyan tree, except that the leaves are larger and of a darker colour. Each tree is tapped daily during the season, which extends from November to June, nothing being done during the remainder of the year. In April 1887 a Chinese syndicate at Bhamo received a monopoly for the extraction of rubber in the Mogong district. This expired last October, and since then the trade has been thrown open to all. On the Chindwin the trade is in the hands of an English company, which, in spite of vigorous opposition from the Chinese traders, is working satisfactorily, because the natives prefer dealing with the Europeans. All the transport is carried on by native boats down the Chindwin to Kendat, where the rubber is transhipped into steamers. The system of collecting is to send a contractor with a sum of ready money to all the villages in a particular district to make advances to the headmen, who, in their turn, send the villagers to the forests to extract the rubber, so that month by month each station has its own stock. This is bought for cash and sent down the river, the headmen keeping the advance for further operations.—*Engineer*, 1889, 117.

NEW LEAD MINES IN RUSSIA.

Very extensive lead deposits have been recently discovered in the upper basin of the river Kubina and its affluents. The most important find is at Katherinskoe, but the others are also valuable. The use of lead has been probably at least doubled in Russia during the last five or six years, and the increased demand led to explorations for further supplies being conducted, under Government patronage, in the Kirghiz steppes and elsewhere. Those conducted in Kirghiz yielded but scanty results; but the efforts of the promoters were very successful in the Kubina basin, and works are there to be started immediately.—*Ironmonger*.

A NEW TEXTILE.

According to the French *Revue des Colonies*, a new textile plant which is called "kamall" by the natives, has been discovered on the shores of the Caspian; and M. O. Blakenbourg, an engineer and chemist, has obtained from it a soft, elastic, and silky material, which gives a very tough thread, and can be chemically bleached without losing its strength. It can also be dyed. It is specially adapted for sacks, tarpaulins, ropes, &c., and it is stated that its specific weight is much less than that of hemp, whilst its tensile strength is greater.

DRAWBACK ON SPIRITUOUS PREPARATIONS.

The following are the settled terms of the new General Order, dated March 1889, relating to the drawback on spirituous medicinal preparations. This Order amends that given in this Journal, December No., 1888, p. 875.

The Board having had under further consideration the conditions prescribed by the General Order of the 26th November last, under which certain tinctures, liniments, and medicinal spirits (hereinafter referred to as tinctures) may be exported, and repayment allowed of the duty on the spirits estimated to be lost in the manufacture of such tinctures, &c.:—

Ordered:

That the tinctures be allowed to be packed in cases containing two or more complete bulk gallons instead of five as heretofore.

The size of the bottles containing the tinctures may range from a quarter of a pint to half a gallon instead of from one pint to half a gallon, as heretofore, and the bottles may contain any of the following quantities, viz.:— $\frac{1}{4}$ -pint, $\frac{1}{2}$ -pint, 1 pint, 2 pints, or 4 pints.

The Form No. 111—4 is to be revised by the addition of a column, in which the actual alcoholic strength of the tinctures is to be entered by the rectifier or compounder exporting them.

A corresponding additional column is also to be added in the officer's book for exporter's declaration of strength of spirit in terms of proof.

One sample out of every ten, or fraction of ten kinds of tinctures prepared at each of the two initial strengths is, as a rule, to be

taken by the officer, instead of a sample of each kind as heretofore. A larger proportion of samples, may, however, be taken should the officer, in his discretion, consider it necessary. The quantity taken for a sample is in future to be one gill. In the cases of compound spirit of ammonia and of sweet spirits of nitre, samples will always be taken.

If on examination of a sample at the laboratory the strength is found to vary by not more than two degrees from that declared by the rectifier or compounder, the declaration will be regarded as correct, and drawback, &c. allowed accordingly.

If the strength found be less than that declared by more than two degrees, a deduction to the extent of the difference, and a further deduction of one degree is to be made in calculating the proof quantities of all the tinctures of the same initial strength in the consignment, but if the difference amounts to five degrees, double that difference is to be deducted from the laboratory strength in calculating the proof quantity.

In future medicinal tinctures of every sort may be exported in cases of a minimum size of two gallons, under the provisions of the General Order of 26th November 1888, as now amended, but tinctures not included in the list appended to that Order, or in the supplementary list issued herewith, will be entitled to drawback and the allowance of 4d. per gallon only, but not to the special allowance for waste granted in respect to tinctures included in those lists.

STATISTICS.

QUICKSILVER.

IMPORTS.

	1889.	1888.	1887.	1886.
February	Bottles. 8,546	Bottles. 10,758	Bottles. 9,641	Bottles. 12,488
Jan.—Feb.	15,798	22,318	19,045	16,984
EXPORTS.				
February	4,489	1,576	3,232	4,906
Jan.—Feb.	8,973	3,757	9,206	8,099
Average Price:	£ s. d.	£ s. d.	£ s. d.	£ s. d.
February	8 8 6	8 19 0	7 5 6	5 17 6

March 1889.

Alex. S. Pickering.

Importations into London for the Three Months of each Season, to 28th February.

	1889.	1888.	1887.	1886.	1885.
	Bottles.	Bottles.	Bottles.	Bottles.	Bottles.
Government Spanish...	17,000	20,000	16,000	16,000	8,000
Other Spanish	204	485	..	170	200
Italian	2,800	2,400	2,200	1,896	2,150
Austrian	1,300	600	1,100	900	..
Californian, Borneo, and indirect import .....	..	800	..	..	..
Total Bottles	21,304	24,285	19,300	18,966	10,350

Export from London for the Three Months of each Season, to 28th February.

	1889.	1888.	1887.	1886.	1885.
Bottles	12,264	6,057	14,316	12,550	12,046

The following table has been prepared from the Board of Trade returns for the United Kingdom.

IMPORTS OF QUICKSILVER INTO AND EXPORTS FROM ENGLAND DURING THE YEAR 1888.

	Flasks.
Total imports	73,768
Total exports as follows	47,133
To	
Russia, Norway, Sweden, and Denmark	123
Germany	1,191
Holland and Belgium	1,358
Channel Islands	40
France	4,881
Austria, Italy, and Roumania	8
Spain and Portugal	475
Turkey	33
Egypt, Morocco, and Gold Coast	88
Cape of Good Hope and Natal	717
Madras, Bombay, and Bengal	3,076
China	10,267
Japan	334
N. S. Wales, Victoria, Queensland, and South Australia	1,598
New Zealand	143
Canada	13
United States, North America	4,649
Mexico	9,967
West Indies	218
Central America	253
Colombia, British Guiana, and Venezuela	190
Brazil, Argentine Republic, Uruguay, and Bolivia	764
Peru and Chili	3,831

Compared with 1887, we have the following:—

	1887.	1888.
Imports	61,114	73,768
Exports	62,606	47,133

BOARD OF TRADE RETURNS.

The Trade and Navigation Returns for February are of a more mixed kind than those of the preceding month. Imports show an increase of 92 per cent., which is as much as they did in January, but exports have decreased 13 per cent. It would be foolish to lay any stress on these figures yet, especially as the imports of raw materials for textile industries continue as heavy as those of food. A mere accident of weather often affects the totals on both sides in the winter months, and the fact that last year gave February the extra working day of leap year would be quite enough to account for the smaller exports. Subjoined are the usual summary tables for the month:—

Imports.

Compared with February 1888.

	Total.	Increase.	Decrease.
	£	£	£
Animals living	486,843	40,733	..
Articles of food and drink (duty free)	9,342,955	1,340,246	..
Articles of food and drink (dutiable)	2,019,174	..	30,239
Metals	1,988,850	..	137,019
Chemicals	955,619	..	109,012
Raw materials for textile manufacturers	8,411,385	969,152	..
Raw materials for other industries	2,353,142	232,072	..
Manufactured articles	5,062,640	419,277	..
Miscellaneous articles	1,330,969	14,291	..
	32,511,877	3,055,371	276,270
		276,270	
Net Increase		2,779,101	

Exports.

	Compared with February 1888.		
	Total.	Increase.	Decrease.
	£	£	£
Articles of food and drink...	687,681	..	56,979
Raw materials	1,129,633	191,551	..
Cotton manufactures	1,766,753	..	386,955
Linen manufactures	491,044	..	18,234
Woollen and worsted man- ufactures	1,058,111	..	60,103
Metals and ironwork	2,674,984	..	289,829
Machinery and millwork....	981,378	54,775	..
Articles of personal use	911,827	..	22,703
All other articles	5,008,773	205,338	..
	18,609,284	451,664	834,803
			451,664
Net Decrease			383,139

—*Chemist and Druggist.*

LEADING IMPORTS IN FEBRUARY.

Amongst the principal imports during February were the following, which are compared with those during the same month of 1888, and also with those of January 1889:—

Article.	Month of February 1889.	Month of February 1888.	Month of January 1889.
Brimstone	Cwt. 116,892	74,544	29,666
Caoutchouc	" 37,734	28,242	22,579
Copper, ore	Tons 10,931	7,435	18,358
" regulus, &c. ..	" 11,156	6,419	6,918
" unwrought ..	" 4,000	4,722	3,917
Glass, all sorts	Cwt. 113,080	131,277	152,967
Gutta-percha	" 1,813	928	2,399
Iron, ore	Tons 366,711	336,379	323,945
" bar	" 1,977	6,647	5,380
" girders, beams, and pillars ..	" 1,962	3,618	6,251
" manufactures, unenumerated ..	Cwt. 241,840	263,342	254,181
Steel, unwrought	Tons 557	434	608
Lead, pig and sheet ..	" 9,423	10,368	12,997
Petroleum, all	Gall. 8,616,780	6,835,619	6,327,762
Pyrites, iron, copper, and sulphur	Tons 67,327	52,362	89,264
Quicksilver	Lbs. 610,962	806,850	543,925
Saltpetre	Cwt. 25,846	32,945	37,833
Tallow and stearine ..	" 89,489	79,755	96,682
Tar	Brls. 2,633	1,778	2,321
Teeth, elephants', &c.	Cwt. 457	606	1,481
Tin, all sorts	" 12,321	79,368	58,917
Zinc, crude cakes	Tons 3,661	4,367	4,369
" manufactured ..	Cwt. 29,885	25,110	30,464

—*Ironmonger.*

THE SALT UNION.

The Salt Union have issued their price list for March. Since the Union recently took over various Cheshire saltfields they have raised the price of common salt from 7s. 6d. to 13s. 6d., butter salt 7s. 6d. to 15s. 6d., Calcutta salt from 8s. 6d. to 16s. 6d., and banded squares for domestic use from 13s. 6d. to 35s. per ton.—*Manchester Evening News*, 8.3.89.

ACID PRODUCTION IN FRANCE.

For the past two years the quantity of sulphuric acid produced has largely increased. Although the exportation in 1888 was 6,000,000 kilos. (6,000 tons) less than in 1887, it was 5,000,000 kilos. more than in 1886. Much of the chemical is used for the manufacture of superphosphates, also quantities of acid at 66° have been required for making melinite. Pyrites are largely employed. Southern manufacturers preferring the Spanish mineral, and Northern the mineral pyrites, as well as the Swedish, which contain no arsenic. The importation of pyrites was, in 1886, 22,000 tons; in 1887, 24,000; and in 1888, 30,000; while the exportation for the same periods was 23,500, 19,500, and 21,500 tons. As to sulphur, 192,000 tons were imported during the three years now considered. Muratic acid has experienced similar changes, the production and importation having increased in 1888, while the exportation was about a thousand tons less than the year preceding.—*Chemist and Druggist*.

THE RAILWAY AND CANAL TRAFFIC ACT.

BOARD OF TRADE NOTICE.

The Board of Trade have extended the period within which objections may be lodged against the classifications of merchandise traffic and schedules of maximum rates and charges submitted by the various railway companies, under the provisions of the Railway and Canal Traffic Act, 1888. The period, as originally fixed for lodging objections, would, in the case of the majority of the railway companies, have expired on or about April 9. It having been strongly represented that the period allowed was insufficient, it has now been extended to the 3rd of June next, before which date all objections against the proposed classifications of merchandise traffic and schedules of maximum rates and charges should be transmitted to the Board of Trade.—*Standard*, 22.3.89.

A SUGGESTED CLASSIFICATION OF CHEMICAL MERCHANDISE,
AS APPROVED BY THE CHEMICAL COMMITTEE OF THE
MANCHESTER CHAMBER OF COMMERCE.*

The following is the classification of chemical merchandise suggested by the Committee:—

CLASS A.

In owners' waggons, and at owners' risk. Not sheeted, loaded, and unloaded by owners.

(a) Minerals and all non-combustible solid chemicals, and raw materials used in the chemical and allied industries, in bulk, and in quantities of not less than four tons.

(b) Liquids, when sent in vendors' or purchasers' tank-waggons in quantities of not less than five tons.

(a) Such as for example:—

Acetate of lead.	Bichromates.
Acetate of lime.	Bisulphite of soda.
Acetate of soda.	Blacklead.
Alabaster.	Blanc fixe.
Alum.	Bleaching powder.
Alum cake.	Blue, powder and stone.
Alum waste.	Box ore.
Alumino-ferrie cake.	Bone-ash.
Alumino-silicic cake.	Bones.
Antimony ore.	Bone waste.
Antimony ore waste.	Boric acid.
Antimony regulus.	Borax.
Arsenate of soda.	Bronze powder.
Arsenic.	Cake for cattle.
Asbestos.	Carbonate of ammonia.
Barytes.	Carbonate of lime.
Bicarbonate of soda.	Carbonate of potash.

* Note.—This classification is also under consideration by the Chemical Committee of the London Chamber of Commerce.

Carbonate of soda.
Calamine.
Caustic potash.
Caustic soda.
Cement.
Cement stone.
Chalk.
Chalk lime.
Charcoal.
China clay.
China stone.
Chlorate of potash.
Chloride of calcium.
Chloride of zinc.
Chromate ore.
Cinnabar ore.
Citric acid.
Clay.
Coal and cannel.
Coal cinders.
Coal fuel (patent fuel).
Cobalt ore.
Coke.
Colours and pigments (dry).
Coppers.
Copper ore.
Copper precipitate.
Copper regulus.
Cuprolites.
Cryolite.
Culm.
Disinfecting powder.
Dross (metal).
Dye liquor refuse.
Earth (red).
Emery.
Emery dust.
Emery stone.
Farinaceous substances (such as flour, starch, farina, sago, &c.).
Fuller's earth.
Gauze.
Gas carbon.
Gas lime.
Gas purifying refuse.
Guano.
Gypsum.
Infusorial earth.
Iron ore.
Iron ore refuse for and from gas purifying.
Iron pyrites.
Iron salts, in crystal or powder.
Kainit.
Lead ashes.
Lead ore.
Lias lime.
Lime.
Limestone.
Litharge.
Magnesia.
Manganese ore.
Manure of all kinds.
Mill scale.
Mineral white.
Muriate of ammonia.
Muriate of manganese.
Muriate of potash.
Nickel ore.
Nightsoil.

Nitrate of baryta.
Nitrate of copper.
Nitrate of lead.
Nitrate of soda.
Nitro cake.
Ochre.
Oxalic acid.
Oxide of iron.
Peat.
Pipeclay.
Pitch (coal-tar).
Plaster.
Plaster stone.
Plumbago.
Plumbago ore.
Pumice-stone.
Putty.
Pyrites.
Red lead.
Red and purple ore.
Rock crystal.
Rock phosphite.
Rock salt.
Rotten stone.
Sal-ammoniac.
Salt.
Salt-cake.
Salt-petre.
Scrap tin.
Scrap zinc.
Silicate of soda.
Silicate cotton.
Silver ore.
Silver precipitate.
Skimmings flux.
Slack.
Slag or scoria.
Slag wool.
Soapstone.
Soda.
Soda-ash.
Soda crystals.
Spar.
Sulphur.
Sulphur ore.
Stannate of potash.
Stannate of soda.
Stone blue.
Sugar of lead.
Sulphate of alumina.
Sulphate of ammonia.
Sulphate of copper.
Sulphate of iron.
Sulphate of lime.
Sulphate of potash.
Sulphate of soda.
Talc.
Tap or mill cinder.
Tartaric acid.
Terra alba.
Tin crystals.
Tin ore.
Ultramarine (*see* Dry colours).
Umber (*see* Dry colours).
Verdigris.
Whiting or whitening.
White lead (*see* Dry colours).
Zinc ashes.
Zinc ore.
Zinc white (*see* Dry colours).
&c., &c.

CLASS 1.

In companies' waggons and at companies' risk. Sheeted.

- (a) All solid merchandise from Class A, when in smaller quantities than two tons but not less than five cwts.
- (b) All solid combustible chemical merchandise not giving off any inflammable vapours under or at 170° F., securely packed in bags, casks, drums, boxes, or boxes.
- (c) Also all non-combustible liquid and semi-liquid chemical products, securely packed in wooden casks or in iron or steel drums. Goods belonging to Class 4 excepted.

(b) Such as for example:—

Albumen.	Hoofs and horn waste.
Alkanet root.	Hoofs, horns, and horn tips.
Aloes.	Horn piths or sloughs.
Amber.	Ivory.
Angelica root.	Ivory black.
Anatto.	Ivory waste.
Anthracene.	Juniper berries.
Argol.	Lamphack.
Asphaltum.	Myrobala.
Bark.	Oleic acid.
Beeswax.	Orchella weed.
Burns and corks.	Paraffin scale.
Carbolic acid (solid).	Paraffin wax.
Cochineal.	Petroleum grease.
Coal-tar colours.	Rabbit fur.
Dextrine.	Rosin.
Dry divi.	Sealing wax.
Dye-woods.	Seaweed.
Fat (raw).	Sheep dipping powder.
Fenugreek seeds.	Shellac.
Feshmes and glue pieces.	Soup.
Gallnuts.	Stearine.
Gambier.	Sugar.
Gelatin.	Sumac.
Glucose.	Tallow.
Glue.	Turneric.
Gums.	Valonia.
Gutta-percha.	Vaseline.
Hair.	Vegetable ivory.
Hempseed.	Vegetable wax.
Hides and hide cuttings.	Whalebone.
Hops.	Weald.
India-rubber.	Yellow Persian berries.
Indigo.	&c., &c.
Isinglass.	

(c) Such as for example:—

Acetic acid.	Lime water.
Alizarine.	Liquid ammonia.
Alum water.	Logwood liquor.
Bisulphite of lime.	Madder.
Carbolic acid (liquid).	Mordanting liquors.
Colours (liquid or in paste).	Sheepwash.
Distilled water.	Sumac liquor.
Dye extracts.	Syrup.
Extracts of tan.	Tin liquor.
Ind.	Tobacco juice.
Iron liquors (such as nitrate of iron).	Treacle.
Lemon juice.	Vinegar.
Lime juice.	Washing fluid.
	&c., &c.

CLASS 2.

In companies' waggons and at companies' risk. Sheeted.

- (a) Combustible liquids, not giving off any inflammable vapour at less than 150° F., packed in wooden casks or in iron or steel drums.
- (b) All returned empty packages, such as crates, bags, sacks, boxes, casks, earboys, drums, hampers, &c.
- (c) Also all miscellaneous collections and consignments of drugs and chemicals, not containing any corrosive or inflammable substances, when packed together in hampers.

(a) Such as for example:—

Vegetable oils.	Glycerin.
Mineral lubricating oils.	Carbolic acid (liquid).
Blacking.	&c., &c.

CLASS 3.

- (a) All non-combustible and non-corrosive chemical liquids, in glass carboys, cans, tins, and jars, and in bottles securely packed in cases, at companies' risk.
- (b) Also all merchandise from Class 5, when in consignments of not less than two tons, and at owners' risk, subject to well-defined regulations.

CLASS B.

In companies' waggons and at companies' risk. Sheeted if and when necessary.

- (a) All merchandise from Class A when securely packed in bags, casks, or drums, in consignments of not less than four tons.
- (b) Also all merchandise from Classes 1, 2, and 3a, when securely packed, in consignments of not less than four tons and carried at owners' risk.

CLASS C.

In companies' waggons and at companies' risk. Sheeted if and when necessary.

- (a) All merchandise from Class A, in consignments of less than four tons, but not less than two tons.
- (b) All merchandise from Classes 1, 2, and 3a, when securely packed, in consignments of less than four tons, but not less than two tons, and carried at owners' risk.
- (c) Also all merchandise from Class 4, when securely packed according to well-defined regulations, in not less than truck loads, and carried at owners' risk.

Anthracene oil.
Coal-tar.
Coal-tar creosote.
Coke-oven oils.
Crude ammoniacal water (crude gas liquor).
Concentrated gas water.

Crude naphtha.
Gas-tar.
Light oils.
Muriatic acid.
Oil of vitriol.
&c., &c.

CLASS 4.

All merchandise in this class to be subject to well-defined regulations as to packages and procedure.

In companies' waggons, at owners' risk.

Mineral acids and other corrosive chemicals not giving off any inflammable vapours, in glass carboys or other approved packages, or in bottles securely packed in cases, according to well-defined regulations. Such as for example:—

Arsenic acid.	Nitric acid.
Aquaforis.	Oil of vitriol.
Dipping acid.	Phosphoric acid.
Fluoric acid.	Sulphuric acid.
Muriatic acid.	Ac., &c.

CLASS 5.

All merchandise in this class to be subject to well-defined regulations as to packages and procedure.

In companies' waggons at owners' risk.

(a) All volatile inflammable liquids giving off inflammable vapours at temperatures between 73° F. and 150° F., packed in wooden casks or in iron or steel drums.

(b) All volatile inflammable liquids giving off inflammable vapours under a temperature of 73° F., but not commencing to boil below 160° F., packed in wooden casks or in iron or steel drums.

(c) Also all volatile inflammable liquids boiling below a temperature of 160° F., in iron or steel drums only.

(a) Such as for example:—

Solvent naphtha. | Tolnol.

Ac., &c.

b) Such as for example:—

Benzol. | Crude naphtha.

Benzoline. | Ac., &c.

(c) Such as for example:—

Gasoline. | Bisulphide of carbon.

Ether. | Ac., &c.

Criticisms or suggestions for amendment should be addressed either to Mr. George E. Davis, 5 John Dalton Street, Manchester (Honorary Secretary of the Chemical Committee of the Manchester Chamber of Commerce), or to Mr. Kenrick B. Murray, Botolph House, Eastcheap, E.C., Secretary of the London Chamber of Commerce.

THE NEW PROPOSED RAILWAY RATES.

In order to facilitate comparison of the new proposed railway rates with those at present in force for specific substances, and also with the classification approved by the Chemical Committee of the Manchester Chamber of Commerce, we have calculated the cost of carriage of merchandise of each class from the Schedule of Maximum Rates deposited with the Board of Trade by five of the leading companies.

The station and service terminals have been reckoned as comprising one large town and an "other place," so that if both terminals were large towns the charges would be slightly more than are indicated in the tables.

CLASS A. SLACK. INCLUDING TERMINAL CHARGES.

	10	20	30	40	50	100	200
	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.
L. & N. W. Ry. Co.,	s. d. 1 10½	s. d. 2 7½	s. d. 3 4½	s. d. 4 1	s. d. 4 9½	s. d. 7 11½	s. d. 14 2½
L. & Y. Ry. Co.,	s. d. 1 10½	s. d. 2 7½	s. d. 3 4½	s. d. 4 1	s. d. 4 9½	s. d. 7 11½	s. d. 14 2½

There is no "Service Terminal" proposed for this class. The "Station Terminal" at each end is named at s.d. per ton in large towns as defined, and 6d. per ton at any other station. The large towns on the L. & N. W. Ry. system are London, Liverpool, Bootle, Manchester, Salford, and Birmingham. The large towns on the L. & Y. Ry. system are Liverpool, Bootle, Manchester, and Salford.

CLASS A. INCLUDING TERMINAL CHARGES.

	10	20	30	40	50	100	200
	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.
L. & N. W. Ry. Co.,	s. d. 2 0	s. d. 2 10	s. d. 3 8	s. d. 4 6	s. d. 5 4	s. d. 8 5½	s. d. 14 8½
Midland Ry. Co.,	s. d. 2 7½	s. d. 3 8	s. d. 4 8½	s. d. 5 4	s. d. 5 11½	s. d. 8 6½	s. d. 12 2½
G. W. Ry. Co.,	s. d. 2 7½	s. d. 3 8	s. d. 4 8½	s. d. 5 4	s. d. 5 11½	s. d. 8 6½	s. d. 12 2½
L. & Y. Ry. Co.,	s. d. 2 0	s. d. 2 10	s. d. 3 8	s. d. 4 6	s. d. 5 4	s. d. 8 5½	s. d. 14 8½
M. S. & L. Ry. Co.,	s. d. 2 7½	s. d. 3 8	s. d. 4 8½	s. d. 5 4	s. d. 5 11½	s. d. 8 6½	s. d. 12 2½

Proposed Station and Service Terminals.

	Station.		Service.	
	Large Towns.	Other Stations.	Large Towns.	Other Stations.
L. & N. W. Ry. Co.,	s. d. 0 8	s. d. 0 6	Nil.	Nil.
Midland Ry. Co.,	s. d. 0 8	s. d. 0 6	Nil.	Nil.
G. W. Ry. Co.,	s. d. 0 8	s. d. 0 6	Nil.	Nil.
L. & Y. Ry. Co.,	s. d. 0 8	s. d. 0 6	Nil.	Nil.
M. S. & L. Ry. Co.,	s. d. 0 8	s. d. 0 6	Nil.	Nil.

CLASS B. INCLUDING TERMINAL CHARGES.

	10	20	30	40	50	100	200
	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.
L. & N. W. Ry. Co.,	s. d. 3 5	s. d. 5 1	s. d. 6 4	s. d. 7 7	s. d. 8 7½	s. d. 13 0	s. d. 21 4
Midland Ry. Co.,	s. d. 3 5	s. d. 4 5½	s. d. 5 6	s. d. 6 4	s. d. 7 2	s. d. 10 3½	s. d. 16 6½
G. W. Ry. Co.,	s. d. 3 5	s. d. 4 8	s. d. 5 11	s. d. 6 9	s. d. 7 7	s. d. 10 8½	s. d. 16 11½
L. & Y. Ry. Co.,	s. d. 3 2½	s. d. 4 5½	s. d. 5 6	s. d. 6 6½	s. d. 7 7	s. d. 11 9	s. d. 20 1
M. S. & L. Ry. Co.,	s. d. 3 5	s. d. 4 8	s. d. 5 11	s. d. 6 11½	s. d. 8 1	s. d. 11 2½	s. d. 17 5½

Proposed Station and Service Terminals.

	Station.		Service.	
	Large Towns.	Other Stations.	Large Towns.	Other Stations.
L. & N. W. Ry. Co.,	s. d. 1 0	s. d. 0 9	Nil.	Nil.
Midland Ry. Co.,	s. d. 1 0	s. d. 0 9	Nil.	Nil.
G. W. Ry. Co.,	s. d. 1 0	s. d. 0 9	Nil.	Nil.
L. & Y. Ry. Co.,	s. d. 1 0	s. d. 0 9	Nil.	Nil.
M. S. & L. Ry. Co.,	s. d. 1 0	s. d. 0 9	Nil.	Nil.

CLASS C. INCLUDING TERMINAL CHARGES.

	10	20	30	40	50	100	200
	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.
L. & N. W. Ry. Co.,	s. d. 5 7	s. d. 7 8	s. d. 9 4	s. d. 11 0	s. d. 12 5½	s. d. 18 1	s. d. 28 6
Midland Ry. Co.,	s. d. 5 7	s. d. 7 3	s. d. 8 11	s. d. 10 2	s. d. 11 5	s. d. 15 7	s. d. 23 11
G. W. Ry. Co.,	s. d. 5 7	s. d. 7 3	s. d. 8 11	s. d. 10 2	s. d. 11 5	s. d. 15 7	s. d. 23 11
L. & Y. Ry. Co.,	s. d. 5 7	s. d. 7 8	s. d. 9 4	s. d. 11 0	s. d. 12 5½	s. d. 19 9	s. d. 34 4
M. S. & L. Ry. Co.,	s. d. 5 7	s. d. 7 3	s. d. 8 11	s. d. 10 2	s. d. 11 5	s. d. 15 7	s. d. 23 11

Proposed Station and Service Terminals.

	Station.		Service.	
	Large Towns.	Other Stations.	Large Towns.	Other Stations.
L. & N. W. Ry. Co.,	s. d. 1 3	s. d. 1 9	s. d. 0 9	s. d. 0 6
Midland Ry. Co.,	s. d. 1 3	s. d. 1 0	s. d. 0 9	s. d. 0 6
G. W. Ry. Co.,	s. d. 1 3	s. d. 1 0	s. d. 0 9	s. d. 0 6
L. & Y. Ry. Co.,	s. d. 1 3	s. d. 1 0	s. d. 0 9	s. d. 0 6
M. S. & L. Ry. Co.,	s. d. 1 3	s. d. 1 0	s. d. 0 9	s. d. 0 6

CLASS 1. INCLUDING TERMINAL CHARGES.

	10		20		30		40		50		100		200	
	Miles.		Miles.		Miles.		Miles.		Miles.		Miles.		Miles.	
	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
L. & N. W. Ry. Co....	8	6	11	0	13	1	15	2	16	10	23	6	36	0
Midland Ry. Co.	8	6	10	4	12	3	13	8	15	2	20	4	30	9
G. W. Ry. Co.	8	6	10	7	12	8	14	4	16	0	22	3	34	9
L. & Y. Ry. Co.	8	6	11	0	13	1	15	2	16	10	25	2	41	10
M. S. & L. Ry. Co....	8	6	10	7	12	8	14	4	16	0	22	3	34	9

Proposed Station and Service Terminals.

	Station.		Service.	
	Large Towns.	Other Stations.	Large Towns.	Other Stations.
	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
L. & N. W. Ry. Co.	2	0	1	6
Midland Ry. Co.	2	0	1	6
G. W. Ry. Co.	2	0	1	6
L. & Y. Ry. Co.	2	0	1	6
M. S. & L. Ry. Co.	2	0	1	6

CLASS 2. INCLUDING TERMINAL CHARGES.

	10		20		30		40		50		100		200	
	Miles.		Miles.		Miles.		Miles.		Miles.		Miles.		Miles.	
	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
L. & N. W. Ry. Co....	9	2	11	11	13	4	16	6	18	7	27	4	44	0
Midland Ry. Co.	9	2	11	3	13	4	15	0	16	8	22	11	35	5
G. W. Ry. Co.	9	5	11	11	14	5	16	6	18	7	26	11	43	7
L. & Y. Ry. Co.	9	2	11	11	14	2	16	6	18	7	29	0	49	10
M. S. & L. Ry. Co....	9	2	11	6	13	9	15	8	17	6	24	10	35	5

Proposed Station and Service Terminals.

	Station.		Service.	
	Large Towns.	Other Stations.	Large Towns.	Other Stations.
	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
L. & N. W. Ry. Co.	2	0	1	6
Midland Ry. Co.	2	0	1	6
G. W. Ry. Co.	2	0	1	6
L. & Y. Ry. Co.	2	0	1	6
M. S. & L. Ry. Co.	2	0	1	6

CLASS 3. INCLUDING TERMINAL CHARGES.

	10		20		30		40		50		100		200	
	Miles.		Miles.		Miles.		Miles.		Miles.		Miles.		Miles.	
	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
L. & N. W. Ry. Co....	9	11	12	10	15	6	18	3	20	9	31	7	52	5
Midland Ry. Co.	9	11	12	2	14	6	16	4	18	3	25	6	40	1
G. W. Ry. Co.	10	4	13	3	16	2	18	8	21	2	31	7	52	5
L. & Y. Ry. Co.	9	11	12	10	15	6	18	3	20	9	33	3	58	3
M. S. & L. Ry. Co....	9	11	12	5	14	11	17	2	19	6	27	10	44	6

Proposed Station and Service Terminals.

	Station.		Service.	
	Large Towns.	Other Stations.	Large Towns.	Other Stations.
	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
L. & N. W. Ry. Co.	2	0	1	6
Midland Ry. Co.	2	0	1	6
G. W. Ry. Co.	2	0	1	6
L. & Y. Ry. Co.	2	0	1	6
M. S. and L. Ry. Co.	2	0	1	6

CLASS 4. INCLUDING TERMINAL CHARGES.

	10		20		30		40		50		100		200	
	Miles.		Miles.		Miles.		Miles.		Miles.		Miles.		Miles.	
	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
L. & N. W. Ry. Co....	11	7	14	11	18	0	21	2	24	1	37	0	62	0
Midland Ry. Co.	11	7	14	6	17	5	19	11	22	5	30	9	47	5
G. W. Ry. Co.	12	0	15	4	18	8	21	7	24	6	37	0	62	0
L. & Y. Ry. Co.	11	7	14	11	18	0	21	2	24	1	38	8	67	10
M. S. & L. Ry. Co....	11	7	14	6	17	5	20	1	22	10	23	2	50	1

Proposed Station and Service Terminals.

	Station.		Service.	
	Large Towns.	Other Stations.	Large Towns.	Other Stations.
	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
L. & N. W. Ry. Co.	2	0	1	6
Midland Ry. Co.	2	0	1	6
G. W. Ry. Co.	2	0	1	6
L. & Y. Ry. Co.	2	0	1	6
M. S. & L. Ry. Co.	2	0	1	6

CLASS 5. INCLUDING TERMINAL CHARGES.

	10		20		30		40		50		100		200	
	Miles.		Miles.		Miles.		Miles.		Miles.		Miles.		Miles.	
	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
L. & N. W. Ry. Co....	13	8	17	10	21	7	25	1	28	8	43	8	72	10
Midland Ry. Co.	13	8	17	0	20	1	23	3	26	2	38	8	63	8
G. W. Ry. Co.	13	8	17	5	21	2	24	6	27	10	42	5	71	7
L. & Y. Ry. Co.	13	3	17	0	20	9	24	6	27	10	44	6	77	10
M. S. & L. Ry. Co.	13	3	16	4	19	6	22	5	25	4	37	10	62	10

Proposed Station and Service Terminals.

	Station.		Service.	
	Large Towns.	Other Stations.	Large Towns.	Other Stations.
	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
L. & N. W. Ry. Co.	2	0	1	6
Midland Ry. Co.	2	0	1	6
G. W. Ry. Co.	2	0	1	6
L. & Y. Ry. Co.	2	0	1	6
M. S. & L. Ry. Co.	2	0	1	6

SPECIMEN DIAGRAM OF THE PROPOSED OLD AND NEW MAXIMUM RATES.

EXISTING MAXIMUM RATES in force on the NORTH-EASTERN RAILWAY ACT, 1854—at *pence per ton per mile*, covering Road Toll, use of Waggon, Locomotive, and every expense incidental to such conveyance; the proposed Rates here given are inclusive of the same.

CLASSIFICATION IN SPECIAL ACT.

At Pence per Ton per Mile.	Manure.	Lime, Lime- stone.	Iron- stone, &c.	Lead Ore.	Hides, Sugar.	Dye- Woods.	Earthen- ware.	Metals, except Iron.	Coal and Coke.	Drugs and Manu- factured Goods.
	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>
Existing rates for goods carried under 20 miles.....	1'50	1'50	2'0	2'0	2'75	2'75	2'75	2'75	1'75	3'50
Existing rates for goods carried 20 miles and over, for whole distance	1'0	1'0	1'50	1'50	2'0	2'0	2'0	2'0	1'50	3'0
Existing rates for goods carried above 30 miles .....	..	..	..	..	..	..	..	..	1'0	..
Existing rates for goods carried under 40 miles, and intended for shipment.....	..	..	..	..	..	..	..	..	1'50	..
Proposed new rates for goods carried first 10 miles.....	6'10	3'80	3'20	6'10	10'70	9'0	12'40	..	3'20	14'10
Proposed new rates for goods carried next 20 miles.....	3'28	2'10	1'73	3'28	5'50	4'83	6'30	..	1'73	7'
Proposed new rates for goods carried remainder of distance—say 10 miles—so as to make 40 in all.....	2'83	1'82	1'48	2'83	4'86	4'0	5'47	..	1'48	6'8

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

2806. A. Waldbauer, London. Centrifugal apparatus for continuously washing, dyeing, drying, impregnating, and otherwise treating various materials and fabrics. February 18.

2837. Clement, Baron of Bechtolsheim, London. Centrifugal separators. February 18.

3016. Sir B. Samuelson, Bart.—From G. Maffei, Italy. Separating liquids of two different densities. February 20.

3065. W. S. Squire. Machinery for the separation of solid matters from liquids, and for washing out and exhausting the solid matters so separated. February 21.

3208. P. Pierrard. A method and apparatus for determining the density of fibrous, porous, or pulverulent substances, and application thereof in valuing wool and other textile materials. February 22.

3306. S. P. Thompson. Improvements in polarimeters and saccharimeters. February 25.

3311. D. C. Mackenzie. Apparatus for evaporating, condensing, distilling, drying, and heating solid and liquid matter, for chemical, pharmaceutical, and other purposes. 25 February.

3317. W. Simms and E. Houghton. Gas furnaces. February 25.

3644. J. J. Meldrum. Apparatus for distributing air or gases to liquids. Complete Specification. March 1.

3705. R. Hollingdrake. Chilled fire-bars, designed for burning smoke for furnaces of all descriptions. March 2.

3736. M. J. E. Vassel. Apparatus for filtering liquids, or for preparing extracts from substances. March 2.

3753. O. M. Row. Apparatus for condensing steam or other vapours, applicable also for heating or cooling fluids. March 4.

3778. C. W. Guy. Tubes or hollow vessels for cooling, heating, and evaporating liquids. March 4.

3779. C. W. Guy. Tubes or hollow vessels for cooling, heating, and evaporating liquids. March 4.

3963. W. Prickarts. Improvements in and relating to reverberatory and roasting furnaces, or the like. Complete Specification. March 6.

4164. C. W. Guy. Improvements in evaporating apparatus. March 9.

4228. P. de Mol and A. Gerken. Filters. March 11.

4340. D. Halpin and P. W. Willans. Means and apparatus for condensing steam. March 12.

4354. E. B. Parnell. Calcining furnaces. March 12.

4612. J. Hibbert and B. T. Haworth. Improvements in pump valves and other valves, particularly applicable to valves subjected to acid or chemical action. March 16.

4620. J. L. Fletcher. Apparatus or means for separating solid from liquid matter. March 16.

COMPLETE SPECIFICATIONS ACCEPTED.*

1888.

4689. A. Rathbone. Apparatus for cooling, heating, and condensing fluids. February 27.

4851. J. K. Kilbourn. Compression pumps for gaseous fluids. March 6.

5118. W. Schmidt. Method and apparatus for cooling and condensing vapours. February 27.

5812. R. Shackleton. Method and apparatus for superheating steam. February 27.

5829. W. Fairclough. Means for automatically removing scum, impurities, and deposits from boilers, separators, filters, &c. February 27.

6047. O. Murray.—From P. P. Aries. Apparatus for heating liquids, or maintaining them at a certain temperature. February 27.

6124. W. Smith. Machine for agitating or mixing solid and liquid substances. March 13.

6282. O. E. Borend. Means for filtering liquids. March 6.

6874. F. D. Delf. Apparatus for use as retort or filter stands. March 20.

7000. I. S. McDougall, J. T. McDougall, R. K. Hartley, and T. Nuxden. Apparatus for making bisulphites, &c. for the treatment of wood pulp and other fibrous materials. March 20.

1889.

2030. W. Sayer. Apparatus for forcing, exhausting, or pumping air, gases, liquids, &c. March 20.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

2914. J. D. Averell. Apparatus and process for manufacturing gas. Complete Specification. February 19.

2964. H. Bate. A new method of, and appliance for intensifying the light of gas, oil, and other illuminating media. February 19.

3008. A. McDougall. Improvements in the continuous firing of retorts for gas making, for bituminous, mineral, shale, or peat distillation, and other like purposes. February 21.

3137. W. C. Owston. Improvements in the process of and apparatus for manufacturing water gas. February 21.

3201. J. Sawyer. Improvements in fire-lighters. February 22.

3219. J. Jørgensen. An improvement in the manufacture of fire-lighters. February 22.

3237. R. A. Melsom. Producing heating gas by means of a hollow metal ball and pottery plate, entitled a "perforated atmospheric gas radiating sphere and absorbent amalgam plate." February 23.

3391. G. R. Hislop. Improvements in apparatus for charging gas producers and gas or shale-oil retort furnaces with hot residual coke. February 25.

3483. A. C. Jeffrey. Improvements in the method of preparing blocks from coal for fuel and other purposes, and for utilising the waste and dross of shale, coal and coke. February 27.

3498. W. R. Hutton. Improvements in making briquettes as a fuel for household and other purposes. February 27.

3536. J. Chammon. Improvements in fire-lighters. March 6.

3982. C. Moldenhauer and W. Leybold. Improvements in the mechanical revivification of gas purifying masses. March 7.

3984. J. O. O'Brien.—From W. Underwood. Improvements in the manufacture of blocks of fuel from granulated or pulverised coal. March 7.

4040. E. L. Stacey. An improved fire-lighter, and machinery for manufacturing the same. March 7.

4124. J. Maclear. Improved means of increasing the luminousness of ignited gas. March 8.

4168. W. Parbly. An improved instrument for clearing gas-retort ascension pipes. March 9.

4170. J. W. Spencer. Improvements in gas generators. March 9.

4288. A. Besson. Improvements in the manufacture of fuel. March 12.

4339. F. W. Harbord. Improvements in the manufacture and application of water gas for metallurgical and other purposes. March 14.

4544. F. Siemens. Improvements in regenerative gas furnaces and producers. March 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

3907. A. Brin. Apparatus for extraction of oxygen and nitrogen from atmospheric air. March 20.

4372. W. Foulis and A. J. Liversedge. Manufacture of gas, and apparatus therefor. March 6.

6451. E. Brook. Gas producers. March 6.

6514. A. Wilson. Gas producers. March 13.

6663. C. H. Mowll. Composition of artificial or block fuel. March 13.

7219. H. Williams. Artificial fuel. March 20.

7931. S. Chandler, sen., S. Chandler, jun., and J. Chandler. Washing and scrubbing gas, and apparatus therefor. March 6.

14585. W. M. Johnson and J. Jørgensen.—From Trafaradlingsaktieselskab Victoria Nykoping. An improved fire-lighter. March 6.

17444. G. R. Blake. A fire-lighter. March 6.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

3068. A. M. McDougall. See Class II.

4397. W. Young and G. T. Beilby. Improvements in the distillation of mineral oils, and in the apparatus employed therefor. March 16.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

2941. T. R. Shillito.—From J. R. Geigy, Switzerland. Production of a new violet dye or colouring matter. February 19.

3048. I. Levinstein. Improvements in the manufacture of red colouring matters suitable for dyeing and printing. February 20.

3333. T. R. Shillito. From J. R. Geigy and Co., Switzerland. Production of triphenylmethane colours dyeing with the aid of mordants. February 25.

3441. C. Dreyfus. The manufacture or production of a colouring matter or dye-stuff from phenolphthalein. February 26.

3529. B. Wilcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture or production of indulines or induline-like dye-stuffs. February 27.

3628. A. Bang.—From Messrs. Dahl and Co., Prussia. New dye-stuffs, and the production of the same. March 1.

3642. T. Holliday and E. M. Mundviller. Improvements in the manufacture or production of bisulpho acids of beta-naphthol. March 1.

4404. S. Meyer. An improved manufacture of para-dioxybenzol in yellow stable crystals. Complete Specification. March 13.

4539. E. Eisenmann and A. Arche. Improvements in the manufacture of picric acid. March 15.

4555. H. H. Leigh.—From R. G. Williams. Improvements in colouring matters. March 15.

COMPLETE SPECIFICATION ACCEPTED.

1888.

5909. C. D. Abel.—From The Actien Gesellschaft fur Anilin Fabrikation. Manufacture of blue colouring matters. March 6.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

3023. G. F. Priestley. A new or improved machine for dressing silk waste. February 20.

3164. S. Cooper and T. Cooper. Improvements in apparatus to be employed in the manufacture of "wool wool." February 22.

3208. P. Pierrard. See Class I.

4447. G. W. Robertson, D. Black, and J. McGlashan. Improvements in the treatment of vegetable fibrous material to obtain fibre therefrom, and in apparatus therefor. March 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

7024. E. H. Hargraves. Finishing cotton goods and other fabrics. March 6.

13551. D. Nicoll. Manufacture and application of waterproof fabrics. February 27.

1889.

1172. W. Mather. Apparatus for treating textile materials with liquids, gases, or vapours. March 13.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

2806. A. Wuldbauer. *See* Class I.
 2984. T. Incham. Improvements in dyeing mixed woven fabrics. February 20.
 3105. E. Bentz, C. Edmeston, A. Edmeston, and E. Grether. Improvements in bleaching, scouring, or dyeing, or otherwise treating textile fabrics and warps or yarns, and in machinery and arrangements for the purpose. February 21.
 3257. S. Spencer and R. Holt. Improvements in apparatus for sizing, bleaching, soaping and dyeing warps. February 23.
 3291. J. Imray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, France. An improvement in indigo-dyeing. February 23.
 3312. T. Holliday. Improvements in dyeing cotton or other vegetable fibre. February 25.
 3313. T. Holliday. Improvements in dyeing cotton or other fibres black with aniline. February 25.
 3637. J. Ballantyne and G. Lamb. Improvements in apparatus for washing, scouring, bleaching, dyeing, and drying wool or other fibrous materials and yarns. March 1.
 3639. H. W. Brown. Improvements in apparatus for dyeing yarns. March 1.
 3744. S. S. Boyce and G. E. Armstrong. Improvements in apparatus for washing, dyeing, bleaching, and otherwise treating fibrous materials and piece goods. March 2.
 3934. B. Willeox.—From The Farbenfabriken vormals F. Bayer & Co., Germany. Improvements in or connected with the dyeing and printing of animal and vegetable fibres. March 6.
 3993. E. Barlow. An improved indigo-dyeing machine. March 7.
 4322. J. Gamgee. Improvements in chambers for bleaching, drying, or disinfecting clothes or other goods. March 12.
 4368. T. Holliday. Improvements in the method of production of fabrics dyed black, composed partly of animal and partly of vegetable fibres. March 13.
 4514. A. T. Clay. A new or improved machine for blowing or steaming, boiling, cooling, scouring, and dyeing woven fabrics. March 15.
 4602. H. A. Seegall. *See* Class XIII.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

6029. H. Gross, London. Process for dyeing cotton. March 13.
 18,517. H. F. Lippett. Hollow perforated tubes for dyeing, bleaching, or otherwise treating yarn in cops. February 27.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

3071. J. S. MacArthur. Improvements in obtaining cyanides from residuary liquors formed in chemical processes. February 21.
 3072. J. S. MacArthur. Improvements in obtaining cyanides from residuary liquors formed in chemical processes. February 21.
 3338. A. Collingridge.—From V. Cornet and A. Jones, France. Improvements in the manufacture of common salt, and in the construction of appliances for effecting the same. February 23.
 3407. A. Campbell and W. Boyd. Improvements in and connected with the obtaining of chlorine and sulphate of lime. February 26.
 3757. T. B. Saunders. Improvements in the method or process of treating or utilising the spent or residual liquid formed in the process of cleaning iron or steel with hydrochloric acid. March 4.
 3792. S. Daw. A method of treating waste pickle produced in tin,terne, and black-plate manufacture. March 4.
 4037. J. B. Hannay. An improved process and apparatus for the manufacture and transport of liquid chlorine. March 7.
 4195. F. Mühlenbruch. A process for producing monocarbonate of calcium. March 9.
 4239. H. W. Deacon and F. Hurter. Improvements in the manufacture or production of hydrochloric acid, and in the treatment of bisulphate of soda produced in the said manufacture. March 11.
 4286. J. Winkill, jun. An improved construction of kiln for burning limestone. Complete Specification. March 12.
 4316. E. Carez. Improvements in the manufacture of ammonium nitrate. March 12.
 4325. G. E. Carleton. Improved method and apparatus for the calcination of limestone. Complete Specification. March 12.
 4417. W. L. Wise.—From Messrs. Solvay and Co., Belgium. Improvements in the manufacture of anhydrous chloride of magnesium, and in the production of chlorine therefrom. March 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

5762. M. N. D'Andria. Manufacture of ammonia salts. February 27.
 6151. R. E. Chatfield. Ammonia carbonate applicable as baking-powder. February 27.
 6152. R. E. Chatfield. Manufacture of ammonia and its sesquicarbonate. February 27.
 7045. G. Borsche and F. Brunjes. Conversion of chloride of calcium into chloride of magnesium and carbonate of lime by means of oxychloride of magnesium and carbonic acid. February 27.
 14,061. H. J. Kirkman. Utilisation of waste pickle from tinning and galvanising works where hydrochloric acid is used in pickling. February 27.
 16,472. P. M. Justice.—From C. Dietzsch. *See* Class IX.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

3316. J. Gimson and C. Chalfinor. The placing of china saucers in closet ovens and kilns entitled "an improved thimble crank." February 25.
 3673. H. M. Ashley. Improvements in apparatus for manufacturing bottles and other hollow glass articles. March 1.
 3686. H. M. Ashley. Improvement in machinery for making bottles and other like hollow glass-ware. March 1: but ante dated November 10, 1888, being date of application in United States.
 3779. J. T. H. Richardson. An improvement in the process of manufacturing glass articles. March 4.
 4269. C. Wells and L. Ritchie. Improvements in the manufacture of earthenware articles. March 11.
 4264. T. Phoenix and G. Kirk. *See* Class XIX.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

1449. D. Gilles. Furnace for annealing thick plate glass by gradual cooling, and annealing by gas heat. March 6.
 3263. D. Rylands. Machinery for manufacture of bottles. March 6.
 5502. C. Wittowsky. Manufacture of mosaic work. March 6.
 5921. F. Kreysler and J. Mohr. Decoration of glass and ceramic ware. February 27.
 6028. M. Malvez. Apparatus for grinding and polishing plate glass. March 6.
 6980. G. Lazenby. Muffle kilns for bending and firing stained glass, tiles, pottery, &c. March 13.
 7309. J. T. H. Richardson. Manufacture of glass. March 20.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

2808. D. Storrar, Kirkcaldy. A new base, cement, or foundation for making floor covering or wall covering, and as a substitute for oxidised oil in making linoleum. February 18.
 2844. A. C. Ponton, B. L. Mosely, and C. Chambers, London. Improvements in the manufacture of artificial stone. Complete Specification. February 18.
 2919. C. C. Gilman. Improvements in or connected with fireproofing ceilings for buildings and other places or structures. Complete Specification. February 19.
 2921. C. C. Gilman. Improvements in or connected with the construction of fireproof floors and roofs. Complete Specification. February 19.
 2922. C. C. Gilman. Improvements in fireproofing wood or iron posts or columns for buildings and other structures. Complete Specification. February 19.
 2923. C. C. Gilman. Improvements in the construction of fireproof floors and ceilings. Complete Specification. February 19.
 2926. C. C. Gilman. Improvements in pavements or side walks. Complete Specification. February 19.

2962. P. Brannon and E. M. Brannon. Improvements in the employment of combinations of concreted and plastering materials with metal framing wire and ligneous and other fibre in application to fireproofing marine and other works. February 19.

3281. J. Swallow and J. H. Jackson. Improvements in the manufacture of bricks, tiles, and other forms. February 23.

3288. E. Prime. Improved apparatus for grinding cement and other analogous materials. Complete Specification. February 23.

3354. A. C. Ponton, B. L. Mosely, and C. Chambers. Improvements in and relating to blocks or bricks composed of silicious materials. February 25.

3355. W. Hubbard, B. L. Mosely, and J. S. Fairfax. Improvements in or relating to wall tiles or other wall linings. February 25.

3357. H. H. Leich.—From L. H. Clausen, Hamburg. Improvements in the process of manufacturing artificial stone. February 25.

3378. C. Güttler. An improved method and apparatus to form disintegrated or loose material, such as sugar, loam, clay, cement, mortar, turf, &c., into compact bodies. February 25.

3872. L. J. Cadwell. Improvements in pavements, and in blocks therefor. Complete Specification. March 5.

3873. R. Haddan.—From S. E. Haskin, United States. Improvements in and relating to the vulcanising of woods. March 5.

3979. H. Earnshaw. Improvements in means or apparatus employed for annealing or tempering bricks, paving blocks, and the like articles made from slag. March 7.

4060. T. Pense. An improved impregnating liquid for, and method of applying same to render wood in log, plank, or other form non-inflammable. March 8.

4077. E. A. Ashley. A new or improved fireproof starch or composition, applicable as a fireproof dressing for any suitable material. March 8.

4175. E. Mürjahn. A method of producing a useful material or materials from greenstone, diabase, and other varieties of hornblende. Complete Specification. March 9.

4285. G. A. Marsden. Improvements in and relating to the manufacture of ornamental and decorative tiles, bricks, and like articles. March 12.

4333. G. Batchelor. Improvements in arrangements for drying slurry by the waste heat from cement kilns. March 12.

4347. J. Homan. Improvements in fireproof structures, and in bricks for the same. March 12.

4509. W. Davidson. Improvements in and relating to kilns for drying granular substances. Complete Specification. March 15.

4611. W. H. Nightingale, W. Nightingale, and A. E. Powys. Improvements in the manufacture of cement. March 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

5881. A. McEa. Improvements in cement, in "cooling" same, and in apparatus therefor. February 27.

6261. J. C. Sellars. Improvements in cement. March 6.

6229. J. Elliott. Manufacture of roofing slabs, tiles, &c. March 6.

6944. H. H. Lake.—From A. Van Berkel. Manufacture of plates, slabs, or blocks for building purposes. March 13.

16,472. P. M. Justice.—From C. Dietzsch. Furnace for production of carbonic acid gas and burning of calcareous material. March 6.

19,010. G. H. Sharpe and F. W. Turner. Manufacture of cement suitable as plaster and for moulding purposes. March 6.

1889.

1765. L. Brentini. Roofing tiles. March 6.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

2931. E. B. Parnell. Improvements in the treatment of ores for the recovery of metals, and in apparatus therefor. February 19.

2965. W. H. Melaney. Improvements in and relating to the manufacture of safe and armour plates. February 19.

2986. T. Middleton, jun. An improved method of and means for producing steel castings. February 29.

3098. R. H. Braddon. Improved process and apparatus for effecting the hardening of steel. Complete Specification. February 21.

3109. P. Elhs. A new or improved metallic alloy. February 21.

3149. A. J. Boulton.—From W. G. Clark. Improvements in or relating to the coating of metals. February 21.

3286. G. C. Fricke. An improved method of renewing waste pickling liquors and recovering the metals in solution, with apparatus therefor. February 23.

3486. J. E. Bennett. Improvements in the treatment of metallic chlorides for extraction of metals therefrom. February 27.

3497. E. T. Phipson. Combining plates of iron and of copper by means of a flux. February 27.

3555. T. Slater, G. E. A. Holdsworth, and W. V. Williams. Improvements in metallic alloys and refinement of metals, and fluxes used therewith. March 1.

3916. D. I. Reisz, M. Berkovits, and J. Biehler. An improved metallic alloy for syphon heads and other objects, and for tinning purposes in general, denominated nickel tin. Complete Specification. March 6.

4003. E. Lones, R. Davies, J. Davies, and B. A. Webb. Improvements in coating metal plates or sheets with tin and other metals, and apparatus therefor. March 7.

4043. T. Bell. Improved means or method of lining barrels and like vessels to resist acids used when extracting metals by chlorination or similar process from their ores. March 7.

4953. C. J. L. Leffler. Improvements in hardening hollow or tubular pieces of steel, and in apparatus therefor. March 8.

4151. J. Clegg. Improvements in metals and alloys. March 9.

4169. J. L. E. Daniel. An improved process for the manufacture of aluminium, and apparatus therefor. March 9.

4335. W. E. Everitt. A new or improved method of coating plates and sheets of iron with copper or brass, and apparatus to be employed in effecting the said coating. March 12.

4353. A. M. G. Sebillot. Improvements in copper and silver leaching processes and apparatus. March 12.

4428. N. C. Cookson. Improvements in coating iron with antimony. March 14.

4439. F. W. Harbord. See Class II.

4521. J. S. MacArthur, R. W. Forrest, and W. Forrest. Improvements in and connected with the obtaining of gold and silver from solutions containing them. March 15.

4547. A. Hodgkinson, jun. The better extraction of iron from the calcined products of various ironstone mines and shale. March 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

3547. L. Q. Brin. Method and apparatus for making aluminium bronze. March 13.

4034. H. F. Taylor and W. P. Struvé. Apparatus connected with pots for coating with metals or alloys. March 20.

4350. H. F. Taylor and W. P. Struvé. Apparatus for pulverising ores, &c. March 20.

5061. H. Müller. Safety fuzes for firing charges without danger from fire-damp. March 6.

5084. T. Twynnam. Manufacture of ingot iron and steel. February 27.

5316. S. Pearson, J. Liddon, and J. H. Pratt. Manufacture of aluminium and alloys thereof. March 13.

5386. T. Twynnam. Manufacture of ingot iron and steel, and treating the resulting slag for the production of alkalis and alkaline salts. March 20.

5717. P. F. Dillon and J. J. Doyle. Moulds for casting metals. March 6.

6104. J. Weirich. Treating auriferous and auro-argentiferous ores. February 27.

10,347. C. C. Townsend. Manufacture of malleable iron castings without annealing. March 13.

14,061. H. J. Kirkman. See Class VII.

17,333. G. M. Westman. Process and furnace for manufacture of zinc, iron, phosphorus, sodium, &c. February 27.

18,088. L. Keyling. Process and apparatus for producing pieces of iron, steel, and other metal. February 27.

18,477. G. C. Dymond.—From W. H. Appleton. Machines for rolling seamless tubing, columns, &c., from hollow ingots. February 27.

1889.

1590. W. E. Koch. Apparatus for casting steel pipes. March 20.

2068. H. M. Redemann and R. J. Tilford. Treating crude or low grade steel to produce refined or high grade steel. March 13.

2069. H. M. Redemann and R. J. Tilford. Same object as No. 2068. March 13.

2070. H. M. Redemann and R. J. Tilford. Same object as No. 2068. March 13.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

2885. R. H. C. Neville. Improvements in methods and apparatus for charging secondary batteries or electrical accumulators. February 19.
2943. S. D. Williams. Improvements in dynamo-electric machines. February 19.
2949. E. D. Cross. Improvements in galvanic batteries. Complete Specification. February 19.
3222. A. J. Boulton.—From A. K. Reinfeld. Improved process of treating plates and the like for facilitating the removal of galvanoplastic deposits contained thereon. February 22.
3502. A. G. Greenway, B. F. Babcock, and B. Radcliffe. Improvements in or connected with processes of manufacturing iron wherein the iron is subjected to an electric treatment. February 27.
3533. C. D. Abel.—From Messrs. Siemens and Halske, Germany. Improvements in the extraction of copper and zinc from their ores, as also of the precious metals contained therein, by electrolysis, and apparatus therefor. February 27.
3558. H. Kenyon. Method of obtaining aluminium continuously in an electrical furnace. February 28.
3940. G. A. Schoth. Improvements in galvanic batteries. March 6.
3971. J. J. Rathbone. Improved compound or admixture of ingredients suitable for producing electric energy. March 6.
4171. W. L. Wise.—From F. C. Glaser. Improvements in accumulators or secondary batteries. March 9.
4296. J. Kynoch. Improvements in galvanic batteries. March 12.
4559. D. G. Fitzgerald. Improvements in voltaic batteries. March 15.
4599. C. Lever. Electrolytical process and apparatus for producing bleaching powder and other materials. March 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

5191. H. Edmunds. Storage batteries. March 13.
6322. P. R. de Fauchaux d'Hunay. Galvanic batteries. March 6.
8354. M. Leclanché. Depolarisers for primary or secondary batteries. February 27.
- 16,048. W. P. Thompson.—From C. H. Thompson. Secondary batteries. March 6.

1889.

361. H. H. Lake.—From E. Thomson. Methods and apparatus for welding, forging, and working metals by the aid of electricity. March 6.
362. H. H. Lake.—From E. Thomson. Methods and apparatus for welding, shaping, and working metals by the aid of electricity. March 13.
377. H. H. Lake.—From E. Thomson. Riveting metal plates, &c. by the aid of electricity. March 6.
1401. J. T. Dyer, P. Fish, and R. C. Fish. Generating electricity. March 13.
2066. L. Paget. Manufacture of electrodes for secondary batteries. March 13.
2276. E. Guitton.—From M. Sappey. Construction and arrangement of primary batteries. March 13.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

2856. H. Ritter von Dahmen and A. Strauss-Collin, London. A new manufacture of soaps or saponaceous compounds. February 18.
5009. A. McClellan and J. W. Wareing. An improvement in the manufacture or production of soap. February 20.
4145. F. Bosshardt.—From E. de Werchin, France. Improvements in the manufacture of soap for scouring and similar operations. March 9.
4190. G. Hervieux and V. Bedard. Axle grease. Complete Specification. March 9.
4367. W. G. Reid. Improvements in the treatment of used soapy liquors. March 13.
4589. M. Williams. Improvement in the preparation of drying oils. March 16.

4406. W. P. Thompson and G. Tall. Improvements in or relating to the treating or purification of crude or semi-refined cotton-seed oil. March 16.

4651. H. C. Foulsham. An improved soap powder. March 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

5981. T. S. Saunders. An improved soap. February 27.
5985. J. Lewkowitch. Obtaining fatty acids and glycerin from fats and oils. February 27.
6669. A. J. Boulton.—From O. Korschelt. Extracting wool-oil (lanolin) mechanically. March 6.
6671. A. J. Boulton.—From O. Korschelt. Extracting wool-oil (lanolin) mechanically. March 6.
7095. W. P. Thompson.—From C. C. Parsons. Improvements in detergents in which ammonia is an ingredient. March 20.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

4179. S. Kenyon. Improvements in and in the manufacture of a preparation or substance applicable as a substitute for india-rubber, and for waterproofing or dressing cloths, sheetings, and other articles, also for other purposes. March 9.
4567. H. W. Hemingway and W. F. Thompson. Improvements in the treatment of lead for the manufacture of products applicable for use as pigments and otherwise. March 15.
4602. H. A. Seegall. Improvements in the production of chrome preparations. March 16.
4637. R. Seabrook. An improved anti-fouling compound for coating the bottoms of ships and other vessels. Complete Specification. March 16.
4650. W. A. Bes. New or improved compositions for decorative purposes. March 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

5878. The Belfast Paint and Colour Manufacturing Company. Perfuming paint enamels known as "Woodstock" oxydised enamels. March 6.
6012. E. F. Wailes and E. J. Dove. Compositions for coating metal structures, and apparatus for applying same. February 27.
7033. J. B. Hannay. Preservative and anti-fouling coatings for ships. March 20.
- 11,554. W. O. Wotton. Anti-fouling composition. March 13.
- 17,946. F. J. Binns and R. J. Paris. Composition for ships' bottoms, &c. March 6.

1889.

722. J. Y. Johnson.—From G. Fell. Manufacture of lead pigments. March 6.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

3964. G. Johnson and H. Clarke. Improvements in sole leather. Complete Specification. March 6.
4408. A. F. S. Grant and W. Francis. Improvements in tanning. March 13.
4415. G. Mitchell and R. W. Rutherford. An improved process for preparing skins and hides for tanning. March 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

742. L. A. Groth. Apparatus for tanning by the aid of electricity. March 20.
6491. H. Levick. Improvements in tanning. March 6.

XV.—AGRICULTURE, MANURES, Etc.

APPLICATIONS.

4450. W. Y. Hardie. See Class XVI.11.—B.
4655. T. C. Darby and G. C. Phillips. Improvements in the preparation of manure, and in apparatus to be used for this purpose. March 16.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

2960. A. Mally. Improvements in apparatus for moulding or pressing sugar into suitable forms. February 19.
3378. C. Guttler. See Class IX.
3526. A. G. Salamon. Improvements in the preparation of cane and beet sugar. February 27.
4121. F. Demmin. Improved method for cleansing or whitening sugar in the centrifugal machine, and apparatus therefor. March 8.
4444. J. Grass and O. Olme. Improvements in the manufacture of saccharine liquors for brewing and other similar purposes, and in the mode of their manufacture. March 14.

COMPLETE SPECIFICATION ACCEPTED.

1888.

6698. G. Fletcher. Sugar-cane mills. February 27.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

2953. A. Seelbach. An improvement in the manufacture of champagne and like wines. Complete Specification. February 19.
3468. B. Hoff. Improvements relating to distillation and apparatus therefor. February 26.
3574. M. P. Halsechek. An improved system of "pneumatic malting." February 28.
3598. C. E. Mumford. Improvements in tides for malt-kiln floors. Complete Specification. February 28.
3706. J. Mitchell. Improvements in filtering sediment from distilleries and in other similar filtering operations, and in the apparatus employed therefor. March 2.
3797. C. R. C. Tiebhorne, A. Darley, and M. F. Percell. The collection and the utilisation of the carbonic acid and other products given off during the process of all fermentations. March 2.
4444. J. Grass and O. Olme. See Class XVI.
4549. E. A. Barbet. Improvements in process for rectifying and distilling alcohol, and in apparatus therefor. March 15.

COMPLETE SPECIFICATION ACCEPTED.

1888.

- 13,675. J. Hemming. Pneumatic malting drums. March 13.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

2820. R. M. Houldsworth, London. A tea compound. Complete Specification. February 18.
3019. E. Sonstadt. Improvements in processes and apparatus for the preparation of an extract of tea, and in the utilisation of the by-products. February 20.
3168. C. Garnier. A new or improved process for the preservation of animal substances, and apparatus for use therewith. February 22.
3172. E. Sonstadt. Improvements in processes and apparatus for the preparation of an extract of coffee, and in the utilisation of the by-products. February 22.
3210. W. H. Pearce. An improved process for preserving fruit, &c. February 22.

3577. P. G. Oster. A new compound or article of food, applicable for preparing a beverage similar to coffee, and process for making the same. February 28.

4391. S. Marmont. A process of and means for curing or preserving all kinds of fish, flesh, and fowl, and apparatus therefor. Complete Specification. March 13.

B.—SANITARY CHEMISTRY.

4058. H. Guthrie. Improvements in treating sewage, and in the construction and arrangement of means therefor. Complete Specification. March 8.
4411. J. B. Paddon. Improvements in the method of and apparatus for destroying town and other refuse material. March 13.
4450. W. Y. Hardie. Improvements in the method of and means for destroying or otherwise treating towns' refuse and sewage sludge, and purifying the fumes and gaseous vapours emitted therefrom, and preparing and utilising the by-products and residuals for commercial and agricultural purposes. March 14.
4620. J. L. Fletcher. See Class I.

C.—DISINFECTANTS.

2858. W. H. Daniels. An improved antiseptic compound for preserving perishable articles. February 18.
3159. R. Hannan. Improvements in sanitary materials or preparations. February 22.
3470. A. M. Clark.—From E. Bean, United States. An improved insect-destroying compound, and method of preparing same. February 26.
3728. A. H. Mason.—From Messrs. Senbury and Johnson, United States. A fumigating or disinfecting candle. March 2.
4387. H. Oppenheim. Tablets for disinfecting, antiseptic, medical, bleaching, and laundry purposes. Complete Specification. March 13.

COMPLETE SPECIFICATIONS ACCEPTED.

B.—SANITARY CHEMISTRY.

7307. A. Fawcett. Apparatus for the clarification of sewage. March 20.
8371. W. Edwards. Prevention of the pollution of watercourses; purifying ordinary river waters for use; and recovery of materials used by paper-makers, dyers, and others. March 20.

C.—DISINFECTANTS.

6738. J. W. Knights and W. D. Gall. Automatic distribution of disinfecting or antiseptic fluids for deodorising the atmosphere. February 27.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

4264. T. Phoenix and G. Kirk. Improvements in the preparation of tissue transfer paper, and of printed transfers for transferring designs on to pottery ware.
4452. E. Partington. Improved apparatus for separating or disintegrating fibres in the manufacture of paper. March 14.

COMPLETE SPECIFICATION ACCEPTED.

1888.

3787. T. J. Pearce and M. W. Beardsley. Manufacture of paper having waterproof and non-conducting qualities. March 13.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATION.

3745. A. Domcier. Improvements in extracting and fixing perfumes. March 2.

COMPLETE SPECIFICATION ACCEPTED.

1888.

3094. L. Merck and E. Menck. Production of hydrargyrum compounds. February 27.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.*APPLICATION*

4324. G. C. Whitfield. An improvement in film photography. March 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

7044. R. Norris. Production of collodion films on surfaces of great sensitiveness. March 6.

1889.

1461. W. J. Wilson. Photographic transparencies. March 6.

XXII.—EXPLOSIVES, MATCHES, Etc.*APPLICATIONS.*

3761. H. C. L. Helden. Improvements in electric tubes and fuzes for firing ordnance and exploding torpedoes and mines, and for like purposes. March 4.

4477. H. S. Maxim. Improvements in the manufacture of explosive compounds. March 14.

4479. A. V. Newton.—From A. Nobel. Improvements in the preparation of explosive compounds. March 14.

4539. E. Eisenmann and A. Arche. Improvements in the manufacture of picric acid. March 15.

COMPLETE SPECIFICATION ACCEPTED.

1888.

6560. A. V. Newton.—From A. Nobel. Explosive compounds. March 6.

THE JOURNAL

OF THE

Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 4.—VOL. VIII.]

APRIL 30, 1889.

[Non-Members 30/- per annum; Members 21/- per Set of extra or back numbers; Single Copies (Members only) 2/6.]

The Society of Chemical Industry.

Past Presidents:

Sir H. E. Roscoe, M.P., LL.D., V.P.R.S.	1881—1882.
Sir Frederick Abel, C.B., D.C.L., F.R.S.	1882—1883.
Walter Weldon, F.R.S.	1883—1884.
W. H. Perkin, Ph.D., F.R.S.	1884—1885.
E. K. Muspratt	1885—1886.
David Howard	1886—1887.
Prof. James Dewar, F.R.S.	1887—1888.

COUNCIL FOR YEAR ENDING JULY, 1889.

President: Ludwig Mond.

Vice-Presidents:

<i>Sir I. Lowthian Bell, F.R.S.</i>	<i>David Howard.</i>
<i>R. Forbes Carpenter.</i>	<i>Ivan Levinstein.</i>
<i>Prof. F. Clowes, D.Sc.</i>	<i>E. K. Muspratt.</i>
<i>Sir J. Neilson Cuthbertson.</i>	<i>Dr. W. H. Perkin, F.R.S.</i>
<i>Prof. James Dewar, F.R.S.</i>	<i>Sir H. E. Roscoe, M.P., F.R.S.</i>
<i>Dr. John Evans, F.R.S.</i>	<i>Prof. W. A. Tilden, F.R.S.</i>

Ordinary Members of Council:

<i>Alexander M. Chance.</i>	<i>F. J. Rowan.</i>
<i>James Duncan.</i>	<i>Dr. Edward Schunck, F.R.S.</i>
<i>A. E. Fletcher.</i>	<i>E. C. C. Stanford.</i>
<i>S. H. Johnson.</i>	<i>J. C. Stevenson, M.P.</i>
<i>B. E. R. Newlands.</i>	<i>T. W. Stuart.</i>
<i>B. S. Proctor.</i>	<i>Thos. Tyrer.</i>

With the Chairmen and Secretaries of Sections.

Honorary Treasurer:

E. Rider Cook, East London Soapworks, Bow, E.

Honorary Foreign Secretary:

Dr. Ferdinand Harter.

General Secretary: Charles G. Cresswell.

Offices:

Palace Chambers, 9, Bridge Street, Westminster, S.W.

THE JOURNAL.

Publication Committee:

The President.

<i>Sir F. A. Abel, F.R.S.</i>	<i>Prof. A. K. Huntington.</i>
<i>A. H. Allen.</i>	<i>F. Hurter, Ph.D.</i>
<i>G. H. Bailey, D.Sc., Ph.D.</i>	<i>F. Jones, F.R.S.E.</i>
<i>Joseph Bernays, M.I.C.E.</i>	<i>Ivan Levinstein.</i>
<i>H. Brunner.</i>	<i>Prof. R. Meldola, F.R.S.</i>
<i>W. Lant Carpenter.</i>	<i>E. K. Muspratt.</i>
<i>Prof. Frank Clowes, D.Sc.</i>	<i>C. O'Sullivan, F.R.S.</i>
<i>W. Y. Dent.</i>	<i>John Pattinson.</i>
<i>Prof. Jas. Dewar, F.R.S.</i>	<i>W. H. Perkin, Ph.D., F.R.S.</i>
<i>John Heron.</i>	<i>Sir H. E. Roscoe, M.P., F.R.S.</i>
<i>D. B. Hewitt, M.D.</i>	<i>John Spiller.</i>
<i>David Howard.</i>	<i>A. Norman Tate.</i>
<i>Prof. J. J. Hummel.</i>	<i>Thomas Tyrer.</i>

Editor:

Watson Smith, The Owens College, Manchester.

ASSISTED BY THE FOLLOWING STAFF OF

Abstractors:

<i>T. L. Bailey, Ph.D.</i>	<i>A. J. King, B.Sc.</i>
<i>G. H. Beckett.</i>	<i>F. S. Kipping, D.Sc.</i>
<i>D. Bendix.</i>	<i>Chas. A. Kohn, Ph.D.</i>
<i>E. Bentz.</i>	<i>F. W. T. Krohn.</i>
<i>E. E. Berry.</i>	<i>T. A. Lawson, Ph.D.</i>
<i>E. J. Bevan.</i>	<i>J. Walter Leather, Ph.D.</i>
<i>Bertram Blount.</i>	<i>A. Liebmann, Ph.D.</i>
<i>Arthur G. Bloxam.</i>	<i>D. A. Louis.</i>
<i>C. H. Bothamley.</i>	<i>W. Maenab.</i>
<i>E. G. Clayton.</i>	<i>G. Harris Morris, Ph.D.</i>
<i>Julius B. Cohen, Ph.D.</i>	<i>J. M. H. Munro, D.Sc.</i>
<i>C. F. Cross.</i>	<i>H. S. Pattinson, Ph.D.</i>
<i>A. R. Davis.</i>	<i>H. T. Penttermann.</i>
<i>W. W. Haldane Gee, B.Sc.</i>	<i>S. G. Rawson, B.Sc.</i>
<i>C. Napier Hake.</i>	<i>A. Ree, Ph.D.</i>
<i>S. Hamburger, Ph.D.</i>	<i>F. W. Renaut.</i>
<i>Oswald Hamilton.</i>	<i>A. J. Smith, B.Sc.</i>
<i>John Heron.</i>	<i>A. Studer, Ph.D.</i>
<i>Bertram Hunt.</i>	<i>Bertram Thomas.</i>
<i>C. C. Hutchinson.</i>	<i>Eustace Thomas.</i>
<i>D. E. Jones, B.Sc.</i>	<i>V. H. Veley, M.A.</i>
<i>W. E. Kay.</i>	<i>R. Lloyd Whiteley.</i>
	<i>A. Wingham.</i>

NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list, will retire from their respective offices at the forthcoming Annual General Meeting.

Sir Isaac Lowthian Bell, Bart., F.R.S., has been nominated to the office of President; and Mr. Ludwig Mond has been nominated Vice-President under Rule 11.

Dr. W. H. Perkin, F.R.S., has been nominated a Vice-President under Rule 24; Mr. James Duncan, Mr. S. H. Johnson, Dr. Hugo Müller, F.R.S., and Dr. Edward Schunck, F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. L. Archbutt, Mr. John Brock, and Mr. John Spiller have been nominated Ordinary Members of Council under Rule 17, in the place of Mr. James Duncan, Mr. S. H. Johnson, and Dr. Edward Schunck, F.R.S., nominated Vice-Presidents.

The Treasurer and Foreign Secretary have been nominated for re-election.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18:—"No such nomination shall be valid, unless it be signed by at least ten members of the Society, who are not in arrear with

their subscriptions, nor unless it be received by the General Secretary, at the Society's office, at least one month before the date of the commencement of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

ANNUAL GENERAL MEETING.

Notice is hereby given that the next Annual General Meeting will be held in London on Wednesday, Thursday, and Friday the 10th, 11th, and 12th of July next. Detailed arrangements and the programme of proceedings will appear as soon as complete. Tickets of membership will be issued in time for the meeting, and will form, as heretofore, vouchers for visits to works and excursions.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Post Office Orders in payment of subscriptions should in all instances be made payable at the General Post Office, London.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

LIST OF MEMBERS ELECTED, 23rd APRIL, 1889.

d'Andria, M. N., Birch Villa, Windsor Road, Levenshulme, Manchester, manufacturing chemist.

Ball, Joseph P., 4533, Main Street, Frankford, Philadelphia, Pa., U.S.A., chemical student.

Bowing, Jno., 259, Gresham House, Old Broad Street, E.C., consulting and manufacturing chemist.

Brown, Chas. J., 12, Victoria Buildings, St. Mary's Gate, Manchester, engineer.

Brammer, Dr. Philip, Clayton Aniline Co., Clayton, Manchester, chemist.

Burger, Dr. Josua, B, Marzellenstrasse, Coln, Germany, chemist.

Cargay, Wm. G., Forest Hall, near Newcastle-on-Tyne, analytical chemist.

Chattaway, Wm., c/o A. H. Allen, 101, Leadenhall Street, E.C., analytical chemist.

Claus, Wm. H., Tonge Villa, Middleton, near Manchester, manager.

Corbould, Wm. H., Flora Bell Proprietary Silver Mining Co., Northern Territory, South Australia, assayer and analyst.

Dodd, Wm. Ralph, Dunsmure Road, Stamford Hill, N., chemical manager.

Fletcher, George, 3, East Ascent, St. Leonards-on-Sea, engineer.

Follows, F. W., Morningside, Fairfield, near Manchester, engineer.

Faukel, Lee K., 1315, Marshall Street, Philadelphia, Pa., U.S.A., instructor in chemistry.

Griffin, Roger B., 103, Milk Street, Boston, Mass., U.S.A., chemical engineer.

Harrison, Ernest M., c/o Hay-Gordon & Co, Widnes, chemical works manager.

Horton, Wm., 5, Edge Lane, Liverpool, chemical student.

Isherwood, Oswald, c/o Mather and Platt, Salford Ironworks, Manchester, chemical engineer.

Law, Arthur Ewing, c/o Jas. Muspratt & Sons, Widnes, chemist.

Little, Arthur D., 103, Milk Street, Boston, Mass., U.S.A., analytical chemist.

McMurtrie, John M., 99, Portuzal Street, Glasgow, brass founder.

Ma'lalien, Thos. C., Albert Villas, Levenshulme, Manchester, student.

Morton, Jas., Dalquhurn Works, Renton, N.B., dyeworks manager.

Richards, Edgar, Office of Internal Revenue, Treasury, Washington, D.C., U.S.A., analytical chemist.

Williams, David, Sutton Alkali Works, St. Helens, analytical chemist.

Wise, Jno. B., 190, Bellfield Street, Glasgow, chemist.

CHANGES OF ADDRESS.

Ashburn, Wm., 1/o Moss Side; 36, Portman Street, Whalley Range, Manchester.

Auerbach, Dr. G., 1/o Elberfeld; 25, Friesenheimer Strasse, Ludwigshafen a Rhein, Germany.

Bell, Geo.; Journals to 17, Greenway Road, Runcorn.

Bendix, D.; Journals to 216A, Romford Road, E.

Beveridge, Jas.; Journals to 4, Kent Road, Gravesend.

Bull, H. J., 1/o Ardwick; 63, Plymouth Grove, Manchester.

Clayton, E. Godwin, 1/o 54; 13, 14, Holborn Viaduct, London, E.C.

Crake, Wm., 1/o Chili; 28, Morley Street, Heaton, Newcastle-on-Tyne.

Curphey, W. S., 1/o Renfrew Street; 2, Prince's Square, Strathbungo, Glasgow.

Elmore, A. S., 1/o Cockermouth; The Mount, Rothwell, Leeds.

Epstein, Dr. W., 1/o Cheetham; 43, Cleveland Road, Crumpsall, Manchester.

Fletcher, R. Steele, 1/o Misterton; 11, Abbey Walk, Grimsby.

Freeman, A., 1/o Liverpool Road; 82, Dentons Green Lane, St. Helens, Lancashire.

Gowland, Wm., 1/o Manchester; c/o F. Dillon, 13, Upper Philimore Gardens, Kensington, W.

Gracey, Robert, 1/o Great George Street; 21, Nile Street, Liverpool.

Graham, J. A., 1/o Putney; 8, Lordship Park, Green Lanes, N.

Greville, H. L., 1/o Hornsey Rise; Diersheim, Chelmsford Road East, Woodford, Essex.

Hale, E. P., 1/o Rock Ferry; c/o Wakefield & Co., Gatebeck, Kendal.

Hamlen, G. J., 1/o Glasgow; c/o Nobel's Explosives Co., Ltd., Ardeer, Stevenston, Ayrshire.

Heriot, Wm. Scott, 1/o Ph. Leonora; Zeeburg House, West Coast, Demerara.

Johnson, Frank, 1/o Rio Tinto; Tharsis Mines, Huelva, Spain.

Jones, T. Tolley, 1/o Little Collins Street; 486, Collins Street, Melbourne, Victoria.

King, Walter, 1/o Mitcham; 23, St. John's Road, Southend-on-Sea.

Knight, J. J., 1/o Queenborough; 17, Warrington Road, Halton View, Widnes.

Liddle, W. T., 1/o Rawtenstall; Carr Bank, Walmersley, Bury.

Matthews, W. E., 1/o Melbourne; School of Mines, Maryborough, Victoria.

Newton, Harry, 1/o Buxton Road; 1, Slegg Street, Macclesfield.

Schulze, Dr. E.; Journals to Chemische Fabrik Lindenhof Walldorf bei Mannheim, Germany.

Smith, Fred., 1/o London; West Parade, Sutton-on-Hull.

Sutherland, D. A., 1/o Burntisland; Chemical Laboratory, Whitehaven.

Thomson, Robt., 1/o Glasgow; 413, Oxford Street, London, W.

Walsh, P. H.; Journals to c/o Dr. Bell, Shady Side, Crescent Ridge Avenue, Chilton, Hamilton Co., Ohio, U.S.A.

Wanser, Percy J., 1/o Warrington; The Grove, Lower Bebington, Cheshire.

Wright, Lewis T., 1/o 511; 1169 Calle Alsina (Casilla 765) Buenos Ayres.

Deaths.

Dr. Warren De la Rue, F.R.S., at 73, Portland Place, W., April 19, aged 74.

Dr. R. S. Newall, F.R.S., at Ferndene, Gateshead, April 21, aged 77.

Joseph Stapleton, at 4, Bloomfield Avenue, Dublin, April 16.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	R. Messel.
H. E. Armstrong.	B. E. R. Newlands.
W. Lant Carpenter.	B. Redwood.
W. Crowder.	T. Royle.
W. J. Dibdin.	John Spiller.
C. Graham.	Wm. Thorp.
S. Hall.	C. R. Alder Wright.
C. C. Hutchinson.	

Hon. Local Sec. and Treasurer:

Thos. Tyrer, Garden Wharf, Battersea, S.W.

SESSION 1888-89.

May 6th.—Mr. C. Napier Hake. "Notes on Explosives."

June 3rd.—Messrs. Newlands Bros. "Improvements in Centrifugal Machines."

" Dr. W. S. Squire. "The Purification of Alcohol by means of Hydrocarbon Oils."

July. — Annual General Meeting.

Meeting held Monday, April 1st, 1889.

MR. DAVID HOWARD IN THE CHAIR.

THE ACTION OF WATER ON LEAD.

BY PERCY F. FRANKLAND, PH.D., B.SC., F.I.C.,
Professor of Chemistry in University College, Dundee.

THE action of water on lead is a matter which is fortunately of but little moment in London, and in the greater part of southern England. In the northern counties, in Scotland, and generally speaking in those districts yielding soft waters, it is, however, a matter of great importance, and one which is too frequently neglected or lost sight of in connexion with the distribution of water for domestic purposes.

In the present paper I do not propose to enter into a detailed disquisition on this subject, which abounds in conflicting literature, but rather to record some of my recent practical experiences in connexion with the corrosion of leaden service pipes, and on the methods which are available for the prevention of the same.

Some time ago my attention was called to the occurrence of numerous cases of lead poisoning in a Lancashire town, and as the occurrence was naturally attributed to the water supply, in the first instance a careful examination of the latter had to be made.

The water supply of this town in question is derived from an upland gathering-ground, the upper half of which is mostly uncultivated moorland and very peaty, so much so that the stream issuing from it is sometimes of a dark-brown colour. The lower half of the gathering-ground is nearly all cultivated meadow and grazing land, but the water draining from it receives some additions of ochreous liquid from an old colliery working. Now, the water from the upper half of the gathering-ground is collected in one reservoir "A," and supplied to one part of the

town, whilst that from the lower half of the gathering-ground is collected in another reservoir, "B," and supplied to a different part of the town.

On being submitted to analysis these two waters were found to differ very considerably in composition. Thus:—

RESULTS OF ANALYSES in PARIS per 100,000.

	Water from Reservoir "A."	Water from Reservoir "B."
Total solids.....	7.80	13.40
Organic carbon.....	.158	.248
" nitrogen.....	.028	.039
Ammonia.....	.002	.004
Nitrogen as nitrates and nitrites.	0	.065
Hardness, temporary.....	0	0
" permanent.....	3.5	7.1
" total.....	3.5	7.1
Chlorine.....	1.1	1.1

Not only did these waters exhibit this difference in composition, but they diverged widely in their behaviour towards lead. Thus the harder water "B" (which had received the coal mine drainage referred to above), had practically no action on either bright or tarnished lead, whilst the softer water "A," after remaining 12 hours in contact with a small piece of bright lead, contained 1.0 part of lead in solution, and, after being similarly in contact with tarnished lead, as much as 1.2 part of lead per 100,000.

This water was, therefore, at once recognisable as one of those peculiarly troublesome ones which act both on new and old lead.

This difference in the activity of the two waters was further found to coincide with the observed fact that no cases of lead poisoning had occurred in the district supplied from the reservoir "B."

It now became necessary to inquire into the available means of rendering the water "A" inactive towards lead.

Effect of Agitation with Carbonate of Lime.—On the laboratory scale I found that this activity of the water "A" could be very easily removed by shaking the water up with precipitated carbonate of lime, and then allowing the latter to subside.

The water which had been in contact with the carbonate of lime for 12–24 hours was found to have no action on either new or old lead.

In extending the investigation of the activity of this water on lead, I employed in all my further experiments pieces of leaden service piping. These pipes were in every case 2 ft. in length, closed by beating out at one extremity, whilst the other was closed with a cork, the tube being completely filled with the water under examination.

Bearing in mind that the water had shown itself more active on old lead than new, it appeared to me very essential to make all the experiments in duplicate, one set of experiments being made with new leaden pipes, and the other with old pipes of similar dimensions and *actually taken from the services of that part of the town which was supplied with the water in question.*

The further experiments were made with samples of the water from the reservoir "A" collected in the months of February, April, and June respectively. Before detailing these experiments, it will be desirable

to record the results of analyses of these several samples, as well as of a sample of colliery water which will be referred to later on:—

RESULTS OF ANALYSIS IN PARTS PER 100,000.

	Water from Reservoir "A."			Colliery Water.
	February.	April.	June.	
Total solids.....	7.40	7.62	11.68	45.92
Organic carbon.....	.141	..	..	.066
" nitrogen.....	.022	..	..	.017
Ammonia.....	.004	..	..	0
Nitrogen as nitrates and nitrites.....	.016	..	..	0
Chlorine.....	1.1	1.2	1.3	1.0
Hardness, temporary ...	0	0	2.1	17.1
" permanent....	3.9	3.3	4.6	17.7
" total.....	3.9	3.3	6.7	34.8
Silica.....	.48	.50	.82	1.46

Experiments on the action of "A" Water on new and old Lead Pipes.—The February sample of water from "A" reservoir was placed in two new pipes of $\frac{1}{2}$ in. and $\frac{3}{4}$ in. diameter respectively. From the table below it will be seen that the water taken from the larger pipe contained more lead than that taken from the smaller one, and points to the necessity of using in all comparisons of this kind tubes of exactly the same diameter.

It was also found that the proportion of lead taken up by the water did not, within certain limits, increase by longer contact; thus generally the water, after standing two days in the tube, did not contain more lead than after standing one day.

Again, the experiments showed that there was no tendency for the quantity of lead taken up to diminish with the age of the pipe; but, on the contrary, the solvent action of the water rather increased from day to day. This important point is more prominently brought out in subsequent experiments with old service pipes.

Some of this water from reservoir "A" was subjected to a sort of crude filtration through chalk on the large scale, and a sample of this filtered water was placed in a $\frac{3}{4}$ -in. new pipe, but from the results given below it will be seen that this treatment had practically left the activity of the water unchanged, the amount of lead taken up being almost exactly the same as in the case of the unfiltered water in the pipe of the same diameter:—

I.	II.	III.
Water from "A" Reservoir.	Water from "A" Reservoir.	Water from "A" Reservoir after Passage through Chalk.
New $\frac{1}{2}$ -in. Pipe.	New $\frac{3}{4}$ in. Pipe.	New $\frac{3}{4}$ -in. Pipe.
Average daily amount of lead found during 12 days' trial.		
.36	.72	.69

Action of Colliery Water on Lead.—The colliery water, the analysis of which is given above, would from its composition be naturally supposed to have no action on lead, and this anticipation was realised on actual trial.

As this colliery water was available in large quantity, it naturally suggested itself that by blending this water with that of the "A" reservoir in suitable proportions, a mixed water might be obtained, which, without being excessively hard, would have no action on lead.

Several experimental mixtures of the two waters were, therefore, prepared and submitted to trial in leaden tubes as below:—

IV. Colliery Water.	V. 10 Vols. "A " Water + 1 Vol. Colliery Water.	VI. 10 Vols. "A " Water + 1 Vol. Colliery Water.
New $\frac{1}{2}$ -in. Pipe.	New $\frac{1}{2}$ in. Pipe.	Old $\frac{1}{2}$ -in. Pipe.
Average daily amount of lead found during 12 days' trial.		
0	.25	1.11
VII. 5 Vols. "A " Water + 1 Vol. Colliery Water.		VIII. 5 Vols. "A " Water + 1 Vol. Colliery Water.
New $\frac{1}{2}$ -in. Pipe.		Old $\frac{1}{2}$ -in. Pipe.
Average daily amount of lead found during 16 days' trial.		
.51		.98
IX. 2 Vols. "A " Water + 1 Vol. Colliery Water.		X. 2 Vols. "A " Water + 1 Vol. Colliery Water.
New $\frac{1}{2}$ -in. Pipe.		Old $\frac{1}{2}$ -in. Pipe.
Average daily amount of lead found during 12 days' trial.		
.39		.88
XI. 1 Vol. "A " Water + 1 Vol. Colliery Water.		XII. 1 Vol. "A " Water + 1 Vol. Colliery Water.
New $\frac{1}{2}$ -in. Pipe.		Old $\frac{1}{2}$ -in. Pipe.
Average daily amount of lead found during 16 days' trial.		
.69		.61
The tube was then filled with London (Thames) water, and after two days it gave .05 Pb.		The tube was then filled with London (Thames) water, and after two days it gave .70 Pb.

Thus, only when the two waters were mixed in equal proportions was the activity of the "A" water counteracted, the proportion of lead taken up being then practically the same as when London water (which is well known to be inactive) is placed in the same tubes.

Indeed, from the analyses of the two waters (the "A" water and colliery water) given above it will be seen that a mixture of the two in equal volumes has a composition very closely approximating to that of ordinary London water.

A remarkable point which is brought out in these experiments on the mixtures of the two waters is that waters containing considerable proportions of

temporary hardness may yet be by no means inactive towards lead.

A few years ago Messrs. Crookes, Odling, and Tidy referred the activity of water towards lead to a deficiency in silica; and although there are many facts which are in harmony with this theory, it will be seen that in the present instance some of the active mixtures contained more silica than the proportion (·5 grain SiO_2 per gallon or ·7 part per 100,000) which in the opinion of these investigators prevents the activity of water on lead. Thus—

Mixture.	Parts per 100,000.	
	Temporary Hardness.	SiO_2 .
"A" water (February sample).	0	·48
Colliery water	17·1	1·46
I. 10 Vols. "A" + 1 Vol. colliery water.....	1·6	·57
II. 5 Vols. "A" + 1 Vol. colliery water.....	2·8	·64
III. 2 Vols. "A" + 1 Vol. colliery water.....	5·7	·81
IV. 1 Vol. "A" + 1 Vol. colliery water.....	8·6	·97

Thus if ·7 part of SiO_2 per 100,000 confers inactivity towards lead on a water, then the mixture No. III. should have no action, whilst from the above tables it will be seen that its activity was still very marked.

The Prevention of Activity by Carbonate of Soda.—Thinking that the activity of the "A" water might possibly be counteracted by the use of an alkali, experiments were made on the effect of adding small proportions of carbonate of soda. The proportions employed were 10 and 5 parts of Na_2CO_3 per 100,000 respectively. The following results were obtained:—

XIII.	XIV.
"A" Water + 10 Parts Na_2CO_3 ½-in. New Pipe, which had been previously used for Experiments in Table I.	"A" Water + 5 Parts Na_2CO_3 per 100,000. Same Pipe as in XIII.
Average daily amount of lead found during 8 days' trial.	
0	0

The "A" water with 5 parts Na_2CO_3 was also tested over the same period of 15 days with a ¾-in. new pipe. The average amount of lead found was only ·03 part, and the maximum, which occurred on the first day, only ·05 part Pb per 100,000.

Thus, even 5 parts of carbonate was sufficient to counteract the activity of this water. A sample from the same source, however, collected in April, when the water was more peaty in character, although containing the same proportion of silica, was considerably more active towards lead, and the activity did not in this case yield to an addition of 5 parts of carbonate of soda.

I have tried the effect of carbonate of soda on several waters, and find that in all cases it either completely suspends or greatly reduces the activity.

According to some authorities, alkaline waters, such as that obtained from artesian wells in the London basin, have a strong action on lead, but this is entirely contrary to my experience; and having

occasion recently to analyse one of these alkaline waters,* from a boring through the London clay, I also investigated its action on lead, and found it to be wholly without action on either the new or old metal. It should be mentioned that these alkaline waters are also specially rich in silica.

The effect of carbonate of soda on the activity of water at higher temperatures was also investigated.

Some of the "A" water alone, and some of the same water with an addition of 10 parts Na_2CO_3 per 100,000, were respectively placed in contact with pieces of old and new lead, and kept at 100° C. on a water-bath for about six hours. The water was then in each case examined for lead:—

"A" water after six hours at 100°	New lead. 2·80 parts Pb.
	Old lead. 2·80 " "
"A" water + 10 parts Na_2CO_3 per 100,000 after six hours at 100° C.	New lead. ·16 " "
	Old lead. ·25 " "

It is thus evident that the carbonate of soda acts as a very perfect protective at higher temperatures also.

Effect of Lime on the Activity of Water.—In order to ascertain whether carbonate of soda might not be replaced by the cheaper material, lime, a number of experiments were made with the latter, the following results being obtained:—

"A" WATER (FEBRUARY SAMPLE) + 2 PARTS CaO per 100,000.

XV.	XVI.
¾-in. New Pipe.	¾-in. Old Pipe.
Average daily amount of lead found during 11 days' trial.	
·08	·76

Owing to the unfavourable results thus obtained in the case of the old pipe, further experiments were made with the April sample from the "A" reservoir, which, as before mentioned, was considerably more active than the February sample, and with larger additions of lime. Thus:—

"A" WATER (APRIL SAMPLE) + 5 PARTS CaO per 100,000.

XVII.	XVIII.
¾-in. New Pipe.	¾-in. Old Pipe.
Average daily amount of lead found during 11 days' trial.	
·39	3·35

The above results show that, whilst the lime has practically the same protective action as carbonate of soda with new pipes, it actually increases the activity of the water towards old pipes, when used in such large proportion as 5 parts per 100,000.

Effect of Sodium Phosphate on the Activity of Water.—Among the substances which are generally accredited with the power of protecting lead, none enjoys perhaps such a high reputation as phosphoric acid. In order to determine whether the activity of the "A" water would yield to this material, experiments were made in which different proportions of hydric disodic phosphate were added to the water. The following results were obtained:—

* The alkalinity was equivalent to 19·8 parts Na_2CO_3 per 100,000.

"A" WATER (APRIL SAMPLE) + HNa_2PO_4

XIX.	XX.
$\frac{1}{2}$ -in. New Pipe.	$\frac{1}{2}$ -in. Old Pipe.
*1 Part P_2O_5 added.	*1 Part P_2O_5 added.
Average daily amount of lead found during 3 days' trial.	
2'60	2'50
*5 Part P_2O_5 added.	*5 Part P_2O_5 added.
Average daily amount of lead found during 3 days' trial.	
2'47	2'10
2'0 Parts P_2O_5 added.	2'0 Parts P_2O_5 added.
Average daily amount of lead found during 2 days' trial.	
*00	1'40

Thus, until very considerable proportions of the sodium phosphate are added, practically no diminution in the activity of the water results.

The Effect of Filtration on the Activity of Water on Lead.—In dealing with the active water of Huddersfield, Messrs. Crookes, Odling, and Tidy found that the activity was greatly reduced by filtration through a stratum of sand, carbonate of lime, and flint, and they attribute the diminished activity of the filtered water to a small proportion of silica dissolved from the flint. As these experiments have, as far as I am aware, not been repeated by any other observers, it appeared of particular interest to examine the efficiency of this method of treatment on the active water in question.

The filters were in the first instance constructed of 1 ft. 3 in. black limestone at the base; upon this followed a layer of 1 ft. 3 in. of flint, and upon this a stratum 2 ft. in thickness of fine silver sand. This filtering medium was arranged in a glass tube about $\frac{1}{4}$ in. internal diameter, and the water was always passed through at a rate not exceeding 50 gallons per square foot of filter-area per 24 hours. This filter is referred to below as "Filter No. 1."

The effect of filtration through this filter will be apparent from the results recorded below:—

XXI.	XXII.
"A" Water (April Sample), before Filtration.	"A" Water (April Sample), before Filtration.
$\frac{1}{2}$ -in. New Pipe.	$\frac{1}{2}$ -in. Old Pipe.
Average daily amount of lead found during 10 days' trial.	
2'06	1'54
This Tube was then filled with "A" Water after passing through No. 1 Filter.	This Tube was then filled with "A" Water after passing through No. 1 Filter.
Average daily amount of lead found during 3 days' trial.	
*37	*97

Thus the activity of this water before and after filtration presents a very strong contrast, but especially in the case of the new tube.

The experiment was then reversed; similar tubes were first filled with the filtered and afterwards with unfiltered water. Thus:—

XXIII.	XXIV.
"A" Water (April Sample), after passing through No. 1 Filter.	"A" Water (April Sample), after passing through No. 1 Filter.
$\frac{1}{2}$ -in. New Pipe.	$\frac{1}{2}$ -in. Old Pipe.
Average daily amount of lead found during 10 days' trial.	
*57	1'28
The Tube was then filled with unfiltered "A" Water.	The Tube was then filled with unfiltered "A" Water.
Average daily amount of lead found during 3 days' trial.	
2'43	2'33

Thinking that perhaps the efficiency of the filter depended mainly upon the carbonate of lime, a second filter (No. 2 Filter) was constructed, in which the layer of limestone was increased to 2 ft. 9 in., whilst the stratum of silver sand was reduced to a depth of 6 in. No. 2 filter was thus composed of—

Sand, 6 in. at the top.
Flint, 1 ft. 3 in.
Limestone, 2 ft. 9 in. at the bottom.

The following results were obtained in similar experiments made with this filter:—

XXV.	XXVI.
"A" Water (April Sample), after Filtration through No. 2 Filter.	"A" Water (April Sample), after Filtration through No. 2 Filter.
$\frac{1}{2}$ -in. New Pipe.	$\frac{1}{2}$ -in. Old Pipe.
Average daily amount of lead found during 10 days' trial.	
*32	2'33
The Tube was then filled with "A" Water after Filtration through No. 1 Filter.	The Tube was then filled with "A" Water after Filtration through No. 1 Filter.
Average daily amount of lead found during 5 days' trial.	
*34	1'62

It thus appears that the efficiency of the filter was by no means increased by increasing the thickness of the stratum of limestone and diminishing that of sand, but, on the contrary, the efficiency of this No. 2 filter was very much less, as shown by the strong action of the filtered water on the old lead pipe.

Although there is this marked difference between the activity of the water before and after filtration, it is very difficult to assign any adequate cause for the contrast. Thus the silica in the water before and

after filtration was practically identical, and was not increased, even after undergoing a second filtration :—

"A" water (April sample), before filtration contained 50 part SiO_2 per 100,000.

Ditto after passing once through No. 1 filter contained 52 part SiO_2 .

Ditto after passing twice through No. 1 filter contained 50 part SiO_2 .

In similar experiments made with a sample of "A" water, collected in June, I have also found that the silica was not increased by filtration through No. 1 filter. Thus:—

"A" water (June sample) before filtration, $\text{SiO}_2 = \cdot 82$ Part.

Ditto after passing through No. 1 filter, $\text{SiO}_2 = \cdot 78$

In this case the total hardness was increased by filtration from 6.7 to 7.0 parts per 100,000.

In the case of a water from Haverfordwest, which however had practically no action on lead, but which I had occasion to submit to filtration through a single layer of fine sand 2 ft. in depth, I found a very slight increase in the proportion of silica. The composition of this water, before and after filtration, is recorded below :—

RESULTS OF ANALYSES in PARTS per 100,000.

Haverfordwest Water.		
	Before Filtration.	After Filtration.
Total solids.....	8.56	8.40
Organic carbon.....	.196	.180
" nitrogen.....	.011	.011
Ammonia.....	Trace.	0
Nitrogen as nitrates and nitrites.....	.013	.011
Chlorine.....	2.4	2.4
Hardness, temporary.....	0	0
" permanent.....	2.6	2.6
" total.....	2.6	2.6
Silica.....	1.52	1.62

In subsequent experiments made in conjunction with Mr. Frew (*see* page 247), I have shown that when distilled water is slowly filtered through *extremely* finely divided flint, a small proportion (.15 part per 100,000) of silica is taken up by the water.

There appears also to be no material difference in the proportions of the dissolved gases present in the waters before and after filtration, although there is *some slight evidence* that the carbonic anhydride undergoes a small increase, and the oxygen a small diminution during the process. This would, of course, according to the explanation of activity given by Graham, Hofmann, and Miller, tend to reduce the activity of the water after filtration. Thus:—

DISSOLVED GASES in 100 Vols. of "A" WATER (JUNE SAMPLE).

	Before Filtration.	After No. 1 Filter.
CO_2	Vols. 190	Vols. 183
O	.678	.677
N	1.396	1.410

	Before Filtration.	After No. 2 Filter.
CO_2	Vols. 191	Vols. 200
O	.618	.634
N	1.348	1.348

	Before Filtration.	After No. 1 Filter.
	I. Vols.	II. Vols.
CO_2	.200	.216
O	.784	.717
N	1.464	1.464

The dissolved gases in the April sample of "A" water, which was much more active than the June sample, were as follows :—

	Vols.
CO_2.....	.078
O.....	.777
N.....	1.601

Again, in the case of a sample of Loch Katrine water, kindly supplied to me by Prof. Mills, I found the dissolved gases before and after filtration through No. 1 filter to be:—

DISSOLVED GASES in 100 Vols. of LOCH KATRINE WATER.

	Before Filtration.	After No. 1 Filter.
	I. Vols.	II. Vols.
CO_2	.034	.031
O	.672	.681
N	1.433	1.431

This sample of Loch Katrine water had the following composition :—

RESULTS in PARTS per 100,000 LOCH KATRINE WATER.

	Parts.
Total solids.....	2.06
Organic carbon.....	.150
" nitrogen.....	.027
Ammonia.....	0
Nitrogen as nitrates and nitrites.....	0
Chlorine.....	.7
Hardness, temporary.....	0
" permanent.....	1.0
" total.....	1.0
Silica.....	.15

It is not a little remarkable that this sample of Loch Katrine water, although so extremely deficient both in silica and carbonic acid, had only a slight action on lead. Passage through No. 1 filter further reduced its activity, as seen from the following experiments :—

LOCH KATRINE WATER.

XXVII.	XXVIII.
Unfiltered.	After No. 1 Filter.
$\frac{1}{2}$ -in. New Pipe.	$\frac{1}{2}$ in. New Pipe.
	Average daily amount of lead found during 5 days' trial.
	'21
	The Tube was then filled with Water twice filtered through No. 1 Filter.
Average daily amount of lead found during 15 days' trial.	Average daily amount of lead found during 9 days' trial.
'35	'15
The Tube was then filled with Water twice filtered through No. 1 Filter.	The Tube was then filled with unfiltered Water.
Average daily amount of lead found during 3 days' trial.	Average daily amount of lead found during 3 days' trial.
'12	'32

A similar reduction in the activity of the water was also effected by filtration through 4 ft. 6 in. of fine sand instead of the composite filter. After this filtration it yielded on analysis:—

	Parts.	
Total solids	2'40	} per 100,000.
Organic carbon	'116	
„ nitrogen	'026	
Silica.....	'17	

I have recently had occasion to examine also two Cornish waters which have a strong action on new lead. These waters, which were derived from Redruth and St. Austell respectively, had the following composition:—

RESULTS in PARTS per 100,000.

	Redruth Water.	St. Austell Water.
Total solids	12'88	7'20
Organic carbon	'037	'020
„ nitrogen	'009	'011
Ammonia	0	0
Nitrogen as nitrates and nitrites	'218	'176
Chlorine	3'0	2'5
Hardness, temporary.....	0	'6
„ permanent	5'0	3'9
„ total	5'0	4'5
Silica.....	'96	1'02

Not having sufficient of these waters at my disposal to examine their behaviour in service pipes, I placed them in contact with small pieces of new and old

lead of equal size in the ordinary way adopted for testing the action of water on lead.

Redruth water after 5 New lead.....	'80 part Pb.
12 hours Old „	'38 „
St. Austell water after 5 New lead.....	1'00 „
12 hours Old „	'36 „

The waters were also each of them treated with 5 parts of carbonate of soda per 100,000, and their action on old and new lead again similarly tested:—

Redruth water + 5 parts Na ₂ CO ₃ per 100,000 (after 12 hours)	New lead '04 part Pb. Old „ '06 „
St. Austell water + 5 parts Na ₂ CO ₃ per 100,000 (after 12 hours)	New lead '08 „ Old „ '02 „

Thus the activity of each of these waters yields to treatment with a small proportion of carbonate of soda.

In view of the great importance of this subject, it is highly desirable that all tests made as to the activity of water towards lead should be made under uniform conditions, so that the results may be strictly comparable.

It is also very important that in investigating the activity of water, the conditions which hold good in the actual distribution of water should be as closely imitated as possible, and from the results which I have brought before you this evening it will be at once apparent how necessary it is that the action of the water on old service pipes as well as on new ones should be carefully inquired into, as the action in the two cases may, as we have seen, be widely different. In fact there can be no doubt that the corroded interior of an old pipe exposes a far more extensive front for the attack of the active water than does the polished surface of a new one.

In order to render the conditions of experiment still more closely analogous to those existing in actual practice, I have in a more recent investigation undertaken, in conjunction with Mr. Frew, and to which I shall presently refer, submitted the water in contact with the lead pipes to a pressure of some 2½ atmospheres.

As regards the means available for counteracting the activity of potable water, there are obviously several different courses open which will recommend themselves according to the particular circumstances of individual cases.

Thus it will be seen from the above results that water from one and the same source may be possessed of very different degrees of activity towards lead at different seasons. This difference is doubtless due not only to variation in the *quantity* of organic matter present in the water, but also to variation in the *quality* of that organic matter, as well as to variation in the nature and amount of the saline ingredients.

In some cases the activity of water supplies may be conveniently counteracted by the admixture of an inactive and somewhat highly saline water in suitable proportions, as in the particular case referred to in this paper. It is, however, extremely noteworthy that the proportion of such a hard water, which must be added in order to neutralise the activity, may be greatly in excess of what one would be led to expect from theoretical considerations only. This method of blending, moreover, will in most cases not recommend itself, owing to the consequent deterioration of the water for steam purposes.

For simplicity, efficiency, and for the promptitude with which it can be applied, no method can compete with that of adding carbonate of soda in

suitable proportions, which may be varied according to the necessities of the water at different seasons.

Extremely remarkable is the protection secured by the filtration of the active water, a protection which does not appear to be adequately accounted for by the change effected in the proportion of any one ingredient present in the water, but which must probably be referred to the minute alteration in a number of the ingredients producing such an aggregate change in the character of the water that the activity is reduced in a marked degree. Thus the hardness undergoes a slight increase, as does the silica, and probably also the dissolved carbonic anhydride, whilst the organic matter, and probably also the dissolved oxygen, undergo a slight diminution.

The filtration of upland surface water, which is in general the offender as regards lead, is, of course, strongly to be recommended on other grounds, and although the process does in the first instance greatly reduce the activity of the water towards lead, it is very doubtful whether this protective action can be maintained without a frequent renewal of the filtering medium. In any case the activity of the water before and after filtration must be kept under constant observation.

It is further evident, from the results recorded in this paper, that although the chemical composition of a water indicates the probability or improbability of its acting on lead, recourse should still invariably be had to actual experiment in order to finally determine this point, whilst the seasonal variations in the character of surface waters should also be duly taken into consideration in such investigations.

There can be no doubt that in the past very insufficient attention has been devoted to the question of the safe distribution of these soft upland surface waters through leaden pipes, their freedom from any suspicion of sewage contamination having led to their enthusiastic recommendation in all quarters. Now, although I do not for a moment wish to suggest that these waters are not of the most excellent quality, especially for the supply of manufacturing towns, still it would appear to be high time that every regard should be paid to their distribution at a minimum risk to the consumer.

RESULTS of ANALYSES expressed in PARTS per 100,000.

— Dundee Water.		Total Solids.	Hardness.			Silica.
			Temporary.	Permanent.	Total.	
1889.						
I.	Jan. 24.....	4.0	6	3.7	4.3	65
II.	Feb. 27.....	7.6	0	6.1	6.1	60

When introduced into new pipes, however, the water has in the first instance a very considerable action on the metal. Thus two new leaden tubes 2 ft. by $\frac{3}{4}$ in. were filled with the above sample No. I, and the lead in suspension and solution determined from day to day:—

Number of Hours during which Water remained in contact with Lead.	Tube I.		Tube II.		Tube III. 10 Parts Na_2CO_3 .		Tube IV. 5 Parts Na_2CO_3 .	
	Lead in Parts per 100,000.							
Hours.								
24	2.72	2.86		..				..
24	2.90	2.88		..				..
66	2.30	2.32		..				..
24	2.46	2.33		..				..
24	2.39	2.15	During the latter half of these experiments, the same water to which 5 and 10 parts respectively of carbonate of soda per 100,000 had been added, was placed in two similar new tubes, and the lead from these simultaneously determined thus:—					
24	2.20	2.20						
24	2.17	2.11						
68	2.13	2.07						
24	2.03	2.05		2.16				2.14
24	2.13	2.12		2.06				2.14
42	2.09	2.15		2.07				2.08
70	2.06	2.11		2.06				2.11
46	2.10	2.13		2.06				2.11
24	2.09	2.14		2.05				2.15

N.B.—In all the experiments recorded in this paper leaden pipes 2 ft. in length and $\frac{3}{4}$ in. internal diameter were used.

The above results show that although this Dundee water has a very strong action on new lead in the first instance, the action rapidly diminishes, and soon becomes insignificant. The experiments with carbonate of soda, moreover, show that by the addition of this substance to the water in the above proportions, even this initial action is entirely done away with, thus confirming the results previously obtained by one of us with other waters.

The Action of Water containing Ammonium Nitrate.—Wishing to render the Dundee water more active for the purpose of some other experiments, we prepared samples of this water* to which 2 and 10 parts respectively of ammonium nitrate had been added, inasmuch as this salt is generally supposed to cause the solution of lead. (M. M. P. Muir, J. Chem. Soc. 1877.)

To our surprise, however, we found that on filling the lead pipes with these waters the amount of action was actually less than in the case of the Dundee water alone, and less in the case of the sample to which 10 parts of ammonium nitrate had

* Collected, February 27, 1889; for analysis, see above.

FURTHER EXPERIMENTS ON THE ACTION OF WATER ON LEAD.

BY PERCY F. FRANKLAND, PH.D., B.Sc., ETC., AND WILLIAM FREW (Student in the Chemical Laboratories of University College, Dundee).

In continuation of the previous experiments made by one of us on the action of water on lead, we have extended these investigations with a view to further testing the protective action of various substances, as well as to ascertain the effect of bringing different kinds of water into contact with the metal at a high pressure.

In the first instance we made some experiments with the water supplied to Dundee. This water, although obtained from an upland gathering-ground, soft, and in fact often quite destitute of temporary hardness, has no permanent action on lead. Thus:—

been added than in that which had received only two parts.

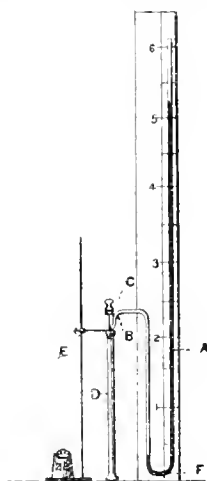
DUNDEE WATER + 2 PARTS $(\text{NH}_4)\text{NO}_3$ per 100,000.

Date.	Hours in Contact.	Temp. ° F.	Lead in Parts per 100,000.	
			Tube I.	Tube II.
March 5	24	43	'05	'09
" 6	24	43-44	'06	'10
" 7	24	44-45	'06	'11

DUNDEE WATER + 10 PARTS $(\text{NH}_4)\text{NO}_3$ per 100,000.

Date.	Hours in Contact.	Temp. ° F.	Lead in Parts per 100,000.	
			Tube I.	Tube II.
March 9	24	46-45	'06	'08
" 11	42	45-43	'03	'06

Effect of Pressure on the Action of Water on Lead.—In order to test the action of water on lead under pressures greater than that of the atmosphere, we made use of the following apparatus:—



A large U-tube of glass (A) is fastened to a board bearing a scale of feet and inches. The lower end (B) of the U-tube is connected by a piece of thick walled india-rubber pressure-tubing to a glass tube passing through one of the perforations of an india-rubber stopper, through the other perforation of which passes a stoppered funnel (C). The leaden pipe (D) is filled with the water under examination, the india-rubber stopper is then inserted and held firmly in position by means of the clamp and stand (E). More of the same water is then introduced through the funnel (C) until it flows over into the U-tube and passes beyond the bend (F). The stop-cock of the funnel is then closed and mercury is poured in at the open upper end of the U-tube until the desired pressure is obtained. At the end of the experiment the india-rubber joint is closed with a clip at (B), the leaden tube disconnected, and the water poured out for testing.

In the first instance we submitted the sample of Dundee water collected on January 24th, 1889, and the analysis of which is given above, to examination with the following results:—

—	Hours in Contact.	Temp. ° F.	Tube XI. Pb per 100,000.	Total Pressure on Water, including that of the Atmosphere.
1889, Feb. 11	66	43-40	0	90 inches of mercury.
" 13	46	41-43	0	66 " "
" 14	24	43-44	0	83 " "
" 15	24	44-45	'09	Atmospheric pressure only.

From the above experiments it appears that under a high pressure the Dundee water takes up no lead either in solution or suspension, even from a perfectly new tube; and further than this, that the tube which has been submitted to the water under pressure in this manner for several days is as much protected against further action as a tube which has been in contact with the same water under atmospheric pressure for a considerably longer period of time, as is seen from a comparison of the last result in the above table with the results recorded for the same water in the first table of this paper.

Distilled Water under Pressure.—Experiments were then made with the same apparatus, using distilled water instead of Dundee water; the distilled water was in each case also simultaneously placed in an ordinary lead tube under atmospheric pressure.

The following results were obtained:—

Date.	Hours in Contact.	Temp. ° F.	Tube XII. Atmos. Pressure.	Tube XI.	Total Pressure including Atmosphere.
			Pb. '04 parts	Pb. '05 parts	92 in. of mercury.
1889, Feb. 18	2	45	'15 "	'30 "	78 " "
" 18	3	45	'80 "	1'30 "	90 " "
" 20	5	47	4'17 "	5'00 "	78 " "

It thus appears that the activity of the distilled water is distinctly greater under increased pressure.

Further experiments were then made with the view of ascertaining whether the gases (oxygen and carbonic anhydride) dissolved in the distilled water exercised any influence on the activity of the water, both at ordinary and at increased pressures. For this purpose the distilled water was first boiled for one hour, then rapidly cooled, and then a stream of carbonic anhydride or oxygen passed through it for two hours. With distilled water thus saturated the following results were obtained at atmospheric pressure:—

Date.	Hours in Contact.	Temp. ° F.	Tube VII. saturated with CO_2 .	Tube VIII. saturated with O.
			Pb. 1'30 parts	Pb. '32 parts
1889, March 8	20	44-45	1'80 "	'24 "
" 9	20	45-43	This tube was now filled with a mixture of equal volumes of the water saturated with CO_2 and O.	
" 12	20	43-45	Pb. 1'50 parts	Pb. '28 parts
" 11	20	48-47	1'43 "	'15 "
" 15	20	47	'90 "	" "

Thus the distilled water saturated with carbonic anhydride is very much more active than that saturated with oxygen, although much less active than ordinary distilled water, whilst the mixture of the two waters in equal volumes does not differ materially in its activity from that of the distilled water saturated with carbonic anhydride only, but is much less active than ordinary distilled water.

Distilled water thus saturated with these gases was then placed in lead tubes under increased pressure with the following results:—

DISTILLED WATER SATURATED WITH OXYGEN.

Date.	Hours in Contact.	Temp. ° F.	Tube XIV. Atmospheric Pressure.	Pressure. Tube XIII.	Total Pressure including Atmosphere.
1889. Mar. 14	16	48—46	Pb. '10 part	Pb. 0	84 in. mercury.
" 15	20	47	'17 "	Very slight trace.	90 " "

DISTILLED WATER SATURATED WITH CARBONIC ANHYDRIDE.

Date.	Hours in Contact.	Temp. ° F.	Tube XVI. Atmospheric Pressure.	Pressure. Tube XV.	Total Pressure including Atmosphere.
1889. Mar. 15	18	48	Pb. 2'30	Pb. 2'80	84 in. mercury.
" 16	4	48	2'00	1'60	90 " "

These experiments show that the distilled water saturated with oxygen only, and which is only faintly active under ordinary atmospheric pressure, becomes actually inactive under increased pressure, whilst the distilled water saturated with carbonic acid undergoes but little alteration, as regards its activity, on increasing the pressure within the limits employed by us.

The Effect of Filtration through Siliceous Material.—We have also made some further experiments on this subject, with the special object of ascertaining to what extent silica is dissolved when the siliceous material is presented to the water in an extremely fine state of division.

For this purpose some flint was finely powdered, and only that portion passing through a sieve with 28 meshes to the linear inch was used for experiment. The powder thus obtained was first digested with hydrochloric acid to remove any iron that might have gained access to it during the process of pulverisation, after which it was thoroughly washed and then placed in a glass tube '75 inch in diameter, so as to form a compact filtering stratum 35 inches in height. The particular water under examination was then passed through this filter at a rate not exceeding 50 gallons to the square foot in 24 hours.

The Effect of Filtration on Dundee Water.—This water was passed through the filter at the rate of 26 gallons per square foot in 24 hours. The same water, both before and after filtration, was then placed in new lead tubes, and the lead present, both in suspension and solution, determined, with the following result:—

Date.	Hours in Contact.	Temp. F.	Tube V. Filtered Dundee Water.	Tube VI. Unfiltered Dundee Water.
1889. March 8	24	45—46	Pb. '20 parts	Pb. '16 parts
" 9	24	46—45	'18 "	'23 "
" 11	42	45—43	'22 "	'17 "
" 12	24	43—45	'18 "	'15 "
" 13	24	45—48	'19 "	'20 "
" 14	24	48—47	'15 "	'17 "

SiO₂ in unfiltered water = '60 parts per 100,000.

" filtered " = '75 " "

From the above it appears that the filtered water had from the first less action on lead than the unfiltered, but that the action of the two became rapidly equalised.

The proportion of silica was distinctly though slightly greater in the filtered than in the unfiltered water.

The Effect of Filtration on Distilled Water.—This water was passed through the same filter at the rate of 35 gallons per square foot per 24 hours. The filtered and unfiltered waters were then compared in similar new lead tubes, with the following result:—

Date.	Hours in Contact.	Temp. F.	Tube IX. Filtered Distilled Water.	Tube X. Unfiltered Distilled Water.
1889. March 15	20	47	Pb. '25 part	Pb. 4'20 parts
" 16	20	..	'28 "	7'60 "
" 19	24	..	1'50 "	6'00 "
" 20	22	..	1'30 "	4'40 "
" 21	22	..	Fresh Sample of Water. '95 part	Fresh Sample of Water. 4'40 parts

SiO₂ in unfiltered distilled water = '000 part per 100,000.

" filtered " = '15 " "

Thus the difference in the activity of the distilled water before and after filtration is extremely pronounced, whilst the difference in the proportion of silica before and after filtration is identical with that previously found in the case of the Dundee water.

Thinking that possibly the difference in the activity before and after filtration might be occasioned by some alteration taking place in the nature and amount of the dissolved gases in the water during the process of filtration, we made a number of determinations of these gases in both samples of water, but without being able to establish any material difference between the two.

The principal results we have arrived at in the course of our investigation are:—

- (1.) That the activity of water towards lead may, according to its composition, be either increased or diminished by increased pressure.
- (2.) That water containing oxygen has its activity diminished, whilst the activity of water containing carbonic acid is not materially affected by such increased pressure as we employed.
- (3.) That by very slow filtration through extremely finely-divided flint a small proportion of silica is dissolved.

- (4.) That the water after such filtration has less action on lead, both in the case of distilled water and other soft potable waters that have been submitted to examination.
- (5.) That the activity of soft water is very materially reduced by the addition of small proportions of carbonate of soda.

Finally we would call attention to the great importance of invariably submitting waters to the pressure-test described, so that the conditions found in actual practice may as far as possible be reproduced.

DISCUSSION.

The CHAIRMAN said that the question of the pollution of water by lead was one of primary importance, and it was a matter which proved the utter worthlessness, and indeed danger, of a moderate knowledge of chemistry. He had been taught in his youth that if there was one thing in chemistry which was thoroughly understood, it was the reasons for the contamination of water by lead. Yet, after a century of such knowledge, it was found that very little was really known about the matter. So far as recent work had yet gone, it suggested that the cause of the evil was organic rather than inorganic; but what was the exact cause of the action of peaty waters on lead appeared to be one of the most obscure problems of the day. These waters of very small temporary hardness and absolute freedom from contamination would be sought for as the very best for drinking purposes but for their unfortunate capacity for dissolving lead. He would like to ask whether the mixture of "A" water and colliery water described by Dr. Frankland had been allowed to stand for any considerable time, or whether it was put into the lead pipe at once; and also whether the amount of soda added was sufficient to produce a permanent precipitate. If so, it was possible that not only were the bases precipitated, but also some of the slightly soluble organic acids which were the possible cause of the mischief.

Dr. THOS. STEVENSON regarded the communication as a valuable contribution to our knowledge of the action of water on lead and of lead upon water. He was sorry to find, however, that the author had not directed attention to the question at one point, viz., the acidity of the water. However, as Mr. Allen was present and had specially studied the effects of the acidity of these upland surface waters, and the relative actions on lead of acid and non-acid upland waters, no doubt the meeting would derive some valuable information from him on that point. This point was brought forcibly to his mind in considering one of the remedies for the action of such waters on lead—the addition of carbonate of soda. It would have been interesting to have known with respect to the "A" water whether there was any free acid, either organic or inorganic, which could have been neutralised by the carbonate of soda. Dr. Frankland had not found that lime—which should have been equally effective, if added in sufficient quantity—had the same action as carbonate of soda in preventing the reciprocal action of water and lead. This was a point which ought to have an important bearing upon Dr. Frankland's calculation of the temporary hardness of the mixture of the "A" water with water that had temporary hardness. Of course if the "A" water, having no temporary hardness, were an acid water, its mixture with the colliery water would not give the amount of temporary hardness recorded by Dr. Frankland. Those figures must therefore, for the present, be regarded as somewhat hypothetical. His own experiments

with regard to the action of silica, flints, and lime upon water agreed with those of Dr. Frankland. The amount of silica which went into solution on filtering water through siliceous material was very small, and did not seem to have much effect in diminishing the action of water upon lead. There was always one great mechanical difficulty in testing waters for this action—a difficulty which Dr. Frankland had overcome to some extent, but not entirely. In testing the water one must use either a fresh lead pipe or one that had become tarnished. If one used fresh pipe, two pipes, or two portions of one pipe, would not agree in the character of their surface. It was impossible to get them exhibiting exactly the same kind of surface. One pipe would be rougher than another; and if the operator attempted to clean them he at once got a different surface. The action of water upon a new pipe was not a fair guide to what its action would be on a pipe in actual use. He was therefore glad to see that Dr. Frankland had tested with pipe that had been used with the waters under examination; otherwise it would be impossible to say whether the water would have more or less action on an encrusted pipe than on fresh lead. Similarly, if one took a pipe encrusted by one water and passed another water through it, one could not predict the action of the new water on another pipe. It was therefore desirable, though not always possible, to employ in these experiments the pipes actually used for the given waters. Another difficulty had been created in his mind by Dr. Frankland's statement that he cleaned his pipes with caustic soda to free them from grease and then passed tap-water through them for some hours. That was a method he hardly approved of. For if Dr. Frankland cleaned the pipe by using strong soda, and then passed through it water which would itself cause a slight incrustation, he could not be said to have acted on a new pipe or on an old pipe encrusted by the water operated on. One interesting result of his experiments on these waters was to show that the silica hypothesis did not hold good. It was seen that Loch Katrine water acted on lead to a very slight extent though it was very free from silica; and in Dundee also they had a water which fell a little below Dr. Tidy's standard of silicated water, and yet appeared to act on lead much as the Loch Katrine water did. He hoped that Dr. Frankland would be able to inform the meeting whether he had tested these waters for free acid. According to his own experience, those waters which were free from temporary hardness were frequently, if not generally, also distinctly acid, containing sometimes as much as nearly one part per 100,000 of free acid calculated as sulphuric acid, part of it being an inorganic acid and part organic, as shown by the residue, after accurate neutralisation, evaporation, and incineration, containing carbonates.

Mr. WM. FOSTER said that it had occurred to him that perhaps the variations in the first series of experiments might be explained by the ratio of volume to surface. Or perhaps air might have gained access in some way. It seemed to him extraordinary that there should be such variation in the action of water on lead pipes which were supposed to be similar in every respect. It was a most important question, and one which it was often extremely difficult to answer definitely, whether a particular water should be condemned or not. Within the last fortnight he had heard of a case of lead poisoning in the county from which he presumed these waters came. In that case, however, the water was found to be exceptionally hard and free from lead.

Mr. A. H. ALLEN said that he would be glad if Dr. Frankland would answer Dr. Stevenson's question as to the acidity of the "A" water at this point, as his own remarks would to a great extent depend on the nature of that reply.

Dr. FRANKLAND said that the water was practically neutral. At any rate, if there was any acidity it was so slight that it could not be determined by the ordinary methods, and the carbonate of soda added in the experiments must have been enormously in excess of any trace of acidity that may have been present.

Mr. A. H. ALLEN, continuing, said that if that was the case, he would like to know how Dr. Frankland had tried to estimate the acidity, if any. He could not agree that the acidity might be so slight as not to be worth determination. There was often only one-half or even one-quarter of a part of free acid, expressed in terms of sulphuric acid, per 100,000; but that was a sensible amount of acidity, capable of acting on lead to a notable extent. Assuming that the free acid had the same molecular weight as lactic acid, in presence of oxygen it would act on more than its own weight of lead. It would also act on oxide of lead. Chemists had talked much nonsense in the past about the solubility of salts of lead. Sulphate of lead, for example, had been regarded as an insoluble salt. But in this connexion and for this purpose it must be regarded as soluble, seeing that a gallon of water dissolved about 3 grains of the salt, equivalent to 2 grains of metallic lead. Similarly, the acidity of water was often regarded as meaning several grains per gallon or several parts per 100,000; but those were extravagant amounts. One had to deal in practice with much smaller quantities—quantities that could not be detected by blue litmus paper applied in the rough and ready manner that was sometimes done. But if one took the water and evaporated it to one-tenth its volume, any acid then found was clearly not carbonic acid. In the case of one water that he had had much to do with—part of the Sheffield supply, which was very similar in character to the water that Dr. Frankland had described, and, like it, had a considerable action on lead—the free acid was clearly a fixed organic acid, for it was not removed by concentration and did not act on methyl-orange. On the other hand it did act on phenolphthalein, and the amount present could be accurately determined in terms of sulphuric acid by titrating the concentrated water with caustic alkali; and when the previously neutralised water was evaporated to dryness and the residue ignited, a carbonate was formed, which showed the previous presence of an organic acid. Again, Dr. Frankland had said that the "A" water had no temporary hardness. But how did he ascertain that? Evidently the ordinary method by means of soap solution was unfit for determining an amount of temporary hardness of less than $\frac{1}{2}$ grain per gallon. Such quantities could only be detected by evaporating to a small bulk, filtering, and testing the insoluble matter for earthy carbonates. With regard to the lead pipe experiments, he did not approve of the method of taking a piece of new pipe and keeping water in it for a certain time, and then taking the water out and ascertaining the amount of lead. Mr. Allen here described and illustrated on the blackboard the method and apparatus which he himself employed for such examinations of water. He did not think that lead pipe could with certainty be cleaned by means of soda; and by washing afterwards with distilled water for several hours one was likely to get a film of oxide.

Dr. FRANKLAND explained that he had used and stated tap-water only.

Mr. ALLEN said that was worse. After each experiment the pipe was exposed to the air. No wonder, then, that lead was dissolved. Air should never be allowed to enter the pipe, which should be kept, as far as possible, under the conditions of actual practice. The experiments under pressure described by Dr. Frankland only went a little way. Dr. Sinclair White and he had made a few similar experiments under a pressure of 10 atmospheres by attaching the tube to the high-pressure service. The results, however, were not so striking as to lead them to suppose that pressure diminished the activity of water upon lead; in fact, in the few trials made, an increased effect was observed. [Mr. Allen here illustrated the method and apparatus for his experiments under pressure-supply.] He did not see any mathematical or chemical reason for the great difference between the results with $\frac{1}{2}$ -in. and with $\frac{3}{4}$ -in. pipe. Other things being equal, he would have expected more action in the narrower pipe. In a wide pipe there was a certain amount of action round the interior surface, but the inner portions of the water never got into contact with the surface; whereas in a narrower pipe there was much less tendency to the formation of such zones. With regard to silica—he had made many experiments in the hope of introducing it into water; and it had been proposed by Messrs. Crookes, Odling, and Tidy to carry out an experiment with silica and limestone at Sheffield on an enormous scale and at an expense to the inhabitants of 100,000%. But considering that it would be rash to commence with such extensive operations, he had made a number of experiments on a small scale. He had taken distilled water and Sheffield high-level water and kept them in contact with fragments of limestone, natural flint, and decalcified flint for from 48 to 72 hours, but he never could succeed in introducing silica to a greater extent than $\frac{1}{2}$ grain per gallon. When he tried the effect on a new lead pipe, both the calcified and silicated water acted strongly at first, but he found that in the case of the limestone the action gradually decreased, and in about 10 or 11 days ceased altogether. The same thing happened in the case of natural flints. But natural flints were not purely silica; they were silica, with an outside coating of silicate of calcium. When this coating was dissolved or decomposed by hydrochloric acid the flint had no action on the water, the water corroding lead as freely after a month as the first day. Dr. Tidy had attributed the action of limestone to the silica in it. However that might be, it was an interesting fact that this combination of silica and lime did seem to have a certain effect in restraining the action of water on lead; but he himself attributed it more to the limestone, for it was evident that if due to the small proportion of silica present, it would be necessary to dissolve such an amount of lime as would render the water intensely hard in order to get the half grain of silica per gallon which Dr. Tidy fixed as the amount necessary to prevent action on lead pipes. He was sorry that Dr. Frankland had not applied his lime and carbonate of sodium in a more systematic manner. If, instead of merely adding 5 parts per 100,000, he had exactly neutralised any free acid which might have existed in the water, and not added an excess of alkali, it would have been more satisfactory. At any rate he should have liked to have learned the result of an experiment conducted in that way. Adding the carbonate in excess of that necessary to just neutralise the acid was perhaps prejudicial. Mr. C. Rawson, of Bradford, had recently read a paper before the

Society of Dyers and Colourists, in which he stated that he had found that carbonic acid had a violent action on lead. That was also the experience of aerated water makers, but it was opposed to Dr. Frankland's experiments, and, he thought, to his father's statements also. He (Mr. Allen) had experimented with phosphates in water with very satisfactory results, and so, independently, had Mr. Rawson. They had found that water containing a trace of phosphates had no action on lead, as pointed out long since by Dr. Edward Frankland; and if the water contained lead, all that was necessary was to pass it through an animal charcoal or bone-ash filter, and the whole of the lead was removed as a highly insoluble phosphate of lead. He had actually taken out provisional protection for a filter consisting of phosphatic material other than animal charcoal. At Sheffield it was the acid water that acted on the pipes, and the neutral water did not; and exactly the same occurred at both Huddersfield and Bradford. So that whether the action of the water examined by Dr. Frankland was or was not due to acidity, it was at any rate a fact that special activity of that description had frequently been found associated with the presence of free acid in the water. At Bradford, they had cured it by mixing the hard and soft waters together; in other words, as he had suggested, by neutralising the free acid contained in the soft water.

The CHAIRMAN, in calling upon Dr. Frankland to reply, said that he also had been perplexed by the figures indicating a greater action of the water on the pipes of the larger diameter. Bearing in mind that the area of a pipe varied as the square of the dimensions, whereas the surface varied directly as the dimensions, the larger the pipe the less would be the proportion of the circumference to the area. He would therefore have expected a smaller proportionate reaction upon the larger pipe.

Dr. PERCY FRANKLAND, in reply, said that he had himself expected to get more lead in proportion from the half-inch pipes than from the three quarter inch pipes; but the fact remained that the smaller pipes almost invariably gave smaller quantities than the larger ones. Whether or not the results might be due to some mass action, he could not say. It showed, however, how necessary it was in tests of this kind to use pipes of the same diameter. In reply to the question as to whether the waters were allowed to stand after the addition of carbonate of soda, he would point out that although some samples were probably used on the same day that the addition was made, still they would have stood for about a fortnight before the experiments were concluded, because all the results tabulated were averages of about 14 days' trial. With regard to the questions of Dr. Stevenson and Mr. Allen as to the acidity of the "A" water, it was a water which under ordinary circumstances would be described as practically neutral, and even when tested with phenolphthalein the acidity was hardly perceptible.

Mr. ALLEN asked whether that was before concentration, as, in that case, it might be carbonic acid.

Dr. FRANKLAND, continuing, said the water would certainly have been described by any ordinary analyst as neutral. But he knew Mr. Allen made a great point of acidity, and tested for it with exceptional care. Exception had been taken to his method of cleaning the pipes. He could only say that he would be very glad to hear of a better method. To wash a pipe with soda was the ordinary way of removing grease; and that tap-water did not injure the lead was shown by the fact that lead would

remain bright for hours in London water. With regard to the Sheffield pressure experiments which Mr. Allen had described, he would have been glad to have exposed the waters under notice to that pressure of 10 atmospheres, but it was impossible in this case. In all tests of the action of water on lead it was desirable that experiments should be made under pressure. He was convinced that water acted on lead very differently under high pressure and under ordinary pressure, and that a water which might be condemned when tested at atmospheric pressure would be found to have very slight action on lead if tested at high pressure, and perhaps *vice versa*. In the case of Glasgow water, it was found some years ago that when the pipes were charged intermittently the water acted upon them strongly, but on the introduction of the constant service that action on the lead practically vanished. The flints used in his later experiments with distilled water were washed in hydrochloric acid, and the acid was then completely washed out. So that it would seem that contact with the flint did produce some effect upon the water.

THE ECONOMY OF PURE CAUSTIC SODA.

BY C. F. CROSS AND E. J. BEVAN.

IN the course of the examination of a number of samples of caustic soda intended for use in paper-making, we observed that in titrating certain specimens they gave very varying results, according to the particular indicator employed. Thus, in one case a sample that "tested" 60.73 per cent. with litmus, gave 64.70 per cent. when titrated with acid in presence of methyl-orange. This large difference we subsequently found to be due to the presence of about 3 per cent. of alumina.

When such a caustic is titrated hot in presence of litmus, the final point is reached when the whole of the alkali present has been saturated with acid, and the alumina has commenced to precipitate. This is, of course, in accordance with the fact that sulphate of alumina is acid to litmus.

When, however, methyl-orange is used, the final point is not reached until not only is the soda saturated, but the precipitated alumina is re-dissolved, sulphate of alumina being neutral to methyl-orange.

The fact that alumina can be titrated with standard acid in presence of methyl-orange is not new, having been pointed out in the excellent papers on the use of indicators by Robert T. Thomson (Chem. News, 1883 and 1884), but its bearing on the valuation of commercial caustic soda has, we think, been overlooked. Even in such a work as Lunge and Hurter's "Alkali-makers' Pocket-book," where one might reasonably expect to find it, no mention is made of the fact. Although the proportion of alumina in commercial caustic (excepting caustic bottoms) is usually small, and, therefore, of small influence upon the results of its industrial application, it often exceeds the limit of a negligible quantity. We shall consider it first in regard to its analytical determination. Finding, in a number of cases, the differences between the titration with litmus and that with methyl-orange approximately proportional to the amount of alumina present, the suggested relationship was more closely investigated, as follows:—We prepared a solution of pure caustic soda, the strength of which was accurately determined. In

varying volumes of this solution we dissolved known quantities of pure precipitated alumina. The results of the various titrations are given in the following tables:—

	Cc. N. Acid consumed.		
	Litmus.	Phenolphthalein.	Methyl-Orange.
•496 soda alone	12•4	12•4	12•4
•496 soda + •084 Al ₂ O ₃	13•0	12•4	16•5
•496 soda alone	12•4	12•4	12•4
•496 soda + •16848 Al ₂ O ₃	13•0	12•4	20•1
1•24 soda alone	31•0	31•0	31•0
1•24 soda + •084 Al ₂ O ₃	31•9	31•0	35•0
1•24 soda alone	31•0	31•0	31•0
1•24 soda + •421 Al ₂ O ₃	33•0	31•1	51•4

The titrations with litmus were performed in the boiling solution in the usual way. In the case of phenolphthalein, the solutions were boiled with a slight excess of acid (about 0•5 cc.), and, after cooling, were titrated back with normal soda. In the case of methyl-orange, a slight excess of acid was added, and the solution titrated back in the cold.

It was found that under these conditions the final point, with litmus, was somewhat indistinct; with phenolphthalein the reaction was sharper and, as will be seen by the numbers given, satisfactory.

In a few instances cochineal was used as indicator, with nearly the same results as with methyl-orange, but the final point was less exact.

Assuming that the normal sulphate $\text{Al}_2\text{S}_3\text{SO}_4$ is formed before an acid reaction is produced, with methyl-orange as indicator, 1 cc. should be equal to •01716 grm. Al_2O_3 . Taking, however, the mean of the differences between the titration with phenolphthalein and methyl-orange, we find that 1 cc. of normal acid is equal to •0212 grm. of Al_2O_3 , corresponding to the molecular ratio $2\text{Al}_2\text{O}_3 : 5\text{SO}_3$.*

The results are summarised in the subjoined table, of which column I. represents the amounts of alumina added; column II. the amounts calculated from the mean equivalent in Al_2O_3 for 1 cc. of acid; and column III. the amounts calculated on the assumption that the normal sulphate is formed at the "neutral" point:—

I.	II.	III.
•0840	•0870	•0704
•0849	•0818	•0687
•1285	•1632	•1320
•4210	•4325	•3503
•4219	•4113	•3331

The value of •0212 Al_2O_3 for 1 cc. of normal acid is confirmed by the titration of recently-precipitated alumina alone with the acid. Thus, the mean of two such experiments gave the number •0210 for 1 cc. This equivalent is, moreover, independent of the acid employed. Thus, precisely similar results were obtained with normal sulphuric, nitric, and hydrochloric acids.

Thomson states (*loc. cit.*) that alumina can be titrated in presence of methyl-orange, and that

"about 100 per cent. is indicated." As, however, he gives no numbers, it is impossible to say to what extent we agree.

We next endeavoured to apply the method to the determination of alumina in different samples of caustic soda and in sodium aluminate. The following table contains the results obtained:—

	Caustic Soda.				Sodium Aluminate.
Percentage Al_2O_3 determined gravimetrically	0.70	1.40	2.40	2.78	20.59
Percentage Al_2O_3 determined volumetrically from difference between titrations with litmus and methyl-orange	0.62	1.35	2.32	2.84	20.90

As all the specimens of caustic examined by us contained considerable quantities of sodium sulphite, we investigated what influence, if any, this salt would have on the determination. For this purpose we prepared a solution containing known quantities of caustic soda, alumina, and sodium sulphite. Without troubling the Society with the analytical numbers, we will merely state that they showed that the sodium sulphite exercised no influence on the result. The same holds good with sodium thiosulphate.

The estimation of the exact amount of alkali in such a mixture as 60 per cent. commercial caustic soda is a matter of very great difficulty, and, as far as we know, no satisfactory method has been described.

If the sample contains, of the impurities dealt with in this paper, only sodium sulphite and no thiosulphate, the alkali can be determined fairly accurately in the following manner:—

A known weight is titrated with normal acid in the cold in presence of phenolphthalein. In this way the whole of the soda present as hydrate, together with rather more than one-half of that existing as carbonate, is estimated (titration A). In solutions containing only hydrate and carbonate the titration with phenolphthalein gives the hydrate and exactly one-half the carbonate; but this does not hold good in such a mixture as 60 per cent. caustic.

An excess of acid is now run in, and the solution titrated with standard iodine solution. As the presence of starch would interfere with the subsequent operations, we take the iodine solution as its own indicator. The solution is now boiled to expel carbonic acid, allowed to cool, and titrated back with normal soda, still using phenolphthalein as an indicator.

If much alumina be present, some little time must be given before the final point is decided upon. The total amount of acid consumed (that is, the original volume added) plus that calculated from the amount of standard iodine solution consumed and minus the equivalent of the alkali used in back titration, gives the total amount of soda present as hydrate and carbonate (titration B).

The difference between this and the original titration (A) gives a rough estimation of the soda existing as carbonate. In our experience it is invariably too low, being only about 90 per cent. of that actually present. The reason for adding a volume of acid equivalent to the iodine consumed is, that by the oxidation of sulphite into sulphate by means of iodine, an equivalent quantity of free acid is formed according to the equation:—



* This ratio would seem to indicate the formation of a new sulphate of alumina. This we propose to further investigate.

the amount to be added should, of course, be exactly equal to the volume of iodine consumed, or one-tenth in the case of decinormal iodine. It should be noted, however, that we find on oxidising pure sodium sulphite in this way the amount of acid formed is not quite equivalent to the iodine consumed. The difference, however, is so slight as to be unworthy of consideration in a commercial analysis.

The total soda and sulphite having been determined, methyl-orange is added and the same solution again titrated with normal acid. The final point is somewhat slow in arriving, and the better plan is to add an excess of acid and titrate back with normal soda, when a fairly sharp final point is obtained. The amount of acid consumed is calculated into alumina on the basis already given.

Such an easily conducted analysis will be found very useful in examining samples of caustic soda containing no thiosulphate. If this be also present a small error will be introduced due to the fact that when thiosulphate is oxidised by iodine only neutral salts are produced. Thus:—



As a further instance of the unreliability of methyl-orange as an indicator in testing for alkali, we may cite the following numbers obtained during an examination of the effluent from a paper mill:—

	Na ₂ O Grains per Gallon.	Indicator.
Effluent titrated direct.....	21·8	Methyl-orange.
	14·3	Litmus.

In order to ascertain which result gave the true amount of alkali, the effluent was evaporated to dryness, ignited, and the alkali determined in the solution of the residue. This method gave 14·3 grains per gallon, both with litmus and methyl-orange.

In concluding this part of our paper, we would briefly summarise the conclusions at which we have arrived:—

1. Neither methyl-orange nor cochineal can be used as indicators in testing for alkali in presence of alumina.

2. Of the two, phenolphthalein gives more reliable results than litmus. This will be seen on examination of Table I.

3. Alumina is determined with sufficient accuracy from the difference between the titrations with phenolphthalein and methyl-orange, taking 0·0212 as the equivalent of Al_2O_3 per cc. normal acid.

We now approach the main subject of our paper, viz., the economical advantages of the use of pure caustic soda. While we propose to discuss this mainly in relation to the use of caustic soda in paper-making, that is, for the isolation of cellulose from the various raw fibres, our conclusions will be found to have an equally direct bearing upon others of its industrial applications. Prior to the introduction of pure alkali in the form of ammonia soda, paper-makers were entirely dependent for their alkali on three distinct products, viz., 60 per cent. cream, 60 per cent. white, and 70 per cent. white. Of these, 60 per cent. cream was by far the most generally employed, and was to be preferred to 60 per cent. white as relatively purer, and, indeed, on the ground of proportionate expense, to 70 per cent. There were, in addition, other sources of alkali, such as the various soda-ashes, but these were generally less economical. We must also mention the pure caustic soda manufactured by the Greenbank Alkali Com-

pany, but this had only a theoretical interest for the large consumer, its price being prohibitive. Being thus entirely dependent for their supplies of alkali on the Leblanc alkali-makers, it is not perhaps altogether surprising that paper-makers and others should have been contented with the rough and ready method of doing business imposed upon them. If the alkali-maker contracted to supply a consumer with 60 per cent. alkali the latter had no legal ground for complaint so long as the article conformed to the very unscientific criterion known as the alkali test, although, from the nature of this test, the 60 per cent. may have included, and probably did include, a considerable proportion of alkali existing as sulphite, thiosulphate, &c. Of these impurities the aluminate is, as we shall demonstrate, positively harmful, as are also such neutral salts as chloride and sulphate; those salts, on the other hand, which are compounds of soda with weak non-metallic acids, are objectionable rather, because, with a less hydrolytic efficiency than the equivalent of soda *uncombined*, they increase the percentage of Na_2O as returned on the alkali test. We may preface our experimental proofs of these statements by one or two theoretical considerations.

The primary action of caustic soda in resolving raw fibrous materials cannot be more simply or comprehensively expressed than by the term hydrolysis. Hydrolysis belongs to the class of decompositions known as catalytic; the decomposing reagents, whether alkali or acid, undergoing themselves no change in the process. The activity of caustic soda is the property of the soluble base *per se*, or, as we may say, a simple function of the alkalinity of its solutions. Acid radicles, therefore, weaken the activity of the soda with which they are combined, and in proportion to their acidity. The value of carbonate, silicate, sulphate, thiosulphate, and such salts of soda, is therefore less than that of the soda which they contain.

The secondary action of the alkali is that of combining with the products of resolution of the fibre substance and of holding them in solution. Whatsoever, therefore, diminishes the solubility of such compounds is an impediment to the process. This consideration affords a sufficient proof of the objectionable influence of such salts as sulphate and chloride; and when we remember that the colloid hydrates, and notably alumina, are precisely those agents which are most active in fixing organic colouring matters upon cellulose, we should certainly seek to eliminate them from a process designed to undo such combinations. Of the other saline impurities, *e.g.*, sulphite, thiosulphate, and carbonate, we admit from this point of view a certain value, but where the hydrolysis is dominated by caustic soda they can have no other value than that of the soda which they contain.

In a recent paper by Scheurer on the alkaline treatment of cotton textiles in the bleaching process (Bull. Soc. Ind. Mulh. 1888, 399; this Journal, 1888, 841—843), this author contends that the efficiency of the hydrolysis attains a maximum with an admixture of carbonate with the caustic in the proportion of 1 to 3. This paper contains critical references to the Mather keir and the caustic alkali process which it was designed to bring under control. Having been connected with this process since its origin, we take this opportunity of joining issue with Scheurer, on the basis of the experience which has been accumulated, and from which we have concluded that the maximum efficiency is attained with the purest possible solutions of caustic soda. It may also be noted as a digression that to secure

the "bottom" bleach, which is simply the purest possible cellulose, a preliminary treatment of the raw cotton with a dilute acid is necessary, the immediate effect of which we can only regard as the removal of the looser basic impurities. The elimination of these having an important effect on the character of the bleach, it is a fair inference that conversely the presence of bases other than soda have a prejudicial effect upon all similar boiling processes. Returning to the question of the relative efficiency of sodium carbonate, which may be taken as the type of salts of soda with weak acids and caustic soda, we have to introduce the results of experiments upon the "pulping" of the vegetable fibres. We will content ourselves with the more important of these, which were results obtained on the large scale. At a paper mill where esparto was treated, very imperfect boilings were being turned out, notwithstanding that the "alkali" employed was sufficient, as also the other conditions. On examining the liquors employed we found them very imperfectly causticised. On remedying this detail not only were perfect results obtained with quantities of liquor as heretofore, but the proportion of liquor to esparto was considerably reduced, without prejudicing the quality of the pulp.

The relative efficiency of pure and impure (commercial 60 per cent.) caustic soda we tested in the laboratory by experiments also upon esparto. Equivalent quantities of the two reagents were employed under normal and exactly equal conditions. The pulp obtained from the experiment with the pure soda was found to contain 88 per cent. cellulose, that from the 60 per cent. caustic only 77 per cent. cellulose. The external character of the pulps and their behaviour on bleaching corresponded with the difference thus proved in favour of the former.

The effect of the impurity of neutral salts was investigated separately by boilings of esparto with uniform quantities of pure caustic soda, with and without the addition of sodium chloride and sulphate. The addition of these salts caused a considerable deterioration in the quality of the resulting pulp.

We may now sum up our discussion of this branch of the subject with the general conclusion that in all cases where caustic soda is used in the arts as a hydrolytic agent, the maximum of chemical work is obtained *ceteris paribus* with the minimum of impurity in the reagent.

Not only is 60 per cent. caustic inferior from the point of view of chemical action, but also from the point of view of recovery. To prove this point a number of experiments were carried out with pure caustic alone, and with known quantities of impurities. In each case equal weights of alkali were taken, and with the solution known weights of esparto were boiled. The liquors and washing were then evaporated to dryness and incinerated, and the alkali recovered was determined in the ash. The results are as follows:—

	Percentage Na ₂ O recovered.
* Pure caustic	96·3
† 60 per cent. cream caustic	93·4

* The fact that only 96·3 per cent. of alkali is recovered when pure caustic is used is due to the action of the mineral constituents of the esparto.

† This particular sample of caustic soda gave the following analytical numbers:—

NaOH	71·08
Na ₂ CO ₃	8·22
NaCl	8·17
Na ₂ SO ₄	2·38
Na ₂ SiO ₃	3·34
SiO ₂	0·20
Al ₂ O ₃	2·78
Fe ₂ O ₃	0·18

This difference in the amount of soda recovered we believe to be due chiefly to the presence of alumina, which, on ignition with the ash renders a certain quantity of soda insoluble, probably forming with it a kind of glass.

By increasing the relative proportion of alumina, an even greater loss of soda can be effected. Thus 20 grms. of esparto were boiled with 4 grms. of Na₂O and 1·0 gm. of dissolved alumina. The amount of alkali recovered from the ash was only 20 per cent., as against 96 when soda alone was used.

In order to avoid any possible sources of error in these experiments, such, for example, as loss of soda from imperfect washing, a number of trials were made by boiling small quantities of esparto in a platinum dish, and finally evaporating to dryness and igniting. The alkali recovered was estimated by titrating the solution of the residual ash. The results confirmed our observations regarding the loss of alkali if alumina be present.

The importance of these facts to the paper-maker must be obvious to all.

Of the minor disadvantages of caustic of low strength there remain to be noted (1.) the effect of the saline impurity on the consumption of fuel in the evaporation for recovery. The necessary result of their presence in solution is to raise the temperature, while they lower the rapidity of evaporation. Without attempting to express this result in terms of increased consumption of fuel, we may merely note that it is an item of increased expense in this direction. (2.) Those which are common to all impure products, viz., the increased expense of carriage and handling per unit.

It would, of course, be satisfactory to contrast the results obtainable with 60 per cent., 70 per cent., and the magnificent 77 per cent. caustic recently introduced to commerce, in actual numbers, but we will not attempt more than a comparison based upon the more purely chemical factors which we have elucidated.

Assuming the caustic soda, of which the analysis is cited above, to be bought at the same price, *pro rata*, as the pure product, we will show the approximate percentage discount of value deducible from our experimental results.

The sample would show by the ordinary alkali test about 61·66 per cent. of alkali; as a matter of fact it contained only 60·72, the difference being 0·84 per cent. We may safely assume that carbonate of soda possesses only one-half the chemical activity of sodium hydrate; for this we must make a further deduction of 2·40 per cent. Then we have, in addition, the retarding action of 8·47 of chloride, 2·38 per cent. of sulphate, 3·34 per cent. of sulphite, and 2·78 per cent. of alumina. For the whole of these impurities we may safely assume that an increased quantity would be necessary, equal to, say, 5·0 per cent. of alkali.

Although it is very difficult to quantify this retarding action, we know from practical experience that our assumptions are, if anything, below the mark.

Then we have further the loss of alkali during recovery. Taking the loss as 2·9 per cent. on 93·4, this amounts to 1·8 per cent. on 60·72. Putting these figures together thus, we arrive at the following total:—

	Per Cent. Alkali.
Error due to alkali test	0·84
Loss due to imperfect action of sodium carbonate	2·40
Loss due to retarding action of impurities	5·00
Loss of alkali in recovery	1·80
	<hr/> 10·04

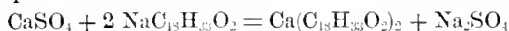
That is to say, the caustic in question has only about 85 per cent. of the value assigned to it by the alkali test. Purer products would, of course, show a higher percentage chemical value in proportion to the approximation to purity. But while we freely admit all the mitigating considerations which can be advanced, we affirm, in conclusion, that as we are now in possession of pure forms of alkali, and as these are demonstrated to be more efficient per unit than the impure products, the continued use of the latter can only be defended on the grounds of particular convenience.

CLARKE'S SOAP TEST.

BY FRANK L. TEED, D.S.C. [LOND.], F.I.C., F.C.S.

WHEN a standard soap solution is run into a solution of a calcium salt till a lather is formed, as for instance in determining hardness in water, it is commonly taken for granted that each equivalent of lime destroys an equivalent of soap.

Put in an equational form in the case of calcium sulphate and sodium oleate—



I find that an equivalent of lime requires $1\frac{1}{2}$ equivalents of soap, or CaSO_4 requires $2\frac{1}{2} \text{NaC}_{18}\text{H}_{35}\text{O}_2$.

In the case of magnesium salts the reading is rather more obscure, but an equivalent of magnesia requires rather more soap.

As the mean of many experiments, I find that an equivalent of magnesia requires $1\frac{1}{2}$ equivalents of soap, or MgSO_4 requires $3 \text{NaC}_{18}\text{H}_{35}\text{O}_2$.

I obtained these results both with oleic acid and with the solid fatty acids (commercial stearic acid).

I was acquainted with the above facts at the time that Mr. Allen's recent paper on Clarke's soap test appeared in this Journal, but I was working at the subject with a totally different object, which I have for the present been obliged to relinquish.

Mr. Wanklyn's statement in his "Water Analysis," that magnesium requires $1\frac{1}{2}$ times as much soap as calcium is well known to be incorrect, but it is probably based on the observation that magnesium requires $1\frac{1}{2}$ times as much soap as theory indicates, coupled with the erroneous assumption that calcium requires only its theoretical quantity.

It is a pleasing thing for soap consumers to find that a grain of chalk or magnesia in a water supply destroys $1\frac{1}{2}$ or $1\frac{1}{2}$ times as much soap respectively as has been hitherto thought.

NOTE OF CORRECTION RESPECTING "SALUFER."

BY C. T. KINGZETT, F.I.C., F.C.S.

IN my paper on the comparative antiseptic values of various chemical substances which was printed in the Society's Journal for November 30th, 1888, I made reference to "Salufer," and described some comparative tests which led me to the conclusion that a saturated aqueous solution of that substance has an antiseptic value ranking about equal with that of 5 per cent. solutions of sulphate of aluminium and the chlorides of lead and tin. This, I think, appears clearly enough from the context; but in summing up my results I used the following expression:—"Respecting 'Salufer,' it is seen to

rank about equally with 5 per cent. solutions of sulphate of aluminium and the chlorides of lead and tin."

Mr. William Thomson having taken friendly exception to this statement, I shall be glad to be allowed to state that I did not intend to compare "Salufer"—the pure substance—as an antiseptic with these solutions, but only to indicate the antiseptic value of a saturated solution of "Salufer" in water. "Salufer" is, I understand, soluble in water to the extent of only 0.61 per cent.

Liverpool Section.

Chairman: F. Hurter.

Vice-Chairman: A. Norman Tate.

Committee:

E. Bibby.	H. Gaskell, jun.
J. Campbell-Brown.	S. Hamburger.
H. Brunner.	J. W. Kynaston.
E. Carey.	E. K. Muspratt.
H. Deacon.	G. Shack-Sommer.
T. Fletcher.	James Simpson.

Hon. Local Sec. and Treasurer:

W. P. Thompson, 6, Lord Street, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Wednesday, 2nd April 1889, at
University College, Brownlow Street.

MR. A. NORMAN TATE IN THE CHAIR.

THE CHAIRMAN, in opening the proceedings, said that Dr. Hurter was prevented by a domestic bereavement from taking the chair that evening. He hoped that the meeting would offer him their cordial sympathy in his affliction, and express their deep regret for the cause which had prevented his presence among them.

A vote of sympathy was passed unanimously.

The Chairman also called the attention of members to new proposals in connexion with the Elementary Education Act, and advised their perusal with a view to see how far they might be of service to technical education in chemistry.

THE APPLICATION OF ELECTROLYSIS TO QUANTITATIVE ANALYSIS.

BY CHARLES A. KOHN, B.S.C., PH.D., AND J. WOODGATE.

As a labour-saving appliance in quantitative analysis electrolysis needs little recommendation; the electric current does a large share of the work of the analyst and it reduces the amount of manipulation necessary, whilst the electrolysis itself is a simple operation requiring little manipulative skill.

Luckow's method for the determination of copper has come into general use and nickel and cobalt are at times determined electrolytically, but beyond this the various methods which have been suggested

from time to time have been regarded rather as scientific curiosities than as methods which can well bear comparison with the ordinary gravimetric and volumetric determinations. It is in the hope of drawing the attention of chemists to the advantages offered by the methods to be described that we bring this account of our experience with the same before the Society.

Silver, copper, bismuth, mercury, platinum, and palladium can be quantitatively determined as the metal by electrolysis, in a solution of a salt acidified by either nitric or sulphuric acid, whilst thallium, cadmium, tin, antimony, gold, iron, cobalt, nickel, and zinc are only completely separated from solutions of double salts with sodium, potassium, or ammonium.

The following table contains a summary of the most important methods proposed:—

TABLE OF METALS which can be DETERMINED QUANTITATIVELY by MEANS OF ELECTROLYSIS.

		Metals precipitated as such from—	Metals separated as Oxide at Anode from—
I.	Nitric acid or sulphuric acid solution.	Ag. ¹ Cu ² Cd ³ Bi ³ Hg ¹ Pt ¹ Pd. ¹ Zn. ⁴	Tl ⁵ (as Tl ₂ O ₃). Pb ¹ (as PbO ₂). Mn ¹ (as MnO ₂).
II.	Solution of double ammonium oxalate.	TL. ⁵ Cu ¹ Cd ³ Bi ¹ Sn ¹ Pt ¹ Pd. ¹ Fe ¹ Co ¹ Ni ¹ Zn. ¹	Bi ¹ (remains in solution as Bi(OH) ₃). Al ¹ (as Al(OH) ₃). Mn ¹ (as MnO ₂). Cr ¹ (remains in solution as ammonium chromate ⁶). V ¹ (remains dissolved).
III.	Solution of double ammonium sulphate.	Ag. ⁶ Fe ⁶ Co ¹ Ni ¹ Zn. ¹¹	Mn ¹¹ (as MnO ₂).
IV.	Solution of double potassium cyanide.	Ag. ¹ Cu ⁷ Au. ¹ Ni ¹¹ Zn. ⁸	
V.	Solution of sulpho-salt.	Sn ¹ Sb. ¹	
VI.	Solution in glacial phosphoric acid, after addition of ammonium carbonate. ¹⁰	Bi Cd Sn. Fe Co Ni Zn.	Al (remains in solution). Mn ⁶ (as MnO ₂). Cr (remains in solution as chromate).

¹ After addition of ammonium sulphate (Riche).

² Solution of double potassium oxalate preferable.

³ After addition of sodium citrate and citric acid. (E. F. Smith: this Journal, 1888, 633.)

⁴ Separation incomplete, complete from solution of double potassium oxalate.

⁵ Separation incomplete.

⁶ Classen, "Quant. Chem. Anal. durch Electrolyse"; also Ber. 14, 1622 and 2772; Ber. 17, 2351 and 2467; Ber. 18, 168, 1101, and 1787; Ber. 19, 323; Ber. 21, 359 and 2502; also this Journal, 1886, 344; 1888, 101; 1889, 137.

⁷ Luckow, Zeits. Anal. Chem. 1869, 1.

⁸ Smith and Kierr, Amer. Chem. J. 8, 204; and Ber. 19, (c), 708.

⁹ Wieland, Ber. 17, 1611.

¹⁰ G. Neumann, This Journal, 1888, 345.

¹¹ J. Krutwiz, Ber. 15, 1264.

¹² Beilstein and Jawein, Ber. 12, 759.

¹³ Beilstein and Jawein, Ber. 12, 646.

¹⁴ E. Smith, Amer. Chem. J. 2, 41.

¹⁵ T. Moore, Chem. News, 53, 209.

¹⁶ See this paper.

APPENDIX.

Cadmium is precipitated as metal from a solution of the double sodium acetate acidified with acetic acid (Smith, Ber. 11, 2048); or from a solution of the double sodium tartrate acidified with tartaric acid (Smith and Kierr, Amer. Chem. J. 8, 204; and Ber. 19, 708).

Zinc is precipitated as metal from a solution of the double sodium acetate acidified with citric acid (Parodi and Mascenzini, Zeits. Anal. Chem. 16, 61); also Lucknow, Jahresber. der. Chem. 1865, 680; and also from a solution of the double ammonium acetate acidified with acetic acid (Riche).

Uranium is separated at the cathode as Ur(OH)₄ from a solution of the double sodium or potassium acetate (E. F. Smith, Ber. 13, 751).

The majority of these methods are due to Prof. A. Classen, of Aachen and he has embodied the results of his work, which dates from 1881, in his book, "Quantitative Chemische Analyse durch Electrolyse,"* which has already entered its second edition in Germany, and a translation of which, by Prof. Herrick, has been published in New York.† It is mainly these methods, which deserve much more consideration than they have hitherto received in this country, both in technical laboratories and in teaching institutions, with which this paper deals.

I.—DESCRIPTION OF APPARATUS REQUIRED.

The Current.—For most of the determinations a current is required giving 10–15 cc. of electrolytic gas per minute (10·436 cc. of electrolytic gas at 0° and 760 mm. = 1 ampère). For this purpose a battery of three Bunsen elements (1 pint size), connected in series, was found convenient; by substituting the nitric acid in the inner cell by a mixture of potassium bichromate and sulphuric acid (10 parts of a saturated solution of potassium bichromate to 1 part of sulphuric acid (conc.)) a current of about equal strength is obtained, which keeps sufficiently constant for 10–12 hours. For weaker currents Daniell or Meidinger cells are the best.

Secondary cells are decidedly preferable to the ordinary voltaic elements, both on account of the regularity of the current obtained and of the trouble saved in recharging. We employed a set of 20 accumulators, each containing five positive and six negative plates, 10 in. long, by 9½ in. high, and which could be charged to 15 to 20 ampères and discharged up to 22 ampères. The E.M.F. of each cell was a little above 2 volts; the internal resistance of course very small and the capacity about 200 ampère-hours when used for the electrolytic determinations. Three such cells connected in series yield a current of 10–12 cc. electrolytic gas per minute with a voltameter and one determination in circuit and an addition of two cells is necessary for each extra solution placed in the circuit. In order to keep the cells fully charged the specific gravity was kept up to 1·200, and not allowed to run down below 1·175 before recharging. The charging was effected by a Mather and Platt No. 2 "Manchester" dynamo (shunt wound), run by a gas engine.

With five cells connected in series and two determinations in circuit at a time 35–40 analyses can be made without having to recharge the cells.

Measurement of the Current.—A Bunsen voltameter filled with sulphuric acid of sp. gr. 1·22, is sufficiently accurate for this purpose, the current being expressed in cc. of electrolytic gas per minute or hour, although a galvanometer has the twofold advantage of being more exact and of introducing

* Published by Julius Springer, Berlin. Price 5s.

† Published by John Wiley and Sons, New York. Price 10s.

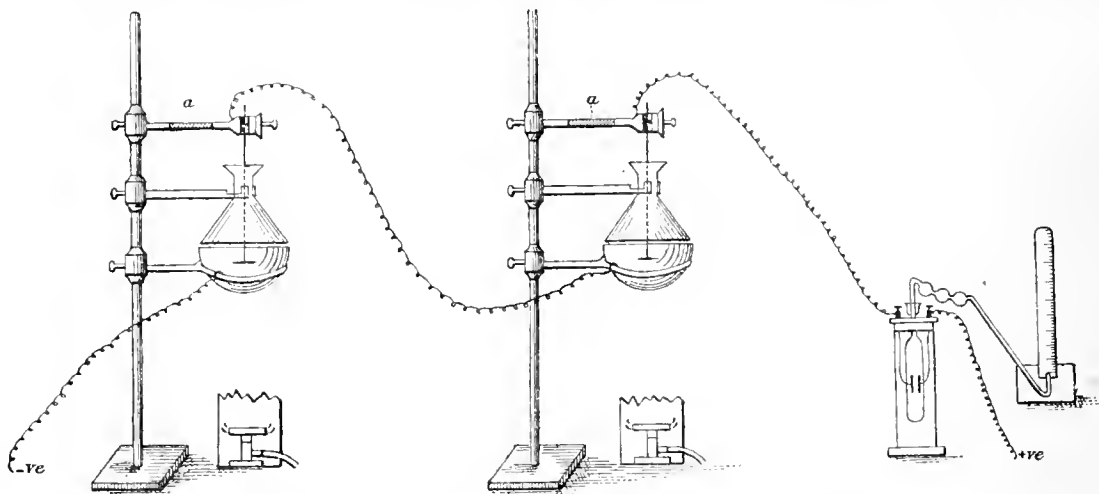
less resistance into the circuit. Classen recommends a modified form of Bunsen's voltameter (this Journal, 1888, 401).

Resistance.—In order to regulate the strength of the current a handy form of resistance is needed. Liquid resistances, such as zinc electrodes in a solution of zinc sulphate, or platinum electrodes in dilute acid, are unreliable owing to polarisation taking place too readily, since it is necessary to bring the two electrodes very close together in order to reduce the current by 2 to 3 cc. per minute, the amount mostly required. This is conveniently effected by means of small coils of German silver wire, the resistance introduced by a known length of the same having previously been ascertained for the current and circuit in use. Resistances corresponding to 1, 2, 3, &c. cc. of electrolytic gas per minute, with a current of 10 to 12 cc., were made in this way and found to work very satisfactorily. Finally a rheostat best with mercury connexions, as suggested by Classen, can be employed.

Method of Analysis.—The electrolysis is preferably carried out in a platinum dish of 150–200 cc. capacity, the positive electrode being a piece of platinum foil about 1 in. diameter attached to a thick platinum wire. It is advisable to punch a few holes in the foil in order to prevent the spurring which ensues when a big bubble of gas collects below its surface and then bursts. A nickel dish

lined with platinum was found inefficient for this work, the connexion between the two metals not being sufficiently good. The dish should be covered during the electrolysis; a watch-glass with a hole in the centre answers the purpose if the determination is done in the cold, but if a hot solution is electrolysed, a funnel (the tube of which has been cut off short and widened, and held by a small spring clamp, as shown in the figure) is preferable. The sides of the funnel can easily be kept moist, and thus prevent any spurtings drying on the surface before they can be washed off. For heating the dish a Bunsen burner, the tube of which has been screwed off and with a rose placed over the base, does very well. In carrying out a determination the precipitated metal is washed 2–3 times with water, then twice with absolute alcohol, and dried in the steam bath. The positive electrode should be about 1 in. from the bottom of the dish. It is well to mark the relative positions for the dish and positive electrode on the stand employed.

The arrangement of the apparatus is shown in the following diagram, two determinations being placed in the same circuit. A binding screw is fixed on to the back of the support for the positive electrode, which latter is insulated from the metallic portions of the stand by a piece of glass rod (*a*). The connexion with the dish can either be made on the ring supporting the dish (as shown in figure), or else by means of a binding screw attached to the same.



To protect the metallic connexions from the action of acids they require varnishing; a mixture of lamp-black and copal answers well.

II. DETERMINATIONS.

Antimony.—Antimony is completely precipitated in the metallic form from a solution of its sulphate, obtained by dissolving the sulphide in a concentrated solution of sodium or potassium sulphide of specific gravity (about) 1.22 free from polysulphides. To carry out the determination the precipitated sulphide is dissolved in the solution of the alkaline sulphide, filtered from any separated sulphur, and in case the solution is coloured yellow by the presence of polysulphides, oxidised by gentle warming with a solution of hydrogen peroxide until the solution is colourless. This oxidation is best effected in a porcelain dish and the resulting solution filtered from any sulphide of iron introduced by the reagents

into the previously weighed platinum dish in which the electrolysis is to be made. This is then connected with the negative pole of the battery and the current completed at the voltameter. A current of 1.5 to 2.0 cc. of electrolytic gas per minute is required for the reduction (two Bunsen cells with resistance) which is done in the cold and best allowed to proceed over night. The deposited metal is of a dark grey colour and adheres well to the dish; it is very hygroscopic and increases rapidly in weight during the weighing. It is therefore necessary to check the first weighing by a second drying in the steam-bath and weighing again. Up to 0.2 grm., antimony can be precipitated by the above current in 10–12 hours.

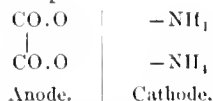
Tin.—Tin is not precipitated from a solution of its sulphide in concentrated sodium or potassium sulphide solution, and advantage is taken of this fact to separate it from antimony. The ammonium sulpho-salt of tin, however, is decomposed with separation of the metal at the cathode. The

sulphide of tin dissolved in ammonium sulphide (free from ammonia) is electrolysed in the cold by a current giving 10 cc.* (three Bunsen cells). Sulphur separates during the electrolysis, which sticks to the deposited metal and has to be carefully rubbed off with the finger whilst the surface is moist after washing with alcohol; this, however, can be successfully accomplished, but the nauseous odour evolved during the reaction (H_2S , SO_2 , &c.), renders the method objectionable.

It is better to precipitate tin from a solution of its double ammonium oxalate when the metal is obtained as a silver white deposit which sticks well to the dish. The electrolysis is effected in the hot solution with a current of 10 cc., and takes five to six hours. Since tin is mostly obtained in analysis in the form of sulphide, this must first be oxidised, best by means of hydrogen peroxide (Classen. This Journal, 1889, 137), and the resulting stannic hydrate dissolved in oxalic acid, the acid neutralised by ammonia and the hot solution electrolysed after the addition of 3–4 grms. of ammonium oxalate.†

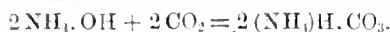
The majority of Classen's electrolytic methods depend upon the decomposition of a double oxalate of a heavy metal with that of ammonium, as in the case of tin. It may therefore be of interest to point out the decomposition which takes place. A solution of ammonium oxalate is decomposed as follows by the electric current:—

(1.) *Primary decomposition.*

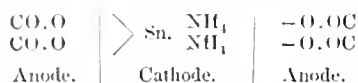


(2.) *Secondary decomposition.*

At Cathode. $2\text{NH}_3 + 2\text{H}_2\text{O} = 2\text{NH}_4\text{OH} + \text{H}_2$.
The ammonia thus formed combines with the CO_2 liberated at the anode with the formation of ammonium bicarbonate—



The decomposition of the double oxalates of Sn, Fe, &c., with ammonium oxalate, takes place along similar lines.



The (NH_4) forms ammonium bicarbonate as above. Whether the tin is deposited directly or indirectly it is difficult to say, but the ease with which many metals can be separated from double salts of the alkalis in this way points to the indirect separation as the more probable.

Separation of Antimony and Tin.—The precipitate containing the mixed sulphides is dissolved in sodium or potassium sulphide, and oxidised with hydrogen peroxide as above. One gram. of sodium hydrate (in solution) is then added, and the antimony deposited under the conditions already mentioned. In dissolving the sulphides use as little potassium or sodium sulphide solution as possible, and restrict the quantity of wash water in the filtrations as far as is compatible with accuracy in order to save having to concentrate the solution before electrolysis, a process which has to be conducted very carefully and one which involves a considerable waste of time. After the

deposition of the antimony, filter the resulting solution from sulphur and treat it with dilute acid to separate the sulphide of tin, which can then be either filtered off and weighed finally as SnO_2 , or else determined electrolytically as described above.

This method yields good results; it requires careful manipulation, as do all methods for the separation of these two metals. The time necessary for the separation is comparatively short, since the antimony is precipitated over night and the tin in the course of the following day. Should arsenic be also present, the mixed sulphides are dissolved by treatment with potassium chlorate and hydrochloric acid and the arsenic removed by Fischer's distillation method (this Journal, 1887, 353); the residue contains the antimony and tin which are precipitated by sulphuretted hydrogen and then separated as above.

The following determinations were made under the above conditions, the metals being first precipitated as sulphides from the solutions of their salts:—

Antimony—

Taken.		Found.
Grm.		Grm.
0.0500	Sb	0.0505
0.0500	Sb	0.0505
0.2020	Sb	0.2019

Tin—

0.0831	Sn	0.0837
--------	----	--------

Antimony and Tin—

0.2020	Sb	0.2019
0.0831	Sn	0.0839

Arsenic, Antimony, and Tin—

(Arsenic by distillation)

0.0500	As	0.0500
0.1010	Sb	0.1020
0.0115	Sn	..

Iron.—Classen's method yields excellent results in the case of iron. The solution should be free from nitrates and any excess of free acid (except sulphuric acid, which may be neutralised by ammonia), must be removed by evaporation; the resulting iron in the form of chloride or sulphate is first treated with neutral potassium oxalate in sufficient quantity to dissolve the precipitate of iron oxalate first formed (i.e., to form the double salt), and then 5 grms. of ammonium oxalate added for every 0.1 gm. of Fe. The warm solution is electrolysed with a current of 10–12 cc. The metal is obtained as a compact steel grey deposit; it sticks well to the dish and does not oxidise appreciably on exposure—a deposit of 0.2 gm.—Fe only increasing 1 mgrm. in weight after 17 hours' exposure to the air. Complete precipitation is tested by potassium ferrocyanide, a little of the solution in the dish being withdrawn by means of a capillary tube. 0.1 gm. of metal can be precipitated in 2½ hours from a ferric salt; ferrous salts are decomposed more quickly. The deposition can also be effected in the cold, but it takes more than twice the time.

Separation of Iron and Manganese.—Solutions of manganese salts are decomposed by the electric current with the separation of manganese dioxide (MnO_2) at the positive electrode. This decomposition takes place in a solution of the sulphate acidified with sulphuric acid, in a solution of the double ammonium sulphate, or in one of the double ammonium or potassium oxalate. In presence of ammonium salts the separation is incomplete. The result then of electrolysis of a solution of an iron salt under the conditions described above in presence of

* Where not otherwise indicated cc. refer to cc. of electrolytic gas per minute.

† The best way to add the ammonium oxalate is to dissolve the requisite quantity in hot water and filter the hot solution into the platinum dish.

manganese is that the former is deposited as metal at the cathode, whilst the latter separates partially as MnO_2 , a portion of which adheres to the positive electrode, a portion floating about in the solution. To effect the separation quantitatively, electrolyse the hot solution containing the mixed salts, after the addition of potassium and ammonium oxalate as above with a current of 10–12 cc. The presence of manganese tends to reduce the rate at which the iron is precipitated, but it in no way affects its completeness, or the tenacity with which the metal adheres to the dish. The contents of the dish are poured off as soon as the whole of the iron is precipitated and the metal washed, dried, and weighed. The manganese dioxide sticking to the positive electrode as well as that suspended in the solution is dissolved in hydrochloric acid, and the manganese precipitated by means of bromine and ammonia and weighed as Mn_2O_3 as usual.

Beyond trying this method with mixtures of the salts we have also used it in the analysis of spathic iron ore, and in the separation of iron and manganese in a sample of metallic iron, in all cases with satisfactory results. In the former instance the ore, which contained SiO_2 , FeO , MnO , CaO , MgO , and CO_2 , was dissolved in hydrochloric acid; the silica removed as usual, and the filtrate treated with potassium and ammonium oxalates. Calcium, together with some manganese is precipitated; the filtrate contains the iron, the rest of the manganese, and the magnesium; this was then electrolysed and the manganese precipitated in the filtrate by bromine and ammonia. This precipitate, together with that originally obtained by the addition of the oxalates, must be ignited to decompose the oxalates, dissolved in hydrochloric acid, and the resulting solution added to the filtrate from the manganese precipitate; the separation of manganese, calcium, and magnesium is then conducted in the usual way. The presence of calcium considerably complicates the separation of the iron and manganese, but in its absence, as in the case of metallic iron, spiegeleisen and the like, the advantages of the method are more apparent since the complete separation of the two can be effected in the solution of the metal after the removal of the carbon, silicon, &c.

Separation of Iron and Aluminium.—Solutions of aluminium salts, when treated with an excess of ammonium oxalate and electrolysed, are decomposed with the separation of the hydrated oxide ($Al(OH)_3$) at the anode, but this separation only takes place after the current has been passed for a long time and the hydrate does not stick well to the electrode. To separate iron and aluminium, the hot solution containing the mixed salts, after the addition of potassium and ammonium oxalates, is electrolysed with a current of 10–12 cc.; as soon as all the iron is deposited, decant the solution, wash, dry, and weigh the iron, and determine the aluminium as hydrate by precipitation with ammonia in the usual way, after first boiling the solution so as to decompose the ammonium and potassium bicarbonates formed.

Should it be necessary to pass the current so long as to separate a portion of the aluminium as hydrate, this is readily brought into solution again by the addition of a few drops of hydrochloric acid.

The advantage of this method over the ordinary gravimetric method for the separation of these two metals is evident; no double precipitation is necessary, and the presence of fixed alkalis is (save for the small amount of potassium carbonate present) entirely avoided.

Separation of Iron and Chromium.—Chromium salts are oxidised by the current in presence of

ammonium oxalate to ammonium chromate. In the separation of iron and chromium the solution is treated with potassium and ammonium oxalates and electrolysed as above; as soon as the iron is completely deposited, decant the solution at once, wash and weigh the iron, otherwise the alkaline chromate formed will be found to oxidise the iron and thus bring the results too high. Further, by the prolonged heating of the ammonium chromate solution, the hydrate of the oxide Cr_2O_3 separates in yellowish brown flocks, which adhere very tenaciously to the surface of the metal. Since the presence of oxalic acid prevents the complete precipitation of chromium by ammonia, the alkaline oxalates added must first be completely decomposed. This takes longer than is necessary for the precipitation of the iron, and in order to avoid the sources of error above referred to the solution, after the separation of the iron, is transferred to a second dish in which the decomposition of the oxalates is completed. A current of 10 cc. suffices to decompose 5 grms. of oxalate in six hours. The chromium can then be precipitated by ammonia after reduction with alcohol and hydrochloric acid and weighed as Cr_2O_3 .

The following results were obtained by the above methods:—

Determination of Iron—

Taken.		Found.
Grm.		Grm.
0.0211	Fe	0.0210
0.0394	Fe	0.0395
0.0817	Fe	0.0815
0.1038	Fe	0.1035

Separation of Iron and Manganese—

0.1038	Fe	0.1036
0.0097	Mn_2O_3	0.0096
0.2076	Fe	0.2085
0.0194	Mn_2O_3	0.0196

Analysis of Spathic Iron Ore—

	Per Cent.
SiO_2	2.09
FeO	50.91
MnO	4.71
CaO	2.92
MgO	1.08
CO_2	35.49
	<hr/> 100.20

Separation of Iron and Manganese in Sample of Metallic Iron—

Per Cent.		Per Cent.	
(1.) 82.44	Fe	(2.) 82.58	Fe
1.32	Mn	1.43	Mn

Separation of Iron and Alumina—

Taken.		Found.
Grm.		Grm.
0.1038	Fe	0.1035
0.0094	Al_2O_3	0.0098
0.1038	Fe	0.1033
0.0188	Al_2O_3	0.0181

Separation of Iron and Chromium—

0.0519	Fe	0.0520
0.2077	Cr_2O_3	0.2079
0.1052	Fe	0.1054
0.1062	Cr_2O_3	..
0.1038	Fe	0.1038
0.0608	Cr_2O_3	0.0608

Nickel.—Nickel is precipitated from a solution of the double ammonium oxalate as a silver white deposit which adheres well to the dish. If the nickel is obtained in the form of sulphide in the course of

analysis, this is dissolved in aqua regia, the excess of acid evaporated off, and the nitric acid completely removed by taking up the residue with hydrochloric acid, and again evaporating to dryness. The solution of the chloride is then treated with 4 grms. of ammonium oxalate, and electrolysed hot with a current of 10 cc.; 0.1 gram of nickel is precipitated in two hours.

Fresenius and Bergmann's method consists in treating the solution with an excess of ammonia, and then adding 4--5 grms. of ammonium sulphate. A current of 5 cc. is sufficient (two Bunsen cells). Both methods yield satisfactory results.

We also tried the determination of nickel from a solution of the double potassium cyanide with a view to separate cobalt and nickel by converting the former into the cobaltcyanide, and the latter into the double potassium cyanide, and electrolysing the resulting solution. Nickel can be completely precipitated in this way, but our results up to the present are not sufficiently conclusive to show whether a separation of the two metals by this means is possible or not; and since Dr. G. Krüss has recently thrown doubt upon the elementary nature of these two bodies,* we have discontinued our experiments on this point for the present.

Cobalt.—This metal can be determined similarly to nickel, both in the solution of the double ammonium oxalate and in that of the double ammonium sulphate. The complete precipitation of both cobalt and nickel is best tested for by the red-brown colouration obtained with a solution of potassium sulphocarbonate (K_2CS_3).

The determination of manganese in presence of nickel or of cobalt is carried out as in the case of iron, the manganese separating partially at the anode as MnO_2 , both from the solution of the double ammonium oxalate and also from that of the double ammonium sulphate; in neither case is the separation complete.

The following results were obtained:—

Determination of Nickel—

	Taken.		Found.
(1.) From ammonium oxalate solution—			
	Gm.		Gm.
	0.0828	Ni	0.0827
	0.1654	Ni	0.1664
(2.) From ammonium sulphate solution—			
	0.0401	Ni	0.0396
	0.1241	Ni	0.1250
(3.) From potassium cyanide solution—			
	0.0401	Ni	0.0401
	0.0435	Ni	0.0434

Determination of Cobalt and Nickel—

0.0799 Ni + CO 0.0810

Separation of Nickel Nickel and Manganese—

0.1241 Ni 0.1250
0.1355 Mn_2O_3 ..

Zinc.—Several methods have been proposed for the determination of zinc (*vide* Table). From a solution of the double ammonium oxalate the precipitation is slow, and the metal, which does not adhere very fast to the dish, is obtained in the form of a fine crystalline powder which can easily be rubbed off with the finger. The precipitation should be effected in the cold by a current of 10--12 cc.

after the addition of 4 grms. of ammonium oxalate; if a hot solution be employed, the deposited metal adheres very badly.

If the ammonium double sulphate be electrolysed, the result is similar, the metal showing a like tendency to become detached in the washing. To prepare this latter solution, add ammonia to the solution containing the zinc until the precipitated hydrate is redissolved, and then 5 grms. of ammonium sulphate; electrolyse in the cold with a current of 12--14 cc. In both cases it is best to allow the determination to go on over night; 0.1 to 0.15 gram of metallic zinc can be completely precipitated in 8--10 hours.

The potassium ferrocyanide reaction is not sufficiently delicate to test whether the zinc is all precipitated; at least six hours should be allowed for every 0.1 gram of zinc; the time varies considerably with the smoothness of the surface of the dish. The deposited zinc attacks the platinum of the dish slightly and although the greater portion of the metal is readily dissolved off by dilute acid, a dark brown stain remains which can only be removed after prolonged ignition and treatment with hot acid; for this reason, a layer of metallic iron (or other metal) must first be deposited in order to protect the platinum. A further disadvantage in the electrolytic method for the determination of zinc lies in the fact that at times the metal is deposited in a spongy form; in such cases the precipitate sticks well enough to the dish, but it retains the salts in the solution very tenaciously, and thus leads to high results. From these considerations it is clear that electrolysis offers little attraction as a means for the estimation of zinc; as long as the quantities of the metal are less than 0.1 gram, the methods described give fairly accurate results, but they are far less reliable than the electrolytic methods for the determination of antimony, tin, iron, cobalt, or nickel.

Separation of Zinc and Manganese.—Zinc and manganese are separated as in the case of nickel and manganese but there is always a risk of washing off a little of the precipitated metal with the manganese dioxide, especially if the quantity of zinc exceeds 0.1 gram.

Separation of Zinc and Iron.—Iron in the presence of zinc is precipitated with it at the cathode from a solution of the double oxalates as long as the proportion of Fe to Zn is more than 3:1; if the proportion of zinc is greater, some of it goes back into solution, and ferrie hydrate separates. (Classen. Ber. 17, 2481.)

In determining the two metals in samples of crude zinc, hard spelter, and the like, where the above proportion is exceeded, the following process, which we adopted in an analysis of this nature, works well. The spelter analysed contained lead, iron, and zinc. After removing the lead by means of sulphuric acid, the filtrate is treated with an excess of ammonia, when a precipitate results containing the whole of the iron, and a little of the zinc, the remainder of the latter being in the filtrate. Dissolve the precipitate in acid, and after evaporating off the excess, electrolyse the resulting solution after the addition of potassium and ammonium oxalates. Then dissolve the deposited metals in hydrochloric acid, and titrate the iron with potassium bichromate after reduction with stannous chloride, the quantity of zinc of course being obtained by difference. The filtrate from the precipitated hydrates must be neutralised with oxalic acid (if a precipitate forms add a drop or two of ammonia until it is dissolved) and then electrolysed after the addition of ammonium oxalate; or else 5 grms. of ammonium sulphate are added, and the alkaline solution electrolysed as described.

* Ber. 22, 11.

The following results were obtained:—

Determination of Zinc—

	Taken.		Found.
	Grm.		Grm.
(1.) From solution of double oxalate—		Zn	
	0.0517	Zn	0.0510
	0.1289	Zn	0.1290
(2.) From solution of double sulphate—		Zn	
	0.0517	Zn	0.0510
	0.1435	Zn	0.1434

Separation of Zinc and Manganese—

From solution of double sulphates....	{ 0.0862 Zn	0.0862
	{ 0.1355 Mn ₂ O ₃	..

We have also obtained satisfactory results with mercury and silver, the former being electrolysed in a solution acidified with nitric acid, with a current of 3–4 cc., the latter from the double potassium cyanide, with a current of 1–2 cc. In both cases the deposition is complete, and the deposited metal adheres well to the dish.

The methods described form only a portion of those recommended by Classen, and which have been worked out with satisfactory results in his laboratory, where the arrangements for this electrolytic work are very complete.

In his book already referred to methods will be found for the determination of copper, bismuth, lead, cadmium, thallium, platinum, palladium, and gold, and for the separation of these and of the metals treated of in the paper in part from one another and in part from other metals, chiefly those which are not precipitated in the metallic form from solutions of their double ammonium oxalates (Al, Cr, Mn, Fe); Classen also gives a long series of examples of analyses which can be carried out by these electrolytic methods.

The real value of these methods to the analyst, when compared with the volumetric and gravimetric methods in use, depends greatly on the nature of the work done, but there is little doubt that all chemists will be able to find some of them of decided advantage, and by judiciously combining the same with the ordinary methods employed, a saving both of time and labour should be effected.

DISCUSSION.

The CHAIRMAN said that the author had given the meeting an excellent digest of the various electrolytic operations suggested for use in chemical analysis; but before these processes could be fully relied upon for making quantitative determinations for analytical and technical purposes, they would require further trial and investigation. At the same time the thanks of the meeting were due to Dr. Kohn for bringing the subject before the Society in such a manner as to encourage other members to pursue a subject which might prove of great practical value to analytical and technical chemistry.

Dr. J. CAMPBELL BROWN said that in these days, when electricity was applied either nominally or really to all sorts of purposes, it was satisfactory to find a case in which not merely the name, but the actual current was being applied successfully. The application of electrolysis to analytical purposes was by no means new; and they were all aware of its use, as for instance in the case of Reinsch's arsenic test, and the elegant method of determining copper now more than 20 years old. That being so, it was to him

very surprising that electrolysis had not come into more general use. Possibly analysts had not taken the trouble to teach themselves how to apply it, and he was quite sure that their Society would approve of Dr. Kohn's lucid exposition of the method, and the details which he had given them of his experience both in practice and in teaching the processes. In those cases where the difference between the strength of current necessary to precipitate the whole of one metal without commencing to precipitate the other, was very fine, he would like to ask whether it would really be feasible to attain the exact degree of strength of current so as to make the method applicable? Dr. Kohn had indicated to them a sufficient number of metals which could be neatly, conveniently, and easily determined electrolytically to make it desirable that every analyst should be familiar with the methods. When once the application of electrolysis became common, then its extension to other metals would gradually proceed as they acquired more experience, and as different experimenters exchanged views, and told each other the results of their experience. He hoped that they would have more papers of this kind in their Section, for the application of new methods of analysis would be of peculiar use in their Society. Already there were valuable methods in private use which deserved greater publicity.

Mr. KNIGHT said he could not help feeling that if there were any present, like himself, employed in analytical work, principally metallurgical, they would be thankful to Dr. Kohn for bringing all those useful methods before them. He had heard a good deal from Dr. Kohn which he was sure would be useful to him in the future. The method he was principally interested in was the separation of antimony from tin. Any chemist constantly employed in the separation of these metals would know what a difficulty there was to do this quickly and obtain reliable results. He should like to know whether there was any difficulty in the separation of antimony and tin when the proportion of tin was very much larger than the proportion of antimony, say 95 per cent. tin and 5 per cent. antimony.

Dr. KOHN said that his experiments had been in the opposite direction, in which the antimony was in excess; but that he had no doubt the separation could be made to work equally well in cases in which there was a large excess of tin.

Mr. KNIGHT said that in commerce the general run was to estimate antimony in commercial tin, and if it could be done practically by electrolysis it would be a very great help.

Mr. ALEXANDER WATT asked if the exact strength of the current used could be given in amperes?

Dr. KOHN, in reply, said that he had not tried the method for the separation of antimony and tin in presence of large amounts of tin and very little antimony. The method, as far as he knew it, was one rather for the separation of tin from antimony than of antimony from tin. It was certainly well worth trying under the suggested conditions; the separation was so complete in the cases given, that there was every reason to hope that it would be equally so in presence of a large excess of tin. Dr. Campbell Brown had asked whether it would be easy to regulate the strength of the current in separations. In the first place perhaps he did not point out sufficiently clearly in the paper that the strength of current need only be approximately regulated, *i.e.*, whether they had 10 cc. or 12 cc. of electrolytic gas per minute, or whether sometimes

it went down to 9 cc. or up to 13 cc., did not materially affect the majority of determinations with which he had had to deal. The slower the current the longer the deposition took, and *vice versa*. The separations in most cases did not depend upon the strength of the current; for instance, take the separation of antimony and tin. Tin was not precipitated at all from the solution of its sodium or potassium sulpho-salt, provided the solution was a concentrated one; they could accordingly put on a much stronger current than needed for the precipitation of antimony without precipitating any tin at all. Mr. Watt had asked him to express the strength of the current in amperes; one ampère was equivalent to 10.436 cc. of electrolytic gas per minute. In conclusion he felt very glad that some interest had been excited in these methods which he brought before them, and he trusted that those who had not tried them might be led to do so. They were methods which were not simply to be read of in books, but to be tried and worked out, and it was only by analysts trying the way the method worked in their hands that its real value would become apparent.

Glasgow and Scottish Section.

Chairman: R. R. Tatlock.

Hon. Vice-Chairmen: { E. C. C. Stanford,
Sir J. Neilson Cuthbertson.

Committee:

J. Addie.	T. P. Miller.
G. Beilby.	E. J. Mills.
A. Crum Brown.	J. M. Milne.
J. Christie.	T. L. Patterson.
W. S. Curphey.	J. Pattison.
W. Dittmar.	F. J. Rowan.
D. B. Dott.	D. R. Stewart.
R. Irvine.	A. Whitelaw.

Hon. Treasurer: W. J. Chrystal.

Hon. Local Secretary:

G. G. Henderson. Chemical Laboratory, University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Sixth Meeting of the Session was held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, 2nd April 1889.

MR. E. C. C. STANFORD IN THE CHAIR.

ON DYEING WITH MIXED COLOURS.

BY EDMUND J. MILLS, D.S.C., F.R.S., AND J. J. HAMILTON.

It has long been a practice with dyers to obtain modifications and changes of shade by employing in the vat two or more colouring matters at the same time. The results of such an admixture are, as might have been expected, far more complicated

than those which attend the process of dyeing with a single colour. The specific action of each tinctorial constituent is modified by each of the others; and the general phenomena—far from always preserving a gradual character—occasionally exhibit what appear to be the abruptest transitions.

It is now known that the process of the dye-vat admit, in many cases, of fairly accurate measurement. We have, therefore, thought it of interest to determine, as exactly as we could, the nature of the transaction which occurs when wool is acted on by two soluble colours conjointly. Reference may be made to a precedent for this investigation in a research by Mills and Smith (*Proc. Roy. Soc. XXIX.*, 181) on the equivalence of nickelous and cobaltous sulphates, as precipitated by weak caustic soda solutions. The conclusions were, that precipitability is proportional to mass of precipitable substance; and that, for an equal weight, nickelous and cobaltous sulphates are equally precipitable: the attraction of the one towards the reagent being inverse to that of the other.

It was by no means easy to select two suitable colours. We first made experiments with a mixture of picric acid and Victoria blue (4 R.). This, when heated to the boil, was capable of dyeing a green colour on white cashmere (tissue). But after cooling and allowing the liquid to stand for some time, the blue in the solution began to settle out and could not be estimated. Several attempts were made to keep the blue from precipitating, but they were unsuccessful. It was evident that picric acid precipitated the blue, and another yellow colouring matter was resorted to.

A solution containing Victoria blue and hydrochloride of berberine (yellow) was heated to a temperature of 94° C., and kept at that point for one hour. No blue separated out during the heating, nor after standing for 48 hours. A similar experiment was then made with a piece of cashmere in the vat, the liquid being kept at about 95° C. The cashmere was dyed blue, and not green. A skein of woollen yarn worked in and out of the vat, after the cashmere had been dyed, was dyed green. The nearly-exhausted vat still dyed cashmere blue.

We next tried the effect of a lower temperature on the deposition of the colours. An experiment was made at 40° C., a piece of cashmere being inserted at that temperature. The cashmere was dyed green. On heating the solution, along with the cashmere, to boiling, the wool was dyed blue on the top of the green. A temperature of 40° C. was therefore selected for the dyeing experiments.

Standard solutions of Victoria blue and berberine hydrochloride were made up. The Victoria blue solution was prepared by dissolving a quantity in cold water, letting it stand overnight, and filtering.

This was diluted with water to about twice its bulk. The amount of substance in this solution was estimated by evaporating 20 cc. of it to dryness, in a vacuum, over sulphuric acid, and weighing the residue. The residue from 20 cc. weighed .139 gm. Each cc. of the solution therefore contained .00695 gm. blue.

The yellow solution was made by dissolving berberine hydrochloride in a large quantity of water and filtering off from some insoluble matter. The chloride in 250 cc. of this solution was precipitated with nitrate of silver. The chloride of silver was filtered, washed, dried, ignited, and weighed. 250 cc. of solution gave a precipitate of .133 gm. argentic chloride, which is equivalent to .3452 gm. hydrochloride of berberine ($C_{20}H_{11}NO_4 \cdot HCl$); so that 1 cc. contained .00138 gm. of colouring matter.

A piece of cashmere was cut into pieces about 38 in. long, and $1\frac{1}{2}$ in. broad. Each piece was by clipping made to weigh 4.94 grms., and was then scoured in a dilute solution of ammonia, washed, and dried in a quiet room. When dry the pieces were folded up and kept in a glass bottle. Care was taken in the subsequent operations never to touch the wool with the hand. The pieces were lifted out of the bottle either with polished iron tongs or with a glass rod.

Distilled water which had been recently boiled and cooled was used in the experiments; and the cashmere, before dyeing, was boiled off for some time in distilled water. Thus the formation of air bubbles on the cloth while dyeing was obviated.

The dye-vat used was a large Bohemian glass beaker, capable of holding $2\frac{3}{4}$ litres of water. The vessel was filled with two litres of water, and at the level of the liquid a mark was made on its side.

Method of making the Experiments.—The beaker was filled to within about 200 cc. of the 2-litre mark, with water heated to about 30° C. The measured quantities of the blue and yellow solutions were then added. The blue was always added first and stirred well into the liquid before adding the yellow. The liquid in the beaker was then made up with water to the 2-litre mark. The mouth of the beaker was covered half over with a glass plate, and a thermometer, graduated to 1° C., was suspended with its bulb in the centre of the liquid. A stirring rod was also inserted in the beaker, which was mounted on an ordinary retort stand, and heated by a small Argand burner. The whole was surrounded by a metal screen so as to avoid draughts.

The liquid was next heated up to 40° C., and when the temperature had been steadily maintained at 40° C. for some time, one of the weighed pieces of wool, which had been boiled off with water, was put in. The liquid was stirred every few minutes, and the wool was dyed in it for an hour and a half and removed.

The liquid was allowed to cool, and made up with a small quantity of water to the 2-litre mark, and a sample was then put into a bottle, labelled with a letter denoting that particular experiment.

After each experiment a blank solution was made up containing the colouring matters in the same proportions as were in the liquid before dyeing. This was also bottled and labelled.

The following table shows the variations of temperature during one experiment:—

TABLE I.

Minutes.	Temp.	Minutes.	Temp.	Minutes.	Temp.
	° C.		° C.		° C.
0	40.0	34	39.8	64	39.9
9	39.9	39	39.8	69	39.9
14	40.0	44	40.1	74	40.0
19	40.1	49	40.2	79	40.3
24	40.1	54	39.9	84	40.2
29	39.9	59	39.7	89	40.0

The weight of the colouring matters present ranged from .01 grm. of blue and .19 grm. of yellow

to .15 grm. of blue and .05 grm. yellow, the total weight of colour being constant, viz., .20 grm.

Estimation of the Colours.—The solutions kept in the bottles were afterwards examined by means of the detached colorimeter described by one of us (Phil. Mag. 1879, I., 437). The method of examination was as follows:—

Take the experiment G, in which case .1 grm. of blue and .1 grm. of yellow were used. The solution in which the wool had been dyed was labelled G, and the solution containing the colours as they were before dyeing was labelled G₁. 100 cc. of G₁ contained .005 grm. blue and .005 grm. of yellow.

100 cc. of each liquid were measured out and run into the two glass cylinders of the colorimeter, and shades were compared. G was found to be a little yellower in shade than G₁. Accordingly, two drops of the standard blue solution were added to G. The shades of G and G₁ were then alike, but they differed in depth, G being much more dilute than G₁. Water was next added to G, until its shade was equal in depth to that of G₁. It was found that 85 cc. of G₁ required to be diluted with 21 cc. of water. 100 cc. of G + 2 drops blue, therefore, contained as much colouring matter

as $\frac{8500}{106} = 80.189$ cc. of G₁. Omitting, for reasons

stated hereafter, the two drops blue, 100 cc. of G contained $(80.189 \times .00005 = .00400945$ grm. blue and $80.189 \times .00005 = .00400945$ grm. of yellow. Two litres of G, therefore, contain .080189 grm. of blue and .080189 of yellow; and, since the quantity of colour originally in two litres was .10 grm. of blue and .10 grm. of yellow, there must have been deposited on the goods .019811 grm. of blue and .019811 grm. of yellow.

On examining all the solutions, it was found that a small quantity of blue had to be added to the liquid in which the wool had been dyed, to bring it up to the same shade as the standard. This quantity, except in only two experiments (one of which was repeated, and in the other, an error was supposed to have been made), never exceeded 3 drops of standard blue solution per 100 cc. of liquid. As there was always a very small quantity of blue deposited on the side of the beaker while dyeing, and as the loose woollen threads of the cashmere were dyed blue, or a much bluer shade than the cloth itself, the small quantities of blue which required to be added were taken as the correction required, and were, therefore, omitted in calculating the amount of blue deposited on the cloth itself. On this understanding, it follows that the proportion of blue to yellow deposited on the goods is the same as that in which they existed in the vat before dyeing. What also points to this conclusion is, that in no case did we require to add yellow to the partially-exhausted liquor in order to bring it to the same shade as the standard.

In some cases it was found that the blue in the blank solution had separated out before measurement. Fresh solutions had, therefore, to be made up. In experiment D, the blue had also separated out from the partially-exhausted liquid, and a fresh trial had to be made. In experiment F, the dye-vat was, by accident, heated to about 50° C., and had to be cooled again. The temperature was also very irregular during the dyeing operation. Here, also, another experiment was made, viz., G. A, which was the first done, and, therefore, as is usual with first experiments, likely to be irregular, was also repeated. The results of experiment C being evidently subject to some large error, were not further considered.

The accompanying table shows the results obtained:—

TABLE II.

	Taken.		Remaining in Vat.		On Goods.		Remarks.
	Blue.	Yellow.	Blue.	Yellow	Blue.	Yellow.	
K.	Gm. '01	Gm. '19	Gm. ..	Gm. ..	Gm. ..	Gm. ..	Estimated, not done.
J.	'02	'18	'010928	'098351	'009072	'081616	New blank.
I.	'03	'17	'019064	'108027	'010936	'061973	"
H.	'04	'16	'028515	'111060	'011185	'015910	"
A.	'05	'15	'036539	'109616	'013461	'046384	Experiment repeated.
B.	'06	'14	'044737	'104386	'015263	'035611	..
C.	'07	'13	..	..	..	..	..
D.	'08	'12	'051600	'092100	'018400	'027600	Experiment repeated.
E.	'09	'11	'071612	'087562	'018358	'022438	..
G.	'10	'10	'080189	'080189	'019811	'019811	..
L.	'11	'09	'082524	'067520	'027476	'022480	..
M.	'12	'08	'085859	'057230	'031111	'022761	..
N.	'13	'07	'090499	'048751	'039501	'021239	New blank.
O.	'14	'06	'088383	'037879	'051617	'022121	"
P.	'15	'05	'087084	'029059	'062916	'020970	"
F.	'10	'10	'086115	'086115	'013555	'013555	Temperature irregular.

It will be observed that the *total quantity of colouring matter deposited on the goods is least when the weights of the blue and yellow are equal, and that it becomes greater as the disparity between the weights increases.*

The simplest mathematical treatment of the reaction consists in finding an equation for each of the colours separately. Such equations are of the form—

$$y = a + \frac{\beta x}{1 - \gamma x};$$

γ being the reciprocal (= 5) of the total constant quantity (.2) of colour taken as a reagent; and β , a constants of attraction and other conditions. In particular, the constant a represents the effect of an attraction not directly related to the dyeing process as such. This is indicated by the fractional expression: x corresponds to the weight taken of a specific colour, y to the weight deposited therefrom on the goods.

TABLE III.

COMPARISON between THEORY and EXPERIMENT (BLUE).

$$y = .006978 + \frac{.0885x}{1 - 5x}$$

x .	y calc.	y exp.	x .	y calc.	y exp.
'02	'008945	'009072	'10	'024678	'019811
'03	'010102	'010936	'11	'028611	'027476
'04	'011403	'011485	'12	'033528	'031111
'05	'012878	'013461	'13	'039849	'039501
'06	'014564	'015263	'14	'048278	'051617
'08	'018778	'018400	'15	'059078	'062916
'09	'021460	'018358			

Sum of the differences = - .000715. Probable error on a single observation = .001457.

TABLE IV.

COMPARISON between THEORY and EXPERIMENT (YELLOW).

$$y^1 = .016526 + \frac{.0378x^1}{1 - 5x^1}$$

x^1 .	y^1 calc.	y^1 exp.	x^1 .	y^1 calc.	y^1 exp.
'05	'019046	'020970	'12	'027866	'027600
'06	'019766	'022121	'14	'034466	'035614
'07	'020597	'021269	'15	'039206	'040384
'08	'021566	'022761	'16	'046766	'045940
'09	'022711	'022480	'17	'053666	'061973
'10	'024086	'019811	'18	'081566	'081616
'11	'025766	'022438			

Sum of the differences = - .000467. Probable error on a single observation = .0015091.

When $y = y^1$, $x = .09882$ and $x^1 = .10118$, equal weights, therefore, of the two colours are equally precipitated on the goods.

In the two equations, the denominators of the fractions are $1 - 5x$ and $1 - 5x^1$ respectively. Now, $1 - 5x = 5(.2 - x)$, and $.2 - x = x^1$. So that $1 - 5x = 5x^1$, and for the same reason $1 - 5x^1 = 5x$. The two equations may be written—

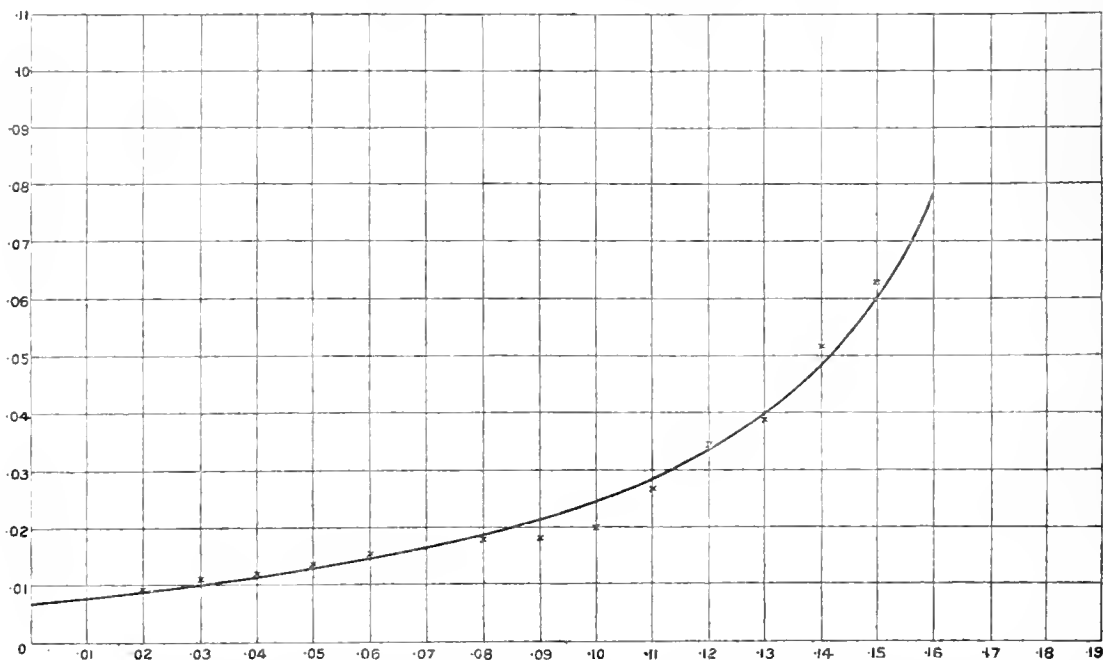
$$(\text{Blue}) y = .006978 + \frac{.0885x}{5x^1} \left(\text{or } \frac{.0177x}{x^1} \right), \text{ and}$$

$$(\text{Yellow}) y^1 = .016526 + \frac{.0378x^1}{5x} \left(\text{or } \frac{.00756x^1}{x} \right).$$

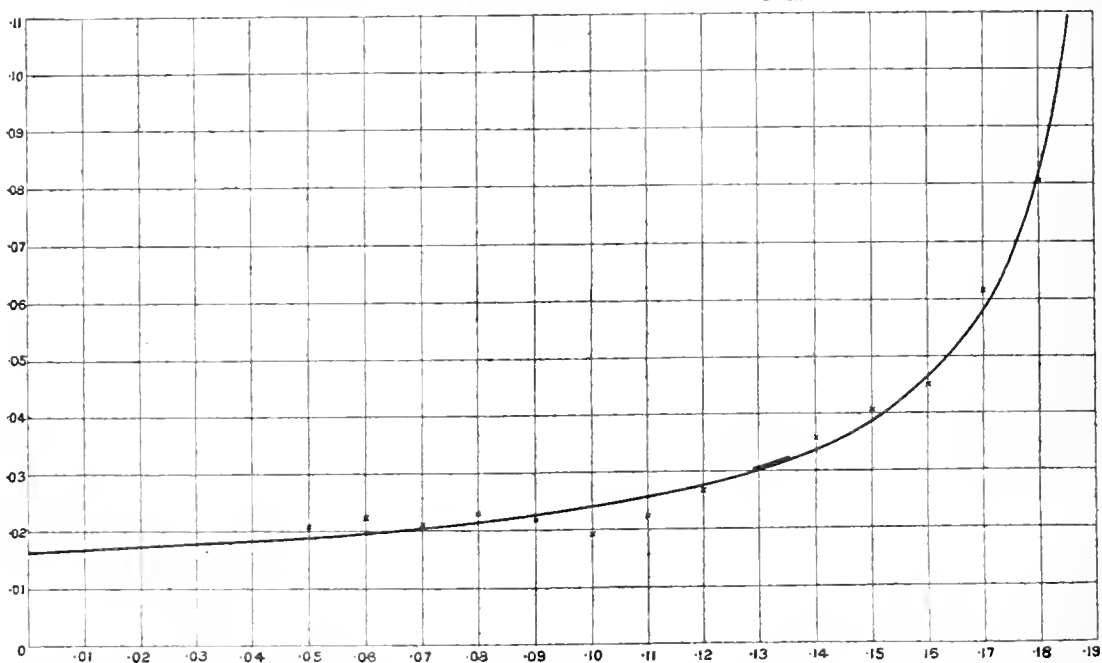
The conclusions from these equations are, that in the case of dyeing wool with mixed solutions of berberine hydrochloride and Victoria blue (\pm R.), there is, first, a certain small amount of each colour (a) deposited on the goods, irrespective of the

amount of each colour taken, and that the quantity of each colour which is afterwards dyed on to the wool is proportional to its own mass, and inversely proportional to the mass of the other colour.

CURVE showing the relationship between BLUE colouring matter TAKEN and that DEPOSITED, corresponding to the equation $y = \cdot 006978 + \frac{\cdot 0885x}{1-5x}$.



CURVE showing the relationship between YELLOW colouring matter TAKEN and that DEPOSITED, corresponding to the equation $y = \cdot 016526 + \frac{\cdot 0378x}{1-5x}$.



Yellow colouring matter deposited (in grams) is represented along the ordinate. Yellow colour taken is represented along the abscissa (horizontal line).

An interesting relation exists between the constants. It is as follows:—

$$\frac{\alpha^1}{\alpha} = \frac{\cdot 016526}{\cdot 006978} = 2.37, \text{ which is nearly equal to } \frac{\beta}{\beta^1} = \frac{\cdot 0885}{\cdot 0378} = 2.34.$$

The ratio between α and α^1 is the reciprocal of the ratio between β and β^1 .

It is evident, as a practical inference from this investigation, that the least effective proportion in which dyes should be mixed is that of equal weights. On account also of the existence of the inverse junction, a "self-colour" must always be more efficient, and least likely to produce irregular effects in dyeing, than any mixture having the same shade.

DISCUSSION ON MR. ROWAN'S PAPER ON
FLAME (JOURNAL VIII., 179).

MR. W. FOULIS quite agreed with Mr. Rowan as to the importance of this subject, for the fuller our knowledge of the properties of flame the more readily would we solve many of the problems relating to fuel consumption, furnace temperatures, utilisation of gas for light, heat, and power, and many questions of great importance in all kinds of manufactures. He thought some reference might have been made to the experiments of Mr. F. Siemens, especially to those dealing with the temperatures of dissociation. The rate of progression of flame in a combustible mixture was of considerable importance. The method of ascertaining this, described in the paper, required great care to obtain accurate results, and it seemed easier to note the time flame takes to travel through a tube of a given length, say 50 or 100 feet, filled with an explosive mixture. The effect of pressure on the rate of progression had not been determined, so far as he knew, though it was well worth accurate investigation; indeed, the whole subject of the effect of pressure on combustion deserved further study. That it had a considerable effect there could be no doubt; thus compression raises the flame temperature, and a mixture of air and coal gas which, at atmospheric pressure, could scarcely be ignited, would burn rapidly if compressed.

The management of combustion so as to produce the flame best suited for the purpose to be secured needed careful attention. He had considerable experience of this in the first introduction of heating by gas the retorts in the gasworks under his charge. In the first attempt made the gas was introduced in comparatively small jets, and so arranged as to be immediately brought into intimate contact with the heated air. The result was a number of short flames, causing local heating, and melting the brickwork, which was of best quality. The ultimate success of this system of heating depended to a very great degree on the method by which the air and gas were brought together so as to produce lengthened combustion and an equal heat throughout the entire setting. There could be no doubt that many failures of heating furnaces of various kinds had been due to want of attention to the method in which the combustion had been accomplished.

On the question of the temperature of dissociation he was inclined to agree with the opinion expressed by Mr. Siemens in a paper contributed to the London Section of this Society, that many of the results attributed to dissociation were in reality due to imperfect combustion, one of the most frequent causes of which was surface interference with the free motion of the gases during combustion. In burning gas for purposes of illumination we knew how important it was that there should be no interference with the free motion of the gases—no cross currents, or indeed currents of any kind—and that the best results were obtained when the gas was allowed to issue from the burner into a still atmosphere at so slow a rate that it might be said to be practically at rest.

The experiments on dissociation referred to in Mr. Rowan's paper were made with very small quantities of gas, and the gases were exploded in narrow tubes, the surfaces of which were cold. What influence these cold surfaces would have in checking combustion was undetermined, but no one accustomed to experiment on the combustion of gases would doubt that it must have been very considerable, and, from the manner in which the

experiments were made, imperfect combustion would have all the appearance of dissociation. One circumstance of importance connected with the dissociation of gases at any known flame temperature was the fact that all flames when burning freely without contact shorten as their temperature is increased. If even very partial dissociation took place, there would necessarily be a lengthening of the flame. A very good illustration of this shortening is seen in the case of regenerative gas burners, in some of which very high flame temperatures are reached. When the burner is cold and the flame necessarily supplied with cold air, the flame is long and smoky, but as the temperature increases by the heating of the air supply, the flame shortens, and in the best regenerative burners the gas burns with a comparatively short flame of high temperature and great brilliancy. When a mixture of air and gas in the exact proportions required for combustion is burned in a closed chamber or otherwise protected from the atmosphere, the flame shortens so much that combustion seems to take place without any visible flame. [Mr. Foulis illustrated this by a striking experiment.]

With regard to the luminosity of flame, he thought he might safely say that the theory held by all engaged in the manufacture of gas for illuminating purposes is that the luminosity is due to free carbon in the flame. This theory was well described by Mr. F. Siemens in a paper "On Combustion," read to the Iron and Steel Institute. It was this theory which guided the work of those who have endeavoured to improve the illuminating power of coal gas. We know that this free carbon can be produced from a coal-gas flame, and we also know that the best photometric results are obtained when the flame is just on the point of smoking, that is to say, when the separation of the carbon is at a maximum consistent with complete combustion. The unconsumed gas in the interior of an ordinary coal-gas flame is subjected to a high temperature, and hydrocarbon gases at high temperatures part with a certain proportion of their carbon, and therefore it is that thick flames are as a rule smoky flames. The high results given by regenerative burners (in many of which the light given per cubic foot of gas consumed is double, and in some cases considerably more than double that obtained from ordinary burners) is not entirely due to the heating of the air supply, but in a great measure to the more intense combustion permitting the use of thick flames, in the interior of which there is greater room for the separation of carbon. It would probably be too much to say that there can be no luminosity without solid particles, but he thought it might safely be said that all artificial illumination is derived from incandescent solid matter. This was quite apart from the question as to whether and why gases which burn in ordinary circumstances with non-luminous flame become luminous when consumed under high pressure. There can be no doubt that pressure has a considerable effect on the luminosity of flames.

MR. ROWAN said that he would reply to Mr. Foulis's remarks in so far as they were controversial.

He had not said anything about specific applications of flame because he did not wish to add to the length of the paper in that way. He had aimed at presenting a general view of the information which was available on such points as the nature, temperature, propagation and luminosity of flame, because he believed that the more the understanding of these points spread the more easy it would become for special applications of flame to be made in an intelligent manner.

He was acquainted with the views expressed by Mr. Frederick Siemens in his various papers to which Mr. Foulis had referred, but he had not quoted Mr. F. Siemens because he did not think his views well founded. In this he referred specially to his views of the nature of flame and on "heating by radiation only," as expressed by Mr. Siemens. Mr. Siemens' remarks on the influence of surfaces in limiting dissociation temperatures were, however, undoubtedly deserving of careful consideration.

The "heating by radiation only" theory required, according to Mr. F. Siemens, the adoption of the so-called "electrical" theory of flame in order to its being properly estimated; whilst according to Dr. Armstrong the view of Mr. Siemens depended entirely on the acceptance of another theory of the nature of flame. This was not very encouraging, but it was more satisfactory to find Mr. F. Siemens in his latest papers practically giving up the "radiation only" view and preferring to describe his idea as "heating with free development of flame," which commended itself much more readily to common sense.

The method of estimating the rate of flame propagation suggested by Mr. Foulis seemed to him to be open to objection, on the score that the disturbing element of contact between the flame and the sides of the tube would be introduced, and this would interfere with the accuracy of any such method of determination.

It is true that very little is known as to the rates of ignition under increasing pressures, and this he had alluded to in the paper. At the same time it might safely be concluded, from all that was known, that increase of pressure tends to increase the temperature and also the luminosity of the flame. He did not know of any deviation from this rule.

As to the question of dissociation, he did not think anything could be proved from the mere shortening of hot flames in the absence of analyses of the escaping products to determine the amount of combustible gas escaping. The shortening of most flames, even on a large scale, as in gas furnaces, by increase of temperature, is a fact, but where surface interference is not present this does not argue dissociation, but rather more rapidly completed combustion.

On the subject of luminosity he thought the theory referred to by Mr. Foulis, and described by Mr. Siemens, would not stand the test of severe criticism. In the first place, although it was quite possible that the flame of hydrocarbon gas contained solid particles, yet it had not yet been *proved* that these particles influenced the degree of luminosity, or even that they were solid carbon. The black deposit produced by presenting a cold surface to the flame of hydrocarbon gas was not carbon, but was a hydrocarbon compound. Granting that smoke consisted mainly of solid carbon particles, this would not help the view that luminosity depended on the presence of solid particles, for a smoky flame was not luminous.

The experiments of Soret and Burch, quoted in the paper, seemed to show that some kind of solid particles may exist in hydrocarbon flames, but although it may perhaps be *assumed* that the light in these experiments was reflected from solid particles, yet it remains to be *proved* that there is any relation between the presence of these particles and the luminosity of the flames.

The theory referred to by Mr. Foulis was ingenious, because it was a fact that hydrocarbon gas on being heated prior to combustion deposited part of its carbon. But whilst that result demanded the application of some external heat, this theory required that such preliminary heating should take place in

the flame itself. Now the blue part of the flame was the only part which contained unconsumed gas, where consequently this preliminary heating should take place. But the blue portion of the flame was not hot. The hot part was the luminous part, where, according to this view, the solid particles previously separated are incandescent. Not only was the fact that gas is a bad conductor of heat against this view, but to prove its truth would necessitate that the blue part of the flame should be hot.

It cannot be said, as Mr. Foulis has remarked, that in no case is luminosity due to the presence of incandescent solid particles in flames; but on the other hand the theory of solid particles palpably fails to embrace many of the most striking facts connected with this subject. On the whole, the balance of evidence, as far as ascertained, is decidedly against that being generally adopted, and is in favour of the theory advanced by Prof. Frankland, who has shown that the luminosity of flames is much more likely to be due to the temperature of the flames, and to the relative densities of the vapours produced by the chemical combination of their constituents in the flame.

Obituaries.

MICHEL-EUGÈNE CHEVREUL.

FRANCE has in Chevreul lost, as a contemporary well remarks, "certainly the oldest of her grand men, if not the grandest of her old men." He died on Tuesday morning, April 9th, aged 102 years, seven months, and ten days.

On the previous Wednesday he took his daily ride to the Eiffel Tower, and observed, with almost childish glee, the flag on the top announcing the completion of the work. On his return home, faintness supervened, and medical aid was summoned. He lingered a few days, and at 1 a.m. on Tuesday peacefully expired, surrounded by his grandchildren and great-grandchildren. During the 48 hours preceding his death the aged chemist appeared unconscious and scarcely spoke. On Tuesday morning he opened his eyes and asked faintly, "*Où allons nous?*" These suggestive words were the last uttered by the famous Chevreul.

His principal scientific works may be enumerated as follows, and a glance at them will indicate their immense importance to Chemical Industry:—

- "Analysis of Guatemala Indigo," 1807.
- "Wood, Logwood, Nitrous Derivatives of Indigo, &c.," 1808—1813.
- "The Chemical Composition of Fatty Substances, their Decomposition into Glycerin and Fatty Acids, Saponification, &c.," 1813—1818.
- "On Animal Tissues, Fibrin, Albumin, &c.," 1821.
- "Stearates, Oleates, Phocenes, Butyrates, Caproates, and the corresponding Acids; Cholesterolin, Ethal, Stearin, Olein, Butyrin, Noieine, &c.," 1823.
- "The Influence of a Successive Look at two Different Colours," 1830.
- "Chemistry applied to the Art of Dyeing," 1830—1836.
- "Prussian Blue and its Changes on Printed Muslins," 1837.
- "On Gastric Juice," 1850.
- "Definition and Name of Colours, after a new Rational and Experimental Method," 1851.
- Many articles on Agricultural Chemistry, Dyeing, and Chemical Analysis, also published from 1851—1888.

The last paper read by M. Chevreul before the Academy of Sciences was on May 22nd, 1888, and was entitled "The Part played by Nitrogen in Vegetable Economy." It is said that Linnaeus died in the same house of the Jardin des Plantes, where Chevreul lived so long and breathed his last.

DR. WARREN DE LA RUE, F.R.S.

A MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY.

It is with regret that we have to announce the death of Dr. Warren de la Rue, which took place at his residence in Portland Place, N.W., on Friday evening, April 19th, at the age of 71 years. He was a native of Guernsey, was educated at the college of St. Barbe, Paris, and subsequently became senior partner in the firm of Messrs. Thomas de la Rue and Co. About the end of the year 1886 he retired from business.

In many branches of scientific inquiry he gained great distinction. The chief scientific work with which his name is associated is that of the application of photography to the recording of celestial phenomena. The photographs, when measured by a micrometer arrangement, which he invented, furnished exact astronomical data. In 1860 he was successful in obtaining a series of photographs of the total solar eclipse of July 18th. The results formed the subject of the Bakerian lecture delivered to the Royal Society in April 1862. In conjunction with the late Professor Balfour Stewart and Mr. B. Lowry, he published "Researches in Solar Physics," founded on observations made at the Kew Observatory under his direction. In 1874 he fitted up a private physical laboratory, where, employing a battery of 15,000 chloride of silver cells, he, in conjunction with his friend Dr. Hugo Müller, carried on a series of researches on the electrical discharge, the results being communicated to the Royal Society and the Académie des Sciences, Paris. Dr. de la Rue was a member of the International Electrical Congress and of the jury of the Electrical Exhibition held in Paris in 1881. He acted for some time as honorary secretary of the Royal Astronomical Society, of which he was also president from 1864 to 1866. He became President of the Chemical Society in 1867 and again in 1879, and was for many years President of the London Institution, from which he retired and became Secretary of the Royal Institution in 1878 on the retirement of Mr. Spottiswoode.

Dr. de la Rue was a corresponding member of the French Académie des Sciences for the department of Astronomy, of the Imperial Academy of Sciences, St. Petersburg, and of other foreign societies.

Three foreign orders were conferred upon him:—Commander of the Legion of Honour, Commander of the Order of St. Maurice and St. Lazare, and Knight of the Order of the Rose, Brazil.—W. S.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements in the Production of Cold and Manufacture of Ice, and in Machinery therefor. A. Conacher and O. L. Williams, London. Eng. Pat. 860, January 19, 1888. 1s. 1d.

The inventors propose various improvements in the apparatus used for producing ice by the vacuum process.

Instead of admitting into the freezing chamber a full body of water to be frozen all at one time, they allow small quantities of water only to enter intermittently and regularly by means of an automatic attachment, whereby the freezing is secured to take place from below, upwards, and a dense, clear, and transparent ice obtained. Several devices for the periodical admission of the water are described and shown in the drawings. The inventors aid the rapid and thorough absorption by the acid of the watery vapour by causing both acid and vapour to permeate a body composed of pumice stone, broken crockeryware, &c., which is porous and not affected by the acid.

They make use of an acid vessel or absorber constructed of iron, of such a shape as will lend itself to being readily lined or coated inside with enamel or glass, which enables the application of stronger acid, as well as the retention of the charge for a greater length of time before re-concentration is required. Nor need re-concentration be carried out under a vacuum, but it can proceed with free access to the atmosphere, as the enamelled iron vessel will safely withstand the greater heat necessary and the greater changes of temperature experienced under the latter circumstances.

They further provide suitable arrangements for mixing and agitation, in order to keep the acid in all parts of the absorber in proper condition. When using a body of pumice-stone, as before mentioned, in connexion with the enamelled absorber, the vacuum pump, and other appliances covered by the patent, it is found that the ice production can be continued even when the acid has attained to a very high temperature, such for instance as 77° C., a result which enables a larger amount of work to be achieved with a given apparatus in a stated time than could be done without the pumice-stone vapour-trap. The specification is accompanied with five sheets of drawings.—B.

Improvements in Apparatus for Compressing and Expanding Air or Gases, especially adapted for Refrigerating Purposes. F. Windhausen, Berlin. Eng. Pat. 2549, February 21, 1888. 11d.

THIS is a modification of part of an apparatus described in the Eng. Pat. 2864 of 1886 (this Journal, 1886, 133), and relates principally to an expansion cylinder provided between the condenser and refrigerator which the liquid carbonic acid enters and becomes cooled therein by partial vaporisation. The compressor is constructed on the principle of the "piston and plunger" pump, the annular space around the plunger being in open connexion with a second cylinder and filled with liquid which alternately enters and retreats from the second cylinder. The compressed gas reaches the expansion cylinder through a valve which is automatically closed at a certain early part of the stroke of the piston working in that cylinder, by which means the acid which has entered above the piston, expands, evaporates, and becomes cooled, until its pressure is about equal to that

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Luck, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	½d.
Above 8d., and not exceeding 18. 6d.	1d.
" 18. 6d., " " 28. 1d.	1½d.
" 28. 1d., " " 38. 1d.	2d.

in the refrigerator into which it is discharged. The drawings show several modifications of the compressing pump, glands, and valves.—B.

Improvements in Vessels, Apparatus, and Appliances for separating Solid Matter from Water or other Liquids during the Process of Purifying or Softening the same by Treatment with Chemical or other Reagents. T. L. Seaton, Padstow. Eng. Pat. 4547, March 21, 1888. 8d.

In place of the zig-zag or sloping shelves in the various forms of apparatus now in use for separating the precipitated matter from a water which has been softened or purified by the addition of reagents, the patentee proposes to use a chamber filled with balls made from any suitable material. A large surface for the deposit of the solid matter is thus secured.—C. C. H.

Improvements in Filter Presses. S. H. Johnson and C. C. Hutchinson, London. Eng. Pat. 4766, March 28, 1888. 8d.

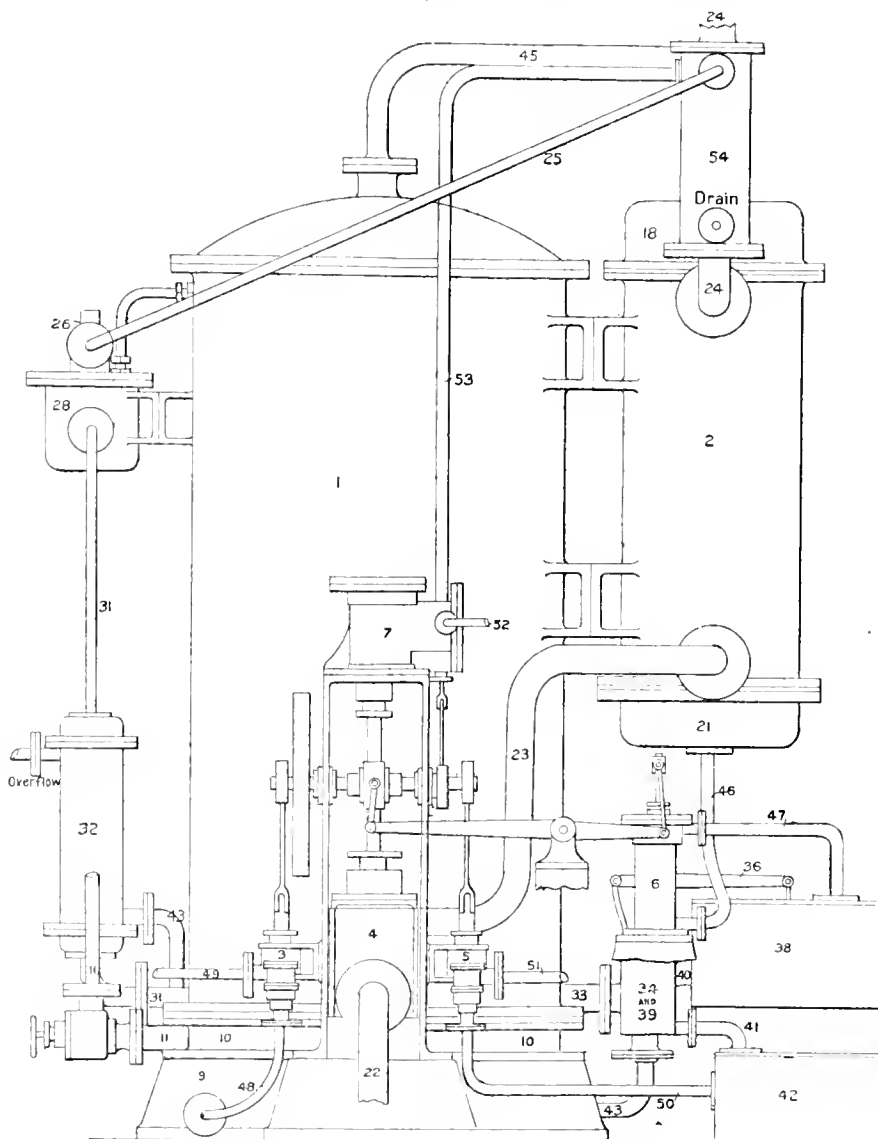
The object of the patentees is to so construct a filter press that the chambers fulfil their functions without the use

of a textile fabric, mat, or media of a perishable description. Two general descriptions are illustrated in the specification:—(1.) Filter-press chambers are constructed in such a way that fine filtering silt is obtained on the filtering faces by the simple contact or juxtaposition of parts of which they are built up. The specification shows four different examples of this method. (2.) Filter-press chambers constructed in such a way as to secure a number of pockets, shelves, or receptacles which are filled with sand, or comminuted or porous material suitable for the purpose intended, through which the liquid filters. The bottoms of such receptacles are in communication with suitably formed outlets. Three examples of this method of construction are illustrated.

—C. C. H.

Improvements in Apparatus for the Evaporation and Condensation of Sea or Impure Water. O. M. Row, Walton, near Liverpool. Eng. Pat. 4775, March 29, 1888. 8d.

The object of this invention is to obtain fresh water from sea or other impure water by evaporation and condensation with the least loss of useful heat. The inventor describes its action in connexion with the accompanying illustration as follows, viz.:—

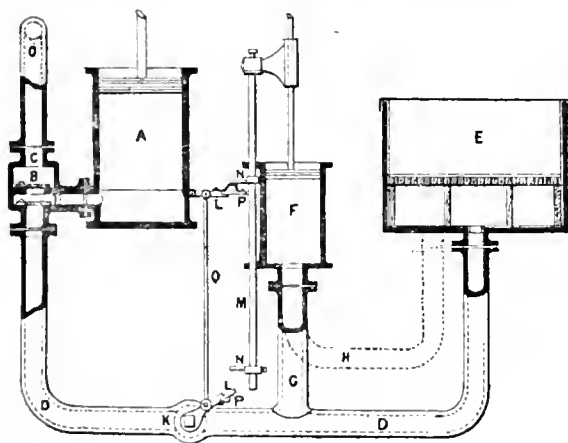


1 is an evaporator, 2 a condenser, 3, 4, 5, and 6 are pumps, 9 is a tank for condensed water, 34 and 39 are valve boxes one behind the other, regulated by floats in cistern 38; 54 is an auxiliary condenser.

Steam from a small boiler enters the engine 7 by pipe 52, and sets the pumps in motion, the exhaust steam passing by pipe 53 through the condenser 54 to the same boiler or to any other place as required. Steam from the boiler also enters space 10 through pipe 11, where it becomes condensed and flows into the tank 9. From here the condensed water is drawn through pipe 48 by pump 3 and forced through 49 back to the boiler, or is otherwise disposed of. Sea water or impure water is drawn by pump 4 through pipe 22 and is delivered through pipe 23 into the condenser 2, where it condenses the steam from the evaporator 1, and thence through the chamber 54, where it condenses the steam from engine 7. Part of the impure water flows away by the pipe 24, and part passes by the pipe 25 to the chamber 26 past a valve by the pipe 31 through the chamber 32 (where it is heated) into the evaporator 1. The salt or impure water in 1 is heated by steam in annular spaces within, and all steam liberated therefrom passes by pipe 45 into the chamber top 18, and thence through 2 condensed into 21. From 21 the pure water flows by pipe 46 to the pump 6, from which it is delivered by pipe 47 into chamber 38. A partial vacuum is also maintained in the condenser by pump 6, whilst the water in tank 38 will be at atmospheric pressure. A float in 38, by means of the lever 36, raises the valves in chambers 34 and 39, so that equal quantities of brine from the evaporator 1 and of the condensed water from tank 38 flow through the pipes 41 and 43. The brine reaches the chamber 32, where it heats the impure water; the fresh water passes to the tank 42, whence it is raised by the pump 5 to any desired place.—B.

Improvements in Apparatus for Accelerating the Passage of Liquids through Filter Beds. W. D. Bohm, London. Eng. Pat. 4824, March 29, 1888. 8d.

E is a filter bed of the usual construction; A is a single-acting pump in connexion therewith through suction pipe D; F is an auxiliary pump cylinder without suction or



delivery valves, but whose piston rod is connected with the tappet rod M, which through the connecting rod Q and hinged levers P P, opens and closes the cock K. After the pump A has drawn a quantity of the liquid through the material on the filter and discharged the same through the valve C, the pump F on the downward stroke closes the cock K and returns the charge through the filter bed, freeing its pores from the slimy matter which would otherwise remain upon and clog it.—C. C. H.

Improvements in Apparatus for Purifying Water for Boilers and other Steam Generators. G. W. Allen, Manchester, and H. J. A. Bowers, London. Eng. Pat. 5223, April 9, 1888. 8d.

THE improvements herein described consist—(1) in providing an injector, or its equivalent, to work in conjunction with the apparatus described in Eng. Pat. 7772 of 1887 (this Journal, 1888, 313), in order to secure good circulation; (2), the scroll separator illustrated in the present specification for the purpose of throwing oil, light scum, &c., from the surface of the water with which the boiler is being fed.—C. C. H.

Improvements in Apparatus for Condensing, Cooling, and Heating Fluids, and Machinery employed in the Construction thereof. J. H. Breze, Liverpool. Eng. Pat. 5246, April 9, 1888. 8d.

THIS invention deals with the use of flattened tubes bent into spiral or other form for the purpose of surface condensation, and includes the construction of tools for the production of tubes of the desired shape without first filling them with any pliable ductile material.—B.

Improvements in Means or Apparatus for the Production of Cold by the Expansion of Compressed Air. A. Marcet, London, and O. J. Ellis, Blackheath. Eng. Pat. 5274, April 9, 1888. 11d.

THE inventors describe apparatus in which compressed air supplied from any existing system of distributing mains is utilised both for providing motive power and for producing cold by expansion, whilst higher pressures may be brought about by the introduction of additional compressing cylinders. In these cylinders it is proposed to use suction and delivery valves of special construction, of which the two accompanying cuts show illustrations.

(For illustrations see top of page 272.)

The valves are annular in shape, double-edged, seated on annular openings and held down to their places by flat circular springs cut out radially like the spokes of wheels, between which spokes the air can escape. In the illustrations, K K are the valves, and m m the springs, the mode of fastening being also indicated.—B.

Improvements in and in connexion with the Method of and Apparatus for Cooling or Condensing Vapours. W. Schmidt, Halberstadt, Germany. Eng. Pat. 5418, April 12, 1888. 11d.

THE inventor's system of cooling and condensing may be gleaned from the claims appended to the specification, which are substantially as follows, viz. :—

1. The method of producing cold or of condensing vapours by allowing a current of heated gas to come into contact with an evaporative fluid and to get loaded with vapour at the expense largely of heat extracted from the fluid itself. The vaporous current of gas being subsequently deprived of the acquired moisture, is heated again and the process of taking up vapour repeated in a continuous cycle.

2. The method of producing cold or of condensing vapours from an evaporative fluid as described, and of using the said fluid as a cooling or condensing medium, at the same time that an independent evaporative fluid is employed for condensing the vapours contained in the heated current of gas. The movements of the fluids and gases form separate complete cycles.

The specification is accompanied by four sheets of drawings showing different arrangements and combinations of the apparatus.—B.

Fig. 1.

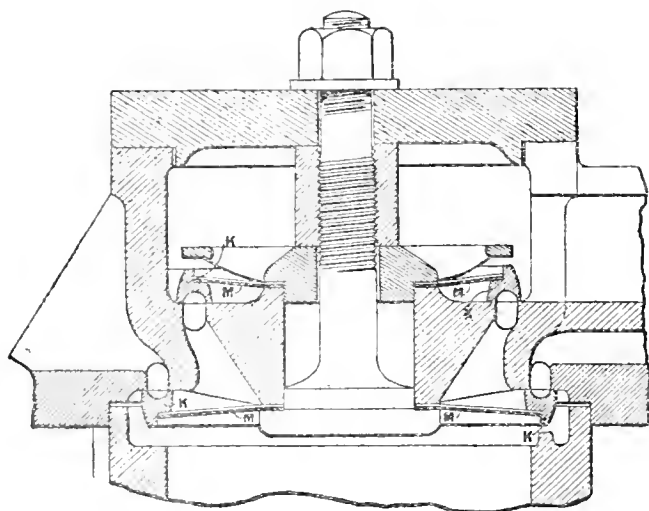
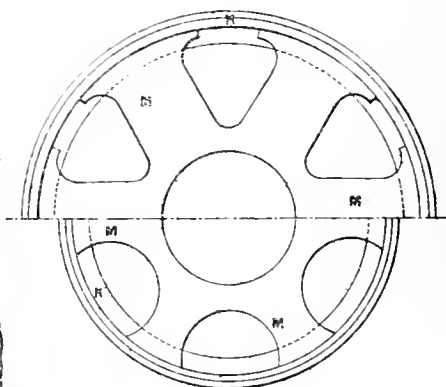


Fig. 2.



Improvements in Apparatus for Separating Liquids from Solid Matters in Suspension therein. J. S. Sawrey and H. Collett, London. Eng. Pat. 5426, April 12, 1888. *Sd.*

THE patentees describe a form of subsidence apparatus consisting, as is usual, of a vessel filled with sloping shelves. Such shelves, however, are so arranged that the liquid flows in a horizontal direction, passing into the spaces between the shelves at alternate sides; in this way a greater amount of settlement or subsidence is the result as compared with the form of apparatus in which the current flows alternately up and down between every alternate pair of shelves.—C. C. H.

Improvements in Apparatus for the Manufacture of Gas. A. McDougall, Penrith. Eng. Pat. 3495, March 7, 1888. *Sd.*

THE object of these improvements is to make the process of gas-making continuous. The coal is taken from a charging hopper by means of an Archimedeian screw and precipitated into the retorts. If these latter be horizontal, some mechanical device must be employed to promote the passage of the coal through them, but when they are vertical no such necessity exists. The tube containing the feeding screw is closed at the bottom by a seal of liquid in the charging hopper, tar being preferably employed for this purpose. A liquid seal also closes the receptacle into which the coke falls on leaving the retorts.—A. R. D.

II.—FUEL, GAS, AND LIGHT.

PATENTS.

Improvements in Treating Small Anthracite Coal and Rendering the same conveniently Available for Use as Fuel. J. T. Williams, Swansea. Eng. Pat. 1195, January 26, 1888. *Ad.*

THE dried small coal is mixed in a pug mill with blue clay, fire clay, shale, or Aberthaw lime, and then made under pressure into bricks. To protect these from atmospheric influence they are coated with pitch, tar, or other suitable substance. The following proportions are recommended for the mixing above mentioned:—Small coal, $14\frac{1}{2}$ cwt.; clay, 5 cwt.; and cement or lime, $\frac{1}{2}$ cwt.—A. R. D.

Improvements in Incandescence Gas Burners. C. von Buch, London. Eng. Pat. 2991, February 28, 1888. *Gd.*

THESE improvements constitute a new method for preparing incandescence mantles, by forming them from a skeleton of platinum electrically deposited. A "core" mantle of fine muslin is dipped in a solution of asphaltum and phosphorus in bisulphide of carbon, and then immersed for a few moments in a weak bath of silver nitrate, by which means it receives a covering of finely-divided silver. Over this a film of copper is electrically deposited, followed by a similar application of platinum or some other very refractory metal. After ignition and immersion in dilute nitric acid the platinum skeleton only is left behind. An alternative method of production is to deposit the platinum directly upon the carbonised "core" mantle.—A. R. D.

Improvements in or connected with Apparatus for the Carburation of Gas or Air. G. Seagrave and P. A. Olivier, London. Eng. Pat. 3538, March 7, 1888. *Sd.*

THE carburetted apparatus consists of an outer closed vessel (or hydrocarbon container) and an inner buoyant vessel through which the air or gas passes. This latter vessel, which is closed at the top and sides, is caused to float at a constant depth in the hydrocarbon in the outer vessel, and is provided with baffle plates to cause the gaseous current to take a zig-zag course. These baffle plates are clothed with flannel or other porous material dipping into the hydrocarbon below, and the zig-zag passages are hung with loose thread curtains to cause a more minute division of the gas. The means for introducing this latter into, and conveying it from the apparatus, are included in the improvements, and may be best understood by reference to the drawings attached to the specification.—A. R. D.

Improvements in Apparatus for Generating and Burning Gaseous Fuel. R. B. Avery, New York, U.S.A. Eng. Pat. 4158, March 17, 1888. *Sd.*

WITHIN a closed fire-box is placed a number of generating tubes which constitute the retorts. A steam injector drives oil into these tubes, and a portion of the gas here generated is mixed in a special mixing chamber with the requisite quantities of air, and consumed in the fire-box, thus heating the retorts. For details the specification and drawings must be consulted.—A. R. D.

Improvements in or connected with the Manufacture of Gas from Coal. J. H. R. Dinsmore, Liverpool. Eng. Pat. 4885, March 31, 1888. *Sd.*

COAL is distilled in retorts of any suitable kind, and the gas thus made conducted through heated passages (see

Eng. Pat. 15,852, of 1887; this Journal, 1888, 741) into which tar is also introduced. This addition has the effect of increasing both the quantity and the quality of the gas, the yield with Lancashire or Yorkshire coal running from 12,000 to 13,000 cubic feet of 21-candle gas per ton of coal. As this quality is higher than is required by most gas manufacturers, it is proposed to dilute it with hydrogen, water gas, or producer gas to, say, 17-candle power.—A. R. D.

Process for the Manufacture of Illuminating Gas and Coke. G. M. Westman, New York, U.S.A. Eng. Pat. 17,337, November 28, 1888. *8d.*

This invention consists in forcing superheated gas, made in the process, through a column of coal in a producer, and passing the gases leaving the producer through a shaft filled with glowing coke for the conversion of carbonic acid and moisture into combustible gas. The apparatus consists mainly of a producer, two regenerators or superheaters, and two coke shafts, provided with cooling arrangements and the necessary pipes and fittings. The regenerators, as also the coke shafts, are worked alternately, a blast of air being driven through each of the latter in turn to produce carbonic oxide, which is burned in one of the regenerators, while the other regenerator is superheating the gas to be forced through the fuel in the producer, and the second coke shaft is being traversed by the gases leaving the said producer.

—A. R. D.

Improvements relating to Apparatus for the Production of Gas from Liquid Hydrocarbon and to Devices for the Utilisation of Gaseous Fuel. De Witte Stearns, Des Moines U.S.A. Eng. Pat. 17,562, December 1, 1888. *8d.*

This specification describes a process and apparatus for the production of gas by passing superheated steam and liquid hydrocarbon through heated retorts. Each retort consists of a number of pipes connected together, and arranged parallel to one another in pyramidal form. The gas produced in the central retort is utilised for supplying heat to the apparatus. It is mixed with air and steam and delivered into a chamber, the floor of which slopes upwards towards the back. This sloping floor produces an equal distribution of pressure throughout the chamber, so that the gas issues through holes in the tiled roof in uniform streams, and burns in the combustion chamber above, in which are placed the retorts and the steam superheater. In lieu of perforations the tiles forming the roof above mentioned may be provided with parallel slots, over which fit semi-cylindrical burner tips, made of refractory material, and pierced with transverse slots.—A. R. D.

An Improved Incandescent Gas Burner. W. Hooker and D. Murray, Sydney, New South Wales. Eng. Pat. 19,055, December 31, 1888. *6d.*

The burner is made from a thin sheet of platinum irregularly perforated with a large number of holes and moulded or shaped to any desired form. The rough indented or "grater-like" surface is preferably turned outwards, and the burner itself is placed in a downward position. It is not connected directly with the supply pipe, but is fastened by means of platinum wire to a short length of porcelain tube, which screws into the supply pipe. This arrangement is intended to prevent the fusing up of the pipe end. When the gas is lighted the platinum burner soon becomes incandescent and diffuses a brilliantly white, soft light.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Residual Paraffin. E. von Boyen. Chem. Zeit. 13, 29—30 and 64.

TOWARDS the end of the distillation of mineral oil, in Saxony and Thuringia, a hydrocarbon is produced which, owing to its prejudicial effects on the paraffin manufacture, is of some interest. It is obtained as follows:—The still fluid residues of the various retorts are collected together in one retort and again distilled, the distillate which contains paraffin being again distilled after acidulating and neutralising, and the distillate therefrom worked up for paraffin. On melting this crude paraffin a greenish-yellow precipitate separates, and this forms the raw material from which the new hydrocarbon is extracted. 13 kilos. of this were extracted twice with "solar oil" (a heavy petroleum naphtha) and the portion extracted crystallised out. The residue, after pressing, was dirty dark green in colour. From the first extract, and also from this residue, after extraction with warm "solar oil," only about 3 grms. of the new substance were obtained. A better result was attained by subjecting the product to distillation, when 40 per cent. of distillate passed over.

When determining the solidifying point of this distillate, according to Halle's method, a solid skeleton-like substance was observed in the melted globule of paraffin, and this fact formed the basis for a method of quantitatively separating this substance from the paraffin in its manufacture. The crude paraffin was heated to 70° in a dish, and the melted paraffin poured off and filtered, the residue consisting of a greenish-yellow substance, which, after repeated crystallisation from "solar oil" and benzene, melted at 317°, and possessed a pure yellow colour. It proved on further examination to be identical with Burg's *picene*.

It is almost insoluble in alcohol and ether and in most solvents; in "solar oil" and "photogen," boiling benzene, phenol, and the high-boiling oils, it is somewhat more soluble.

100 parts of paraffin, melting point 55°, dissolve only 0.84 parts of *picene* at 65°, while at high temperatures the two substances mix in all proportions. The latter crystallises in yellow plates with a strong green fluorescence. It colours substances with which it is mixed extremely yellow, 0.8 per cent. in paraffin giving a bright canary-yellow colour to the latter. This colour is, however, not possessed by the pure *picene*, as obtained by Burg, whose specimen was colourless and of a blue fluorescence. *Picene* boils at a temperature at which soft glass begins to become pliable. It sublimes, well, however, yellow plates a centimetre long being thus obtained.

Most reagents are without action on *picene*; it dissolves in concentrated sulphuric acid, at 100°, to a green solution, and in fuming sulphuric acid to a brown solution, not precipitated by water. A sulphonic acid was not obtained.

Chromic acid oxidises it to *picene-quinone*, as obtained by Burg, which is more soluble than *picene*, melts at 150° with decomposition, and dissolves in cold concentrated sulphuric acid with a dark violet colour, from which solution water precipitates some of the unchanged substance. It dissolves in phenol with a blood-red colour.

Subjected to the action of light and the atmospheric oxygen, *picene* is changed into the bright red *quinone*.

After making close observations the author was led to conclude that *picene* is formed towards the end of the paraffin distillation, in amount varying up to 5 per cent. After making a number of experiments the *picene* has been successfully separated from the residual paraffin, first by melting and filtration, which produces a paraffin of a bright yellow colour, and then by treating this with fuming sulphuric acid.—J. W. L.

Metacetone. E. Fischer and W. J. Laycock. Ber. 22, 101—105.

FREMY obtained by distilling sugar with lime a substance to which he gave the name metacetone, and the formula $C_6H_{10}O$. The authors find that this body is in reality a mixture of propylaldehyde, dimethylfurfuran, a third substance with hydrocarbon properties, and a number of other lower and higher boiling homologues. The authors distilled 100 kilos. of sugar and 300 kilos. of burnt lime and collected the distillate in fractions. Fraction A, distilling below 65° , combined partly with phenylhydrazine, and this consisted of the hydrazone of propylaldehyde. The distillate from this, and boiling at 25° — 45° , consisted of furfuran, and that boiling at 45° — 65° is probably methylfurfuran. Fraction B, distilling at 65° — 115° , was treated like fraction A, phenylhydrazine being added and the product distilled. The distillate consisted of a hydrocarbon and a substance, which dissolved on heating with dilute hydrochloric acid to 170° forming acetylacetone, and which is probably dimethylfurfuran. The residue, which combined with phenylhydrazine, is the hydrazone of propylaldehyde. The fraction boiling above 115° is a complex mixture consisting of higher homologues of furfuran and aldehydes, which could be removed with sodium bisulphite.

The authors have investigated wood tar and found that this likewise contains propylaldehyde and dimethylfurfuran. —J. B. C.

Chrysene hydrides. C. Liebermann and L. Spiegel. Ber. 22, 135—137.

On treating 1 part of chrysene with 1 part of red phosphorus and 5 parts of hydriodic acid (sp. gr. 1.7) at a temperature of 250° — 260° for 16 hours, the hydride is produced in the form of a crystalline compound melting at 115° and of the formula $C_{18}H_{30}$. Another non-crystalline product is also obtained, boiling at 360° , and having the formula $C_{18}H_{28}$. These bodies are exceedingly stable, resembling the paraffins in this respect. Bromine has no action, and fuming nitric acid produces no effect in the cold. The original chrysene cannot be regained either by oxidation with chromic acid or by distillation over red-hot pumice. —J. B. C.

Creolin. T. Weyl. Ber. 22, 138—139.

Two creolins are found in commerce—Artmann's and Pearson's. The author finds that the two preparations are distinct.

The following is the analysis of the two preparations :—

	Artmann.	Pearson.
Hydrocarbons	84.9	56.9
Phenols	3.4	22.6
Acids	1.5	0.4
Sodium	0.8	2.4

Both preparations contain coal-tar products boiling at 210° — 380° . The phenols are present as sodium salts.

—J. B. C.

IV.—COLOURING MATTERS AND DYES.

On Para-xylidine, its Preparation and its Properties. O. X. Witt, E. Noetting, and S. Forel. Bull. Soc. Ind. Mulhouse, 1888, 630—636.

COMMERCIAL xylidine contains 25 per cent. of para-xylidine. To prepare it the former is converted into its sulphonic compound by means of fuming sulphuric acid, containing 15 to 20 per cent. of anhydrous sulphuric acid. One

molecule of anhydrous sulphuric acid is used for one molecule of xylidine. The mixture is heated for some time on the water-bath and then poured upon ice. The sulphonic acid of meta-xylidine is with difficulty soluble in dilute sulphuric acid, and crystallises out. The mother-liquor contains para-xylidine sulphonic acid. This is converted by chalk into the lime salt, and its solution after conversion into the sodium salt evaporated until crystallisation sets in. The sodium salt is with difficulty soluble in cold water.

On distillation with dry ammonium chloride para-xylidine is obtained. The sodium salt of meta-xylidine sulphonic acid chars under the same treatment. Para-xylidine boils at 212.5° C. Its specific gravity is 0.98. The efforts to prepare the hydrocarbon did not prove successful. The phenol was always formed on treatment of the base with ethyl nitrite and sulphuric acid in absolute alcohol.

Xylenol crystallises out from water in long needles melting at 74.5° C., and boiling at 210° C. Its ethyl ether is a liquid boiling at 205° C. To prepare the hydrocarbon the authors converted the pure diazoxylene into iodoxyline by means of hydriodic acid and then reduced the iodine compound by sodium amalgam. The hydrocarbon thus obtained was oxidised and terephthalic acid obtained. Acetyl para-xylidine melts at 139° C. On nitration, nitro-acetyl-p-xylidine is obtained, crystallising from water in long needles melting at 166° C., which on saponification yields a nitro-xylidine melting at 142° C. On reduction of the latter, p-xylene diamine is obtained, crystallising from benzene in small white needles melting at 146.5° to 147° C. This diamine, as well as the p-xylidine, produce on oxidation with potassium bichromate and sulphuric acid p-xyloquinone (phlorone) crystallising from benzene in long yellow needles melting at 123° C. It is but slightly soluble in water and volatile with steam. The corresponding quinol crystallises from water in small white plates, which sublime and melt at 210° C. On treating nitro-para-xylidine with ethyl nitrite and ethyl alcohol the ethyl ether of p-xylidine was obtained instead of the nitrohydrocarbon. Several commercial xylidines were examined and all proved to contain at least 25 per cent. of para-xylidine. —A. L.

The Sulphonic Acids of Meta- and Para-Xylidine. E. Noetting and O. Kohn. Bull. Soc. Ind. Mulh. 1888, 636—647.

Meta-xylidinesulphonic Acid—



is always obtained, whatever the conditions of the sulphonation may be. It is with difficulty soluble in hot or cold water, and may be purified by crystallisation from it. It forms long flat white prisms. It chars on heating, forming only traces of xylidine. Hydrochloric acid decomposes it at 180° C. into xylidine and sulphuric acid. The barium salt is easily soluble in water, and retains two molecules of water of crystallisation which are given off only at 140° C. The xylidinesulphonic acid obtained from nitro-meta-xylene-sulphonic acid is identical with the one above described.

Diazo-meta-xylenesulphonic Acid.—White plates, decomposing at 60° — 70° C., and forming colouring matters with phenols and amines.

Bromoxylenesulphonic Acid is obtained from the former body by treating it with concentrated hydrobromic acid. Its barium salt crystallises with one molecule of water. The sodium salt being treated with phosphorus pentachloride, and afterwards with ammonia, is converted into the sulphonic amide, crystallising from alcohol in small rhombic prisms, melting at 189° — 190° C. When this compound is reduced in warm alcoholic solution with sodium amalgam xylenesulphonic acid, $C_6H_4CH_3(CH_3)SO_3H [1:3:4]$ is obtained; the bromo-acid is therefore identical with the one described by Weinberg.

Bromoxylidinesulphonic Acid is obtained by adding to the alkaline solution of xylenesulphonic acid one molecule of bromine dissolved in caustic alkali, and by acidulating afterwards. Small white needles soluble in boiling water.

Paraxyldinesulphonic Acid—

Its barium salt crystallises with 7 mols. of water and is easily soluble in water.

Diazoparaxylenesulphonic Acid prepared in the usual way forms brilliant yellow needles decomposing with water at about 60–70 °C. It combines with phenols and amines, and is converted by hydrobromic acid into *Bromoparaxylenesulphonic acid*. The barium salt crystallises with 2 mols. of water. Its chloride, $\text{C}_6\text{H}_2(\text{CH}_3)_2\text{Br}(\text{SO}_3\text{Cl})$ crystallises from benzene in small prisms melting at 77–78 °C. Its amide, $\text{C}_6\text{H}_2(\text{CH}_3)_2\text{Br}(\text{SO}_3\text{NH}_2)$ forms small white crystals melting at 200–201 °C., easily soluble in alcohol and ether, difficultly in boiling water, benzene, and chloroform. The authors did not succeed in preparing a bromoparaxyldinesulphonic acid. The sulphonic acid group was always eliminated and dibromoparaxyldine obtained, melting at 65 °C., and crystallising from petroleum spirit in white needles. On oxidation of paraxyldine with chromic acid paraxyloquinone is formed, which proves that the sulphonic acid group is in para position to the amido group.

Paraxyldinesulphonic Acid—

prepared by heating one part of paraxylenesulphonic acid with $\frac{2}{3}$ parts of nitric acid for several hours on the water-bath. The nitro-compound was reduced; the amido-compound is very little soluble in cold water, crystallises from hot water in white needles with one molecule of water. On oxidation no paraxyloquinone is formed. On treating its alkaline solution with one molecule of bromine in alkaline solution and on acidulating afterwards, *Bromoparaxyldinesulphonic acid* is formed, nearly insoluble in cold water.

—A. L.

The Sulphonation of Primary, Secondary, and Tertiary Rosaniline Bases. O. Mühlhäuser. *Dingl. Polyt. J.* **271**, 359–363.

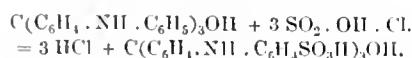
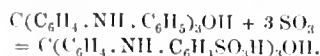
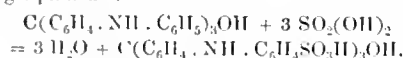
GENERALLY rosaniline bases containing NH_2 groups are sulphonated with difficulty, as are also N-alkyl rosanilines.

On the other hand, phenyl and benzyl rosanilines of secondary and tertiary, or mixed secondary and tertiary nature, are easily sulphonated. From this the conclusion has been drawn that substitution takes place in these benzyl and phenyl groups.

The following means of sulphonation have been suggested:

- (1.) H_2SO_4 .
 - (a.) Pure, at 66° B. (Nicholson).
 - (b.) As monohydrate in the form of strong sulphuric acid, mixed with glacial metaphosphoric acid (2:1) (Kalle & Co.).
 - (c.) Combined with rosaniline as bisulphate (Kalle & Co.).
- (2.) SO_3 .
 - (a.) Pure SO_3 (H. Caro).
 - (b.) Mixed with H_2SO_4 (Monnet and Dury, and H. Caro).
 - (c.) As a mixture of H_2SO_4 and $\text{Na}_2\text{S}_2\text{O}_7$ (Meister, Lucius, and Brüning).
 - (d.) As ethionic anhydride, $\text{C}_2\text{H}_4\text{SO}_3$ (F. Mann).
- (3.) SO_3HCl .
 - (a.) As pure sulphuric chlorhydrin (Jacobsen).
 - (b.) As ethionic chlorhydrin (Mann).

The action of these substances on rosanilines,—for instance, on triphenyl-pararosaniline—is shown in the following equations:—



Then follows an historical account of the subject, and some general remarks as to practical details. The duration of the action and the temperature to be employed depend upon the nature of the sulphonating agent. Sulphuric anhydride acts quickly, and does not require the aid of external heat. Fuming sulphuric acid, and especially ordinary sulphuric acid, act slower, and must be aided by external heat. Strong sulphuric acid is suitable for the sulphonation of secondary or tertiary rosaniline bases, containing phenyl or benzyl groups. Primary rosaniline bases and their fatty alkyl-derivatives require the use of fuming acid or sulphuric anhydride. The separation of the sulphonic acids from the excess of sulphuric acid may be accomplished in two ways. When the sulphonic acids are insoluble in water, the mixture is simply largely diluted and filtered. In cases where the sulphonic acids and their calcium salts are soluble, the mixture is neutralised with milk of lime and filtered. The free acid can be prepared from the calcium salt thus obtained.—H. T. P.

Nitration. L. Meyer. *Ber.* **22**, 18–23.

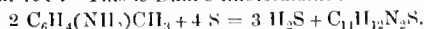
THE nitration of benzene, like many reactions, proceeds rapidly at first, but gradually slackens as the amount of nitro-compound increases. The process of nitration is, however, so far different to other reactions, that nitric acid appears to increase and benzene to hinder the process, whether the latter is in excess or not. Thus 100 parts of nitric acid give, with 100 parts of benzene, 17 parts of nitrobenzene in 15 minutes; but only 3.6 parts if 700 parts of benzene be used with the same quantity of acid. With a given quantity of nitric acid, the less benzene present the greater the quantity of nitrobenzene is formed in the first stage of the reaction. If 100 equivalents of benzene (mixed with 100 equivalents of nitrobenzene to prevent oxidation) be treated with varying quantities of nitric acid, the quantity of nitro-product varies proportionately with the amount of acid, at the rate of about 2.55 per cent. on every 50 equivalents of acid added. With an excess of acid the proportion increases because, firstly, the presence of nitric acids aids the nitration, and, secondly, a larger percentage nitrites.

The nitration at the beginning, therefore, varies as the square of the amount of acid present.

The subsequent slackening of the reaction is due to the formation of water, but as water cannot convert nitrobenzene into benzene and nitric acid, it is probably due to the diluting of the acid. Nitrobenzene prevents the action more than benzene or than its equivalent of water. The diluting action of water is difficult to follow experimentally, as the liquid divides into layers; but when pure HNO_3 is diluted with its equivalent of water, the action appears to stop. Two equivalents of pure acid, or an equivalent of acid and a corresponding quantity of sulphuric acid, are necessary to complete the action.—J. B. C.

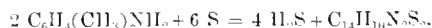
The Action of Sulphur on the Toluidines. L. Gattermann. *Ber.* **22**, 422–426.

TWO compounds appear to be formed by the action of sulphur upon paratoluidine at a high temperature; the one is the subject of a German patent by the firm of Dahl and Co. and the other is the colouring matter known as “primuline” (this Journal, 1888, 180, 386, and 561). The principal difference is the insolubility of the basis of the latter substance in alcohol, and the strong affinity of its sodium sulphonic acid derivative for cotton fibre. If 100 grms. of toluidine and 60 grms. of sulphur be heated to 185° in an oil-bath, sulphuretted hydrogen is evolved. The product may be crystallised from acetic acid or dilute alcohol, and melts at 191°. This is Dahl’s thiotoluidine:—



Its alcoholic solution has a blue fluorescence. By the action of nitrous acid in alcoholic solution, a compound of the formula $\text{C}_{11}\text{H}_{11}\text{NS}$ is obtained in crystals, indicating the presence of one amido-group. It takes up bromine by addition.

The primitive substance of primuline may be crystallised from naphthalene as it is insoluble in the usual solvents. It has the formula $C_{14}H_{10}N_2S_2$, and is probably formed as follows:—



Orthotoluidine and sulphur also combine to form a thio base, which has a similar composition to that from the para-compound. It also yields an addition product with bromine of the formula $C_{11}H_{12}N_2S \cdot Br_2$ —J. B. C.

On the Isomeric Sulphonic Acids of Beta-naphthylamine.
A. G. Green. Ber. 22, 721—724.

It is known that on sulphonating β -naphthylamine by means of ordinary sulphuric acid, a mixture of α - and γ -acids is produced at low temperatures, and at higher temperatures (160° — 170°) a mixture of β and δ . According to the formulæ usually assumed for these acids, the first pair have their sulphonic groups in α -positions, the second pair in β -positions; and their formation is exactly analogous to that of the α - and β -sulphonic acids of naphthalene. According to Dahl (Ger. Pat. 32,276) the product at 100° consists of α -, β -, and γ -acids, but the author finds that, as was to be expected, the δ -acid is also present. The four acids can be readily isolated by a slight modification of Dahl's process. The ammonium salts of the four acids were found to differ in a very characteristic manner: that of the β -acid is less soluble than the three isomeric salts, and by means of this salt the β -acid was obtained in a pure state, and was found to crystallise in prismatic needles, and not as usually stated in naereous plates, the latter form being dependent on the presence of a trace of δ -acid. Although beta-naphthylamine gives four isomeric acids on sulphonation, only two sulphonic acids are supposed to be formed by sulphonating β -naphthol; but bearing in mind the analogous behaviour of hydroxy- and amido-compounds, it would appear much more probable that four acids are formed in the latter case also, and hence a search was made for the δ -sulphonic acid in the product of sulphonation of β -naphthol at 100° . As the separation of isomeric β -naphthol sulphonic acids presents great difficulties, the method adopted consisted in converting the sulphonation product into the corresponding β -naphthylamine sulphonic acids and separating these. By this means it was proved that the product formed at 100° is a mixture of the β - and δ -isomers. Hence at higher temperatures, at any rate, β -naphthol behaves on sulphonation like β -naphthylamine; whether this is also the case at low temperatures remains to be seen.

On Reduction Products from Azo Colouring Matters of the Naphthalene Series. O. N. Witt. Ber. 21, 3468—3489.

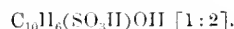
The author has examined reduction products obtained by reducing combinations of diazobenzene with different beta-naphthol and alpha-naphthylaminesulphonic acids. 1 gram. of the previously-purified substance was always taken, and as reducing agent, 2 gram. of tin crystals dissolved in 5 cc. of pure hydrochloric acid, sp. gr. 1.19, were used. The colouring matter was dissolved in the sufficient quantity of boiling water (10 parts of it is sufficient in most cases, in no case more than 20 were required). As soon as all is dissolved, the flask is removed from the fire, and the tin protochloride solution is added at once. The reduction takes place at once, the liquid frequently boiling violently. The amidonaphthol or naphthylenediaminesulphonic acid separates: either at once or after cooling, or not at all.

Beta-naphthol Derivatives.—Azo-colours obtained from beta-naphthol yield, on reduction, amido-beta-naphthol. When Mandarin or Beta-naphthol orange is reduced with the above-described tin protochloride solution, white crystals are obtained on cooling, which consist, after washing with dilute hydrochloric acid, alcohol, and ether, of amido-beta-naphthol hydrochloride, soluble in pure water. This solution is not precipitated by caustic alkali or ammonia, but turns brown. Acetate of soda, however, precipitates glittering plates of the free amido-naphthol, crystallising from ether in square plates. Ferric chloride produces in

the solution of the hydrochloride abundant quantities of beta-naphthoquinone. The sulphonic acid which is formed in the reduction process remains in the mother-liquor as hydrochloride.

Beta-naphthol-monosulphonic Acid Derivatives.—Of the seven isomeric betanaphtholmonosulphonic acids, four are known and used technically:—

(1.) The so-called Bayer's croceinesulphonic acid—



This formula is generally used to express the constitution of this body, but it is not free from objections, as will be shown hereafter.

(2.) Schäffer's beta-naphthol-beta-monosulphonic acid, the probable constitution of which is $C_{10}H_6(SO_3H)OH [3':2]$.

(3.) Casella's beta-naphtholmonosulphonic acid F, obtained by fusing alpha-naphthalenedisulphonic acid with caustic soda at 260° — 250° C., and identical with the one obtained by boiling Bayer's and Dnisberg's β -diazonaphthalene-delta-sulphonic acid with water, and which is expressed by $C_{10}H_6(SO_3H)OH [2:2']$.

(4.) Dahl's beta-naphthol- γ -sulphonic acid, obtained by boiling beta-diazonaphthalenemonosulphonic acid, which is believed by Reverdin and Noëling to have constitution—



All these acids are capable of producing colouring matters with diazo compounds.

Amido-beta-naphthol-alpha-sulphonic Acid was obtained in the above-described manner. It separates from the hot solution and is always red. Recrystallised from a hot sodium acetate solution, it possesses the formula $C_{10}H_7(OH)(NH_2)SO_3H$, soluble in alkalis, &c., but the solution turns rapidly a deep orange-brown when in contact with air. Oxidising agents produce the same effects in neutral or alkaline solution. Silver salts are reduced at once in acid or in ammonia solutions, the metal being separated in powder. Sodium nitrite acts on the acid, but does not form a diazo-compound. Diazo-compounds do not act on the acid, but are decomposed with evolution of nitrogen. Nitrosodimethylaniline hydrochloride heated together with this body in a solution of acetic acid of 50 per cent. produces a violet colouring matter, which in aqueous solution is changed into red by caustic soda.

Amido-beta-naphthol-beta-sulphonic Acid separates from the hot solution in white crystals. It is purified by mixing the acid with glacial acetic acid, boiling and adding so much of an aqueous solution of sodium acetate of 20 per cent. that all is dissolved. The solution is quickly filtered and hydrochloric or sulphuric acid added. The acid is precipitated and filtered from the hot solution. A product treated twice in such a way, washed with alcohol and ether, and dried at 110° C., proved pure. It is the same acid which Griess and Meldola have already mentioned.

If small quantities are dissolved in boiling water and the solution is cooled with ice, the acid is obtained in white needles. If, however, the solution is kept at ordinary temperature, the solution remains mostly clear, becomes yellow after some standing, and finally dark brown. Alkaline solutions show these changes of colour within a few moments. Larger quantities of this acid cannot be dissolved in water without decomposition. Brown solutions result, turning violet on addition of hydrochloric acid. Oxidising agents act on the acid in the same manner as on the alpha-compound. Nitrosodimethylaniline does not produce any colour. Diazo-compounds produce colouring matters when acting on this acid. Diazobenzene forms a red-like magenta and tetrazostilbenesulphonic acid a beautiful red-violet, which is turned into an insoluble blue by addition of hydrochloric acid. None of these colouring matters dyes wool.

Amido-beta naphthol-delta-sulphonic Acid resembles the beta-acid. Nitrosodimethylaniline does not produce a colouring matter. It combines with some diazo-compounds, but only very slowly. Brünner's beta-diazonaphthylamine-sulphonic acid produces only decomposition, whilst the beta-acid yields a beautiful red violet with it.

Amido-beta-naphthol-gamma-sulphonic Acid is soluble with great difficulty, and is the most stable of the four isomers; neither nitrosodimethylaniline nor diazo-compounds act on it.

Amido-beta-naphthol-alpha-disulphonic Acid crystallises from the cold solution in white needles. It is advisable to add to its solution an equal volume of saturated sodium chloride solution, to accelerate the precipitation of the acid. This body is stable when dry, but easily decomposed in solution. To prepare it entirely pure, 0.5 grm. were quickly dissolved in 5 cc. of acidulated water; the solution was mixed with the same volume of cold alcohol and the glass put into a freezing mixture. By repeating this mode of purification a body was obtained, the analysis of which proved it to be the acid sodium salt of the amidonaphtholdisulphonic acid. Alkalis quickly produce oxidation; neither diazo-compounds nor nitrosodimethylaniline form colouring matters. The decomposition of the aqueous solutions is very remarkable. After warming for a short time they contain the ammonia salt of a new acid, probably dihydroxynaphthalene-disulphonic acid.

Amido-beta-naphthol-gamma-Disulphonic Acid is obtained as calcium salt from its solutions after addition of calcium chloride in large dichroic crystals, easily soluble in hot, difficultly in cold water.

It is advisable to add sodium chloride to the solution after the reduction is completed to precipitate the acid sodium salt of amido-beta-naphtholdisulphonic acid. This acid is acted upon much more slowly by oxidising agents than the before described. Silver nitrate is also reduced, but only after a few minutes standing, whilst the alpha-compound is at once acted upon.

Reduction Products from the Colouring Matters of Beta-naphthylaminemonosulphonic Acid.—This acid is patented by the Badische Anilin und Soda Fabrik, and forms with diazobenzene salts a yellow colouring matter. This is, however, not an azo- but a diazo-amido compound. On reduction beta-naphthylaminemonosulphonic acid and phenylhydrazine are formed.

Orthonaphthylene-diamine-beta-monosulphonic Acid is obtained by reducing azo-colours containing Bronner's beta-naphthylaminemonosulphonic acid. It separates even from warm solutions, and is purified by solution in sodium acetate and reprecipitation with acids. Difficultly soluble in hot water, the alkaline solution turns brown through the influence of the air. Excess of sodium hydrate precipitates the sodium salt. Ferrieyanide of potassium turns the solution first brown, afterwards yellow. Ferric chloride produces a dirty green precipitate. Phenanthrenequinone dissolved in sodium bisulphite and added to a solution of the acid in sodium acetate acidulated with acetic acid, separates, when heated gradually on the water-bath, a mass of yellow needles of naphthophenanthrazine sodium monosulphonate. It is distinguished from its isomer by its red-violet solution in sulphuric acid, whilst the isomeric compound dissolves with a blue-violet colour in this agent. If fused with caustic potash an euhodol is obtained as a brown gelatinous precipitate after acidulating the melt, soluble in concentrated sulphuric acid with a pure ultramarine-blue colour; precipitated by addition of water it forms a cherry-red sulphate. The isomeric alpha-compound dissolves in sulphuric acid with an indigo-blue colour, and the sulphate is a brilliant carmine-red precipitate.

Orthonaphthylenediamine-delta-sulphonic Acid, obtained in a similar way as before described, is more soluble in water than the beta-compound. Alkalis, ferrieyanide of potassium, and ferric chloride act on it as on the beta-compound. Sodium hydrate, however, does not precipitate a sodium salt. It forms an azine compound like the body before described, soluble in concentrated sulphuric acid with a red-violet colour. The euhodol, however, dissolves in sulphuric acid with a pure violet colour, and on dilution a brownish-red sulphate is precipitated.

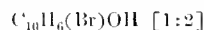
Orthonaphthylenediamine-gamma-monosulphonic Acid, light brown plates, with difficulty soluble in water, but more easily than the beta-compound. Ferric chloride produces in its aqueous solution a deep green colouration, from which, after some

standing, a dark green precipitate separates. Its azine derivative dissolves in sulphuric acid with a violet colour, turning orange on dilution. The corresponding euhodol solution in sulphuric acid is black-violet. On dilution the solution turns at first cherry-red and then a dirty-red sulphate is precipitated. The solution of the potassium euhodolate is orange-yellow.

Disulphonic acids of beta-naphthylamine.—Only two are known, obtained from the corresponding beta-naphtholdisulphonic acids. They are technically known as "Amido-acid R" and "Amido-acid G." The latter or gamma-acid is not capable of combining with diazo-compounds. The alpha-acid, however, produces colouring matters, which on reduction form colourless solutions. On addition of the same volume of hydrochloric acid and a little sodium chloride the acid sodium-salt of a naphthylenediaminedisulphonic acid is precipitated, easily soluble in boiling water. Calcium chloride precipitates an acid calcium salt. Alkalis and silver salts act on it as on the gamma-monosulphonic acid. Ferric chloride produces a deep green solution. By the azine reaction the sodium salt of naphthophenanthrazine disulphonic acid is obtained as a gelatinous mass, which could not be crystallised. The sulphuric acid reaction is very characteristic, a blue magenta-red turning on dilution first yellow, then orange. The euhodol dissolves in sulphuric acid with a green-blue colour, turning on dilution at first violet, then claret-red, finally separating the free euhodol as a yellowish brown precipitate. The monosulphonic acids always form the sulphate.—A. L.

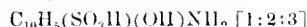
On the Constitution of Beta-Naphthol-Alpha-Monosulphonic Acid. O. N. Witt. Ber. 21, 3189—3192.

ARMSTRONG has converted this acid into bromo-beta-naphthol, for which he considers the constitution—



as proved, and he believes the sulphonic acid to have the same constitution. Claus and Volz prepared a dichloronaphthalene of the same acid, melting at 61° C., which they believed to contain the chlorine atoms in the β_1 — β_2 position.

From the beta-naphthol-alpha-monosulphonic acid can be easily obtained an amido-compound, which, if Armstrong's formula be correct, would be—



and which after elimination of the sulphonic-group would yield an amido-beta-naphthol, β_1 — β_2 . This body ought to yield on oxidation, the third hitherto unknown naphthoquinone. When the amidonaphtholsulphonic acid was heated in sealed tubes for 4—5 hours with concentrated hydrochloric acid to 120° C., white crystals were formed, which were proved to be dihydroxynaphthalene. The sulphonic-group and the amido-group were eliminated. This body decomposed rapidly at the air and was therefore not further purified, but at once oxidised with ferric chloride. A quinone was obtained, identical in every respect with beta-naphthoquinone. It is therefore proved that the amido-group is in the alpha position, and that, therefore, Armstrong's formula is not the correct one for this beta-naphthol sulphonic acid.

—A. L.

New Prussian Blue. C. E. Guignet. Compt. Rend. 108, 178—181.

Ordinary Prussian Blue which has been purified by acids in the usual manner, may be readily converted into the soluble modification by boiling with potassium ferro-ferrieyanide. The latter is most conveniently prepared by gradually adding to a boiling solution of 110 grms. of potassium ferrieyanide a hot solution of 70 grms. of ferrous sulphate. Only one-half of the ferrieyanide enters into the reaction. The mixture is now boiled for two hours, filtered, and washed with pure water until the wash water assumes a deep blue shade. The residue is dried at 100°. This blue dissolves readily in water and is very suitable for anatomical injections, as it remains in solution in presence of considerable quantities of gelatin. From the filtrate a further quantity of soluble blue may be obtained by adding 55 grms. of ferrieyanide and 70 grms. of ferrous sulphate.

If necessary, the soluble blue is freed entirely from ferri-cyanide by washing with weak alcohol (40 per cent.). Solutions of soluble blue are precipitated by concentrated solutions of sulphate or chloride of sodium.

Pure Soluble Prussian Blue is prepared by digesting an excess of Prussian blue paste with a saturated solution of oxalic acid. The filtrate, after standing for two months, deposits the pure blue, the liquid itself becoming colourless. The colour is washed with weak alcohol and dried. It now dissolves readily in pure water. The same result is obtained more rapidly by precipitating the oxalic acid solution with 95 per cent. alcohol, or a concentrated solution of sulphate of soda, and washing the colour with weak alcohol. Tartrate or oxalate of ammonium can take the place of the oxalic acid in the above reactions. On boiling the oxalic acid solutions, ordinary insoluble blue is precipitated. Dilute sulphuric acid also precipitates the insoluble modification.

New Solvents of Prussian Blue.—By boiling Prussian blue with molybdic acid, a deep blue solution is obtained which is not precipitated by gelatin, but, on cooling, the solution sets to a transparent deep blue mass. Instead of molybdic acid, molybdate and tungstate of ammonium may be employed.

Action of Sulphuric Acid.—Prussian blue treated with concentrated sulphuric acid, forms a white paste which on heating is partially decomposed, giving off hydroferrocyanic acid. By treating dry powdered Prussian blue with a mixture of equal parts of sulphuric acid and alcohol for several days it dissolves. On addition of water ordinary Prussian blue is precipitated. The author considers that the soluble product is a sulphuric acid derivative.—A. R.

On Naphthylene Diamines. Zeits. f. angew. Chem. 1889, 48—49.

Ewer and Piek have observed that the dihydroxynaphthalenes when heated with ammonia form naphthylene diamines. For preparing α - α -naphthylendiamine, one part of α - α -dihydroxynaphthalene is heated for 8—10 hours with five parts of ammonia solution (saturated at 10° C.). On opening the vessel the naphthylene diamine is almost entirely crystallised from the ammoniacal solution. Nitrous acid converts it into a diazo-compound, capable of combining with phenols and amines. The following table shows the properties of the different naphthylene diamines.

Position of the Amido-groups.	α_1, α_2 .	α_1, α_3 .	α_1, α_4 .	α_1, β_1 .	—
Literature.	Perkin, Ann. 137, 359; Liebermann Dittler, Ber. 6, 245; Griess, Ber. 15, 2192.	Zinin Ann. 85, 328; Aguiar, Ber. 3, 27, 306; Ladenburg, Ber. 11, 1651; Griess, Ber. 15, 2192.	Aguiar, Ber. 3, 27, 306; Attorburg, Ber. 10, 550; Ladenburg, Ber. 11, 1651; Griess, Ber. 15, 2192.	Griess, Ber. 15, 2192; Lawson, Ber. 18, 800 and 2425; Kereff, Ber. 19, 179; Gellmann and Renny, Ber. 19, 801.	....
Mode of preparation.	From α -nitro-naphthylamine by reduction, and from azo-compounds of α -naphthylamine.	From α -dinitro-naphthalene.	From β -dinitro-naphthalene.	By reducing azo-compounds of β -naphthylamine.	From $\alpha_1 - \alpha_3$ Dihydroxy-naphthalene.
Form of crystals.	Plates.	Needles.	Needles.	Plates.	Needles.
Melting point.	120° C.	189.5° C.	66.6° C.	95° C.	189° C.
Hydrochloride.	Plates.	Needles (?)	....	Plates.	Plates.
Sulphate.	....	Needles.	....	Plates.	Needles.
Reaction of the hydrochlorides with ferric chloride.	Green colouration.	Blue colouration, then blue precipitate.	Chestnut-brown precipitate.	Green, then yellow colouration, brown precipitate.	Blue colouration, then precipitate.
Action of nitrous acid.	Soluble tetrazo-compound.	Soluble tetrazo-compound.	Vermilion precipitate.	....	Soluble tetrazo-compound.
Action of the azo dyes-stuffs on unmordanted cotton.	Do not dye.	Dye the fibre.	....	....	Dye the fibre.

—A. L.

On the Preparation of a New Naphtholdisulphonic Acid. Zeits. f. angew. Chem. 1889, 49.

TWENTY kilos. of naphthalene are mixed with 100 kilos. of fuming sulphuric acid, containing 23 per cent. of anhydrous sulphuric acid. When the naphthalene is dissolved 14 kilos. of strong nitric acid are gradually added, the mixture being constantly stirred and well cooled with ice. After completion of the reaction the product is poured into one cubic metre of water made alkaline with lime, and after filtration from the calcium sulphate and partial evaporation, reduced with iron and sulphuric acid. Milk of lime is again added, the calcium salts are converted into the sodium salts, and the solution is evaporated until crystallisation sets in. On cooling the neutral sodium salt of the amidonaphthalenedisulphonic acid, described in Patent 40,571, crystallises. From the mother-liquor hydrochloric acid precipitates the acid sodium salt of a new naphthylaminedisulphonic acid. The free acid crystallises with 1 mol. of water. The conversion into an α -naphtholdisulphonic acid is done in the usual way through the diazo-compound. Its sodium salt crystallises in colourless prisms, containing 6 mols. of water [Schöllkopf's α -naphtholdisulphonic acid contains 1 mol. of water, and crystallises in small plates]. The new acid does

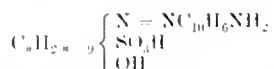
not yield a nitro-compound on treatment with nitric acid, but is oxidised. The α -naphtholdisulphonic acid, described in Patent 32,291, produces, on treatment with nitric acid, dinitronaphthol and dinitronaphtholsulphonic acid. The new α -naphtholdisulphonic acid is distinguished further from these isomerides by its colouring matters, obtained by conjugating with diazobenzene and diazonaphthalene. The following table shows these distinctions clearly:—

Solution of the colouring matter of the acid from α -Naphthol with	Solution of the colouring matter obtained from the acid prepared according to Patent 40,571 with	Solution of the colouring matter obtained from the new acid with
Diazobenzene:— Alkaline: orange. Acetic acid: red.	Diazobenzene:— Alkaline: red. Acetic acid: yellow.	Diazobenzene:— Alkaline: orange. Acetic acid: orange.
Diazonaphthalene:— Alkaline: red. Acetic acid: brown.	Diazonaphthalene:— Alkaline: bluish red. Acetic acid: yellow.	Diazonaphthalene:— Alkaline: bluish red. Acetic acid: bluish red.

—A. L.

Disazo Colouring Matters and Tetrazo Colouring Matters
Zeits. f. angew. Chem. 1889, 50—52.

THE sulphonic-compounds of amidophenols combine with α -naphthylamine and form compounds of the general formula—



These bodies being again diazotised and coupled with alpha- and beta-naphthol-sulphonic acids produce colouring matters showing great fastness to light on the fibre.

To prepare these bodies 21.5 kilos. of sodium amido-*p*-phenol sulphonate are diazotised with 7 kilos. of sodium nitrite, hydrochloric acid being added to the mixture of these two compounds. Then 20 kilos. of naphthylamine hydrochloride are added, and after a short time the new compound, $C_{10}H_7(OH)(SO_3H)N=N \cdot C_{10}H_7NH_2$, separates from the solution. At ordinary temperatures the combination

is finished in several days; but it can be accelerated by warming from 40°–50° C. As soon as a sample, after filtration and some standing, does not produce any more colouring matter, the dark green precipitate is filtered and washed. It dissolves in sulphuric acid with a dark violet, in ammonia with a brown-orange colour. The precipitate is dissolved in 10 kilos. of ammonia of 17 per cent., and to this solution 7 kilos. of ammonia are added. The mixture is poured into hydrochloric acid which is cooled with ice. The diazo-compound thus formed has a pure brown colour and is treated with 38 kilos. of R. salt. The colouring matter obtained, forms a black precipitate. It dissolves in sulphuric acid with a blue colour, and dyes wool violet to violet-black. Similar dye-stuffs are obtained from amidophenol sulphonic acid, α -naphthylamine, and Schäffer's beta- and alpha-(Neville and Winter's) naphtholsulphonic acid, and from amido-ortho-cresol- and amido-para-cresol-sulphonic acids. The following table shows the reactions of the cresol derivatives:—

Properties.	Colouring Matters from Amido-ortho-cresolsulphonic Acid with			Colouring Matters from Amido-para-cresolsulphonic Acid with		
	Schäffer's Beta-naphthol Monosulphonic Acid.	R. Salt.	Neville and Winter's Alpha-naphthol Monosulphonic Acid.	Schäffer's Beta-naphthol Monosulphonic Acid.	R. Salt.	Neville and Winter's Alpha-naphthol Monosulphonic Acid.
Colour of powder.	Greenish-black of a metallic lustre.	Brownish-violet of a metallic lustre.	Brownish-black of a metallic lustre.	Greenish-black of a metallic lustre.	Dark brown of a bronze appearance.	Dark green of a metallic lustre.
Colour of solution.	Red-violet.	Blue-violet.	Blue-violet.	Blue-violet.	Blue-violet.	Violet.
Colour of solution in ammonia.	Blue-violet.	Blue.	Red-violet.	Blue.	Blue.	Blue.
Colour of solution in hydrochloric acid.	Red-violet.	Blue-violet.	Red-violet.	Dark violet precipitate.	Violet precipitate.	Violet.
Action of concentrated sulphuric acid.	Dark green.	Dark green.	Dark green.	Dark green.	Dark green.	Dark green.

—A. L.

PATENTS.

Improvements in the Manufacture of Colouring Matters.
H. H. Leigh, London. From R. G. Williams, Albany, U.S.A. Eng. Pat. 1593, February 2, 1888. 6d.

PHENYLENE diamine and its homologues when diazotised and combined with resorcinol, α -naphthol, the phenols, benzoic and the hydroxy-benzoic acids and their substitution products, forms colouring matters soluble in alkalis, but insoluble in dilute acids; when combined with aniline and its homologues, β -naphthol, the naphthylamines and their substitution products, the colouring matters formed are insoluble both in alkalis and dilute acids. On combining it, however, with the sulphonic acids of amines, amides and phenols, the colouring matters produced are very soluble in dilute alkalis, and are also partially soluble in water. The following example illustrates the method of applying the invention: 10.8 lb. of phenylenediamine or the equivalent weight of one of its homologues are dissolved in 180 lb. of water and 70 lb. of hydrochloric acid of 22° B. After cooling the solution to -10° a solution of 14 lb. of nitrite of soda in 70 lb. of water are slowly added, the temperature not being allowed to rise. A clear reddish-brown solution results, which is run into 22 lb. of resorcinol, and 120 lb. of sodium acetate dissolved in 1,000 lb. of water. A brown colouring matter is at once precipitated, and the reaction is completed when all the free mineral acid is taken up. After filtering and purifying in the usual manner, the colouring matter is obtained in the form of a reddish-brown powder, insoluble in dilute acids or water, but soluble in alkalis.

—T. A. L.

Improvements in the Manufacture of Colouring Substances by the Reaction of Aromatic Hydrazine Sulphonic Acids on Retenequinone. W. P. Thompson, Liverpool. From The Actiengesellschaft für Chemische Industrie Rheinau, Germany. Eng. Pat. 4217, March 19, 1888. 6d.

It has not hitherto been possible to condense retenequinone with the aromatic hydrazines. Condensation, however, takes place when sulphonic acids of the latter are used. These are obtained by reducing the diazo-compounds of amido-sulphonic acids with stannous chloride or sodium sulphite. The hydrazines of the following compounds all form colouring matters when condensed with retenequinone. Sulphanilic acid, *m*-amido-benzene sulphonic acid, *o*-toluidine-*p*-sulphonic acid, *p*-toluidine-*o*-sulphonic acid, xylylidine sulphonic acid (from commercial *m*-xylylidine), cumidine sulphonic acid (from pseudocumidine), α -naphthylamine sulphonic acid, β -naphthylamine sulphonic acid (Ger. Pat. 22,547), β -naphthylamine- δ -sulphonic acid, benzidine disulphonic acid, and benzidine-sulphonic disulphonic acid. The method employed is as follows: 26.4 kilos. (1 mol.) of retenequinone and 37.6 kilos. (2 mol.) of phenylhydrazine sulphonic acid, are boiled in a sufficient quantity of water until a clear red liquor results. This is then neutralised with soda and the colouring matter salted out. The shades obtained with the different sulphonic acids vary from orange-red to bluish-red, and are fast to soap. Both wool and silk completely exhaust the dye-bath.—T. A. L.

Improvements in the Manufacture of Nitroso Compounds, and of Colouring Matters therefrom suitable for Dyeing and Printing. T. Y. Johnson, London. From The Badische Anilin und Soda Fabrik, Ludwigshafen-on-the-Rhine, Germany. Eng. Pat. 4476, March 23, 1888. 6d.

Basic colouring matters are formed by condensing α -naphthylamine and its secondary or tertiary alkyl derivatives with the nitroso compounds of dimethyl and diethyl *m*-amido phenols. The latter are formed by dissolving the dimethyl or ethyl *m*-amido phenol in three times its weight of strong hydrochloric acid, cooling to 0° and adding .53 or .44 parts respectively of 96 per cent. sodium nitrite in about twice its weight of water, care being taken to keep the temperature at 0°. The nitroso compound separates as the hydrochloride in the form of a yellow crystalline substance soluble in water. The base can be obtained by careful neutralisation with an alkali and extraction with benzene or chloroform. The following is an example of the method employed for obtaining blue colouring matters. α -Naphthylamine hydrochloride is mixed with four times its weight of glacial acetic acid, and twice its weight of water. This mixture is heated to 60° in an enamelled pan, and one part of the nitroso-diethyl-*m*-amido phenol hydrochloride is gradually added under constant stirring. The temperature is then raised to 100° until the blue colour does not increase in intensity, when the melt is cooled to 30°, and mixed with two parts by weight of water which precipitates the colouring matter. To render it soluble it is converted into a sulphonie acid by dissolving it in eight times its weight of warm concentrated sulphuric acid, and pouring the mixture into the same weight of water, after which it is filtered, washed with sodium sulphate solution, pressed and dried. The colouring matter obtained from ethyl- α -naphthylamine requires to be salted out by means of chloride of zinc and salt. The colouring matters produced as above are basic, and dye animal fibres directly in a neutral or slightly acid bath. Vegetable fibres require a tannin mordant. The shades produced are similar to those of methylene blue.—T. A. L.

The Manufacture of a New α -Naphthol Disulphonic Acid. C. D. Abel, London. From The Actiengesellschaft für Anilin Fabrikation, Berlin, Germany. Eng. Pat. 4625, March 26, 1888. 6d.

WHEN naphthalene is treated with fuming sulphuric acid below 100°, and subsequently with nitric acid, two nitro-naphthalene disulphonic acids are formed, which, on reduction, yield amido acids, whose sodium salts differ in solubility. The less soluble one corresponds to the α -naphthol disulphonic acid of Ger. Pat. 40,571, and the solution when filtered yields crystals of a new amido-naphthalene disulphonic acid when hydrochloric acid is added. 20 kilos. of naphthalene are dissolved in 100 kilos. of fuming sulphuric acid containing 23 per cent. of sulphuric anhydride at a temperature not exceeding 60°. 14 kilos. of nitric acid of 45 B. are then added at a temperature below 40°, and under constant agitation. When the reaction is complete the melt is dissolved in water, limed, and the filtered solution concentrated. The nitro-naphthalene disulphonic acids are then reduced with iron and sulphuric acid, and converted into the calcium salts by boiling with milk of lime. The filtered solution is decomposed with sodium carbonate, and, after filtering, the solution of the sodium salts of the amido-naphthalene disulphonic acids is evaporated to crystallisation. The filtrate on treatment with an excess of hydrochloric acid yields crystals of the acid sodium salt of a new amido-naphthalene disulphonic acid, which is purified by crystallising it from five parts of boiling water, when it separates in long white needles having the composition—



When distilled with lime α -naphthylamine is produced. Its diazo-compound precipitates in colourless needles and is decomposed by boiling with water, acidified with sulphuric acid, into the new α -naphthol disulphonic acid, of which the sodium salt crystallises in long colourless

needles. The new acid differs from that described in the Ger. Pat. 40,571 by not forming "Brilliant yellow" when treated with nitric acid. By acting on it with the diazo-compounds of diphenyl, ditolyl, stilbene, &c., blue dye-stuffs are formed which dye unmordanted cotton from a soap-bath.—T. A. L.

Improvements in Colour Mixers. A. F. Wenger, Hanley. Eng. Pat. 5234, April 9, 1888. 8d.

THE vessel containing the colouring matter is basin-shaped, open at the top, and turns on trunnions near its base, so that it may be swung over and emptied when necessary; at the bottom may be a steam space for heating its contents. In it is a pear-shaped muller revolving about an axis inclined at about 45° to the horizontal, and having motion communicated to it by means of a pair of bevel cogs from a short shaft bearing a fast and loose pulley, the whole of this arrangement is carried by a frame working on trunnions, so that the muller may be lifted out of the basin when requisite. To facilitate this, from one side of the frame springs a lever carrying a counterweight, sliding upon it, and capable of being fixed at any point by means of a set screw; this lever is hinged at the point where it joins the frame, so that it can be moved over until it is on the same side of its fulcrum as the muller, thereby increasing the pressure on the latter. The muller is provided on its upper side with an adjustable scraper parallel to its surface, which removes any colouring matter clinging to it, and prevents it creeping on to the axle.—B. B.

Improvements in the Manufacture of Colouring Matters. H. H. Leigh, London. From R. G. Williams, Albany, U.S.A. Eng. Pat. 5404, April 11, 1888. 4d.

RED and bluish red colouring matters which dye unmordanted cotton from a soap-bath are formed by the action of tetrazo-diphenyl and its homologues and sulphonie acids on dihydroxytoluene, its homologues, substitution products, and sulphonie acids. 28 lb. of benzidine sulphate suspended in 200 lb. of water and 25 lb. of hydrochloric acid, 22° B., are diazotised at a low temperature with 14 lb. of sodium nitrite in 70 lb. of water, and the solution is then added to 28.4 lb. of orcinol, 100 lb. of sodium acetate, and 10 lb. of caustic soda dissolved in 100 gallons of water. The brown precipitate formed after 15 hours is filtered off, washed, and dried.—T. A. L.

New Blue Colouring Matters and in the Manufacture of the same. S. Pitt, Sutton. From Leopold Casella and Co., Frankfurt-on-the-Maine, Germany. Eng. Pat. 5852, April 19, 1888. 4d.

THE *p*-nitroso derivatives of secondary and tertiary amines combine with diphenyl-*m*-phenylenediamine, or its homologues, with the formation of blue colouring matters. 2 parts by weight of nitrosodimethylaniline hydrochloride are heated in alcohol or other solvent with 1 part of diphenyl-*m*-phenylenediamine, or a corresponding amount of one of its homologues. When the reaction is complete the melt is diluted with water, filtered, and the colouring matter salted out. The dye-stuff is more violet if less of the nitroso compound be used. It dissolves in strong sulphuric acid with a black shade, and dyes wool, silk, and mordanted cotton a dark blue, which is fast to washing.

—T. A. L.

Manufacture of Blue Colouring Matters. C. D. Abel, London. From The Actiengesellschaft für Anilin Fabrikation, Berlin, Germany. Eng. Pat. 5909, April 20, 1888. 6d.

BENZIDINE, tolidine, diamido-stilbene, and the methyl, or ethyl ether, of diamido-diphenol, when diazotised and combined with α -naphthol disulphonic acid (Eng. Pat. 4625 of 1888, see above), gives rise to blue colouring matters, which dye unmordanted cotton more evenly and stronger than those at present on the market. A bluish-violet dye-stuff is obtained in the following manner:—

21 kilos. of diamido-stilbene are dissolved in 58 kilos. of hydrochloric acid and 1,000 litres of water, diazotised by means of 14 kilos. of sodium nitrite in 50 litres of water, and added to a solution of 35 kilos. of sodium α -naphthol disulphonate, and 41 kilos. of sodium acetate in 1,000 litres of water. The intermediate compound thus formed is again combined with an alkaline solution of 35 kilos. of α -naphthol-disulphonic acid. The mixture is allowed to stand for some hours, then heated, and the colouring matter formed is salted out, filter-pressed, and dried. The second molecule of the sodium α -naphthol-disulphonate in the above example may be replaced by salts of α - and β -naphthol, their mono- and disulphonic acids with the formation of similar bluish-violet dye-stuffs. The diamido-stilbene may also be replaced by an equivalent quantity of its sulphonic acid, of benzidine, *o*-tolidine, dianisidine, or diphenetidine—



The colouring matter from dianisidine dyes a very green shade of blue.—T. A. L.

Manufacture of Azo Colouring Matters. C. D. Abel, London. From The Actiengesellschaft für Anilin Fabrikation, Berlin, Germany. Eng. Pat. 5910, April 20, 1888. 6d.

By combining the new α -naphthol disulphonic acid (Eng. Pat. 4625 of 1888, see previous page) with diazo compounds, colouring matters are obtained which dye red, brown, violet, and bluish-black. 15.75 kilos. of xylylene hydrochloride are dissolved in 100 litres of water and 12 kilos. of hydrochloric acid, and diazotised with 6.9 kilos. of sodium nitrite in 50 litres of water. The diazo solution is poured into 700 kilos. of water containing 34.8 kilos. of the sodium salt of the new α -naphthol disulphonic acid, the solution being kept alkaline with sodium carbonate until the reaction is complete. The dye-stuff formed is salted out, pressed, and dried. It dyes wool yellowish red from an acid bath. The following are the various shades obtained from different amines and their sulphonic acids:—Camidine dyes red; α -naphthylamine, brown; β -naphthylamine, red-brown; amido azo-benzene or toluene dye brown; naphthionic acid dyes brown red; β -naphthylamine- β -sulphonic acid, red; sulphamic acid azo- α -naphthylamine, brown; β -naphthylamine- α -sulphonic acid-azo- α -naphthylamine, brown; α -naphthylamine disulphonic acid-azo- α -naphthylamine, red-violet; and β -naphthylamine disulphonic acid G-azo- α -naphthylamine, bluish-black.—T. A. L.

Improvements in the Manufacture of Colouring Matters. H. H. Leigh, London, From R. G. Williams, Albany, U.S.A. Eng. Pat. 6743, May 5, 1888. 6d.

This is an extension of Eng. Pat. 5104 of 1888 (page 280), and provides for the production of colouring matters by combining one molecule of tetrazo-diphenyl, its homologues and substitution products, with one molecule of dihydroxy-toluene, its homologues or substitution products, and afterwards with another molecule of a different dihydroxy derivative or substitution product of toluene or its homologues. The colouring matters as above dye unmodified cotton in an alkaline-bath, and the colours are fast to soap.

—T. A. L.

Improved Process or Method for effecting the Separation of Isomeric Xylidines from Commercial Xylidine in a Pure State for the Production of Colouring Matters. L. Limpach, Manchester. Eng. Pat. 6899, May 9, 1888. 6d.

The method depends upon the fact that when crude xylidine is treated with acetic acid only *m*-xylidine ($\text{CH}_3:\text{C}_6\text{H}_4:\text{NH}_2 = 1:3:4$) forms a solid acetyl compound. The following example is given to show the method employed: 121 grms. of commercial xylidine are treated with 30 grms. of 100 per cent. acetic acid and allowed to stand for 24 hours. Crystals separate out which consist of pure *m*-xylidine acetate which can be converted into the base by known methods.

The mother liquors are treated with hydrochloric acid, and after standing 3–4 days about 20–25 per cent. of *p*-xylidine separates out as hydrochloride. The filtrate from this contains principally derivatives of *o*-xylidine.—T. A. L.

Improvements in the Process for the Manufacture of Azo Colouring Matters. H. H. Leigh, London, From R. G. Williams, Albany, U.S.A. Eng. Pat. 15,654, October 30, 1888. 6d.

TETRAZO-DIPHENYL or one of its homologues is combined with two molecules of "a sulpho acid of diazo-amido-benzene" or its homologues* and two molecules of an amine or a phenol are then substituted for the two molecules of the "diazo-amido-benzene sulpho-acid" employed. The following are the amines employed: aniline, its alkyl derivatives, homologues and sulphonic acids, the naphthylamines and their sulphonic acids. The phenols mentioned are: phenol and cresol, the naphthols, resorcinol, orcinol, dioxy-naphthalene and sulphonic acids of all the preceding. It is to be noted that the colours obtained by this method are identical with those described in Eng. Pat. 6687 of 1887 (this Journal, 1888, 430), which claims the combination of tetrazo-diphenyl and its homologues with the sulphonic acids of amido azo-benzene, and subsequent replacement of these latter by amines and phenols. The following examples are given in the present invention. To obtain Congo-red, 28 lb. of benzidine sulphate are diazotised and the solution is run into 60 lb. of the sodium salt of the "sulpho-acid of diazo-amido-benzene," and 60 lb. of sodium acetate dissolved in 50 gallons of water. The compound separates as a brown flocculent precipitate, and is kept stirred for 12 hours. It is then run into a solution of 55 lb. of sodium naphthionate and 60 lb. of sodium acetate dissolved in 200 gallons of water with constant stirring, which is continued for 12 hours. The colour is then filtered off "and converted into its soda salt." If in the above example 31.2 lb. of tolidine sulphate be employed in place of the benzidine, the colour known as Benzopurpurin is obtained. Congo 4 R. is obtained in a similar manner by using tolidine and replacing one of the two molecules of sodium naphthionate by one molecule of resorcinol.—T. A. L.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

PATENTS.

Improvements in Immersion Rollers used in Printing, Dyeing, Bleaching, Sizing, or other like Purposes. T. Winter, Blackburn. Eng. Pat. 1357, January 30, 1888. 8d.

IMMERSION rollers constructed as heretofore have a solid core or centre, or solid core with corrugated circumference. In this invention the solid core is dispensed with. End pieces or flanges have secured to them a series of laths or strips of copper, brass, or other metal placed so as to radiate from a common centre. These laths are strengthened by supports placed at intervals of their length. The warps or other material under operation are wound on the outside edge of the laths so that the dye or size is better able to permeate through the material than when wound on solid rollers.—W. E. K.

Improvements relating to the Washing or Scouring and Felling of Cloth and similar Materials. F. F. and M. L. Rohart, Paris, France. Eng. Pat. 1464, January 31, 1888. 6d.

THE fatty or greasy matters contained in woollen and similar stuffs are rendered saponifiable by treatment with alkaline hydrosulphides; the hydrosulphide is decomposed, the sulphur combining with the fatty matter, and the base

* The preparation of this body is not described in the patent.

dissolving the compound so obtained. In the case of cloth the operation takes place in the fulling machine. The piece is washed with pure water, left to dry for about 24 hours, then introduced into the fulling machine, into which the hydrosulphide is admitted in a thin jet. The formation of soap is almost instantaneous: one or two kilos. of hydrosulphide at 20° B., diluted to 2°—3° B., is sufficient for each piece of 30 metres. Sometimes it is necessary to add a certain proportion of olein to the fulling machine, preferably before the hydrosulphide is admitted. The cloth should be frequently "tried," and the addition of olein, hydrosulphide and water regulated according to circumstances; if the piece be too greasy, hydrosulphide is to be added, or olein if not sufficiently greasy, water being admitted when the soap is in too thick a paste or the cloth too dry.

After this operation the cloth is rinsed in water and soaked in a solution of carbonate of soda, the strength of which varies according to the more or less greasy state of the cloth; finally it is well washed in flowing water. Either monosulphides or polysulphides may be used, provided they be saturated with sulphuretted hydrogen, and the process is applicable to the washing of greasy wool and the scouring of woollen thread or fabric as well as in the fulling of woollen stuffs.—E. B.

Improvements in Apparatus for Washing, Cleansing, Dyeing or Steeping Fabrics and other like Purposes. W. P. Thompson, Liverpool. From A. Douleuron and E. van Meerbeeck, Ixelles-lez-Bruxelles, Belgium. Eng. Pat. 3232, March 2, 1888. *8d.*

The apparatus consists of a revolving perforated drum, made of copper or other material, which contains the clothes or fabrics to be washed, cleansed, dyed, &c. The lower part of this drum rotates in a pan or receptacle, preferably covered in, containing the washing or other liquid, and the remainder of the pan, not filled with liquid, is filled with steam or vapour. The pan is heated by a fire placed underneath. The form of the drum is cylindrical in cross section about the middle of its length, but its ends are closed by truncated cones. Besides the use for domestic purposes, it is stated the apparatus can find useful application in connexion with bleaching, dyeing, tanning, hat-making, glove-making, leather dressing, &c. A drawing is given.—E. B.

Improvements in Dyeing Apparatus. W. Mycock, Stockport. Eng. Pat. 3490, March 7, 1888. *8d.*

This invention relates to the dyeing of fabrics which have to be immersed successively in a number of dye-vats, and in particular to indigo dyeing of cloths printed with resist pastes, an operation usually performed by hand. The vats are, by preference, arranged as usual side by side in line, but this order may be varied. The cloth is fixed in rectangular hooking frames in the usual way. Extending over the row of vats is a carriage movable on girders and fitted with lifting appliances for raising or lowering a dip-frame, to or from which the cloth frames can be attached or detached by means of self-acting catches. By this arrangement the series of frames can be lifted, the cloth held in the air for the time requisite for the oxidation of the indigo, and the carriage then run forward and the frames dropped into the next succeeding vats. After the cloth frames have been immersed they are unhooked from the carriage and the latter is run back ready for the next lift of cloth frames.—W. E. K.

Improvements in Machinery or Apparatus for Washing or Cleansing Wool or other Fibrous Materials. J. and E. W. Petrie, Rochdale. Eng. Pat. 4786, March 29, 1888. *8d.*

The improvements relate to the mechanism in use for the transfer of the washed wool from the trough, where it has been cleansed, to the squeezing rollers, as described in Eng.

Pats. 43 of 1874 and 4261 of 1880, and also to the method of conveying wool from the trough to the squeezing rollers when these are placed in proximity to the trough, not being submerged in the same, but with the bottom roller placed below or partially below the level of the water-line in the trough. The improvements dispense with the fixed grid and its support, and the upper vibrating rake, described in Eng. Pat. 43 of 1874, and replace these appliances with a vibrating rake armed with one or more rows of prongs, by which the wool is conveyed to the fall plate and thence to the squeezing rollers. This vibrating delivery rake may be combined with the ordinary swing or vibrating rake and actuated by similar mechanical arrangement. In the case where the squeezing rollers are placed above or proximately above the water-line in the washing trough, the double-headed rake described in Eng. Pat. 4261 of 1880 is replaced by a single adjustable vibrating rake held by a jointed radial rod with a check or stop motion at the point of delivery, more effectually delivering the wool on to the slide bars or other travelling appliances used for conveying the same to the squeezing rollers. A drawing is given.—E. B.

A Composite Indigo Dye. La Société L. Durand, Huguenin et Cie., Bâle, Switzerland. Eng. Pat. 15,496, October 27, 1888. *4d.*

This invention describes the employment of indopheno ($C_{18}H_{16}N_2O$) (Eng. Pat. 1373, 1881) as a diluent for indigo thereby effecting a considerable saving in cost and time without impairing the fastness of the colour. The method employed is as follows:—1 kilo. of dry powdered indophenol is mixed with 100 litres of water, 10 kilos. of indigo paste (containing 20 per cent. of dry indigo), 10 litres of sodium bisulphite of 39° to 40° B., 2 kilos. of stannous chloride, and 2,500 kilos. of zinc powder. The mixture is agitated for an hour and is then treated with 8 litres of caustic soda of 38° B. It is again agitated, and on the following day diluted with twice its volume of cold water. After vigorous agitation it is allowed to stand until clear and may then be used for dyeing in the ordinary manner. The colour of the goods is increased 10 to 15 per cent. by passing them immediately after dyeing through a $\frac{1}{4}$ per cent. solution of potassium bichromate. Indophenol, when treated by itself in the above manner, is only reduced with difficulty and dyes a violet-blue colour which fades to a greyish-violet, and is only moderately fast. The composite dye, however, behaves exactly like indigo and resists moreover, better than indigo itself, the action of discolouring agents. (See also this Journal, 1889, 189.)—T. A. L.

Improvements in the Method of and in Apparatus for Dyeing, Scouring, or Washing Wool and other Materials. F. E. Anderson, New Jersey, and S. Hodgson, Mass., U.S.A. Eng. Pat. 17,271, November 27, 1888. *8d.*

This method of dyeing, &c. cannot be properly understood without reference to the drawings. The "staple" is submerged and subjected to the intermittent action of the liquids used, the material receiving, at the same time, a forward impulse. A receiving hopper, containing a toothed drum and flushing mechanism, is connected with a tube having an upturned delivery end; the tube gradually increases in diameter from the hopper to the delivery end. Twenty-two claims are made.—E. B.

Improvements in Hollow Perforated Tubes for Dyeing, Bleaching, or otherwise Treating Yarns in Cops. H. F. Lippitt, Providence, U.S.A. Eng. Pat. 18,317, December 18, 1888. *8d.*

This invention, which relates to the dyeing, &c. of yarn in cops by forcing or sucking liquids through the cops when mounted on hollow spindles, is an improvement on Graemiger's U.S. Pat. 368,715 of 1887. The improvement consists in narrowing or contracting the spindle in that portion of its length which is adjacent to the thickest portion of the cop, for the purpose of permitting a readier

passage of liquid where the cop is least readily traversed by the bleaching or dyeing liquor. The hollow spindle is closed at its upper end, has perforations in its wall for the passage of the liquid used, and at its lower end is an annular flange on which the cop rests. Drawings are given.

—W. E. K.

A new Mordant for Dyeing Purposes. E. O. Fankhauser, Burgdorf, Switzerland. Eng. Pat. 18,717, December 21, 1888. 4d.

This invention relates to a mordant termed "Fankhausine" by aid of which cotton and other fibres can be dyed direct "without requiring previous boiling." For its preparation 100 parts of castor oil are treated with 20 parts of sulphuric acid and neutralised with soda. Next, 7 parts of sumac extract are boiled with 20 parts of "olein soap" and, when cold, well stirred into the castor oil preparation. It is claimed that cotton or mixed fibres, when mordanted with this "sumac-oil-soap," takes up dye-stuffs readily.—W. E. K.

Improvements in Machinery for or connected with the Dyeing of Textile Matters in Skeins. P. Haddan, London. From E. Six-Serve, Tourneing, France. Eng. Pat. 18,776, December 22, 1888. 8d.

This specification does not admit of suitable abstraction. It describes an apparatus for supporting the skeins of yarn, immersing them in the dye-vessel, and constantly turning them during the operation of dyeing. The details are illustrated in eight drawings.—W. E. K.

VII.—ACIDS, ALKALIS, AND SALTS.

Notes on the Reactions in the Sulphuric Acid Chambers. A. Schertel. Chem. Ind. 12, 80—81.

LUNGE and NAEF found some time ago (this Journal, 1884, 258), that the oxidation of sulphurous acid is very energetic as far as the middle of the first chamber, after which it rapidly decreases. The percentage of sulphurous acid in the gases of the second half of a chamber is nearly the same throughout. When the gases pass from one into the next chamber, an energetic reaction sets in again, which diminishes as soon as the gases pass into the second half of the chamber. Schertel's observations confirm Lunge and Naef's results, but he does not consider their explanation satisfactory. He thinks that the mist of nitrososulphonic acid in the second half of the chamber remains undecomposed owing to want of steam, and consequently there is a scarcity of nitrous acid in the gases. When these enter the next chamber, the fresh steam introduced brings about the decomposition of the nitrososulphonic acid, accompanied by a liberation of nitrous acid, which latter is the cause of the renewed activity. Gradually a mist of nitrososulphonic acid is again formed, and thereby a partial suspension of the reaction. It is well known in practice that the oxidation of sulphurous acid is greatly accelerated by an increased admission of steam, and direct gas tests bear out the practical experience. Nitrososulphonic acid is a much more stable compound than is generally supposed, and requires a good deal of steam for its decomposition.

A portion of the gases, as they passed from the first into the second chamber, was passed into a long pipe filled with coke, and was allowed to traverse the pipe for several weeks. When the pipe was opened well-shaped crystals of nitrososulphonic acid were found on that side of the coke which faced the current of the gases. During the time of the experiment the acid formed in the pipe had a specific gravity of 1.49. This interesting phenomenon is quite compatible with Schertel's explanation given above, and it is perhaps possible to base on it a method for accelerating the sulphuric acid reactions.—S. H.

Ammonium Salts in Stassfurt Carnallite. W. Diehl. Chem. Zeit. 13, 64.

By distilling carnallite with sodium hydrate a quantity of ammonia was found in the distillate equal to 0.01—0.015 per cent. of ammonium chloride.—J. W. L.

Change of Rotation of Tartaric Acid in Mixed Solutions. R. Pribram. Ber. 22, 6—11.

OPTICALLY inactive substances alter the amount of rotation of tartaric acid, in some cases annihilating it entirely or even producing an opposite rotation. The aromatic hydrocarbons have a special influence in this direction. Thus a solution of 2 grms. of tartaric acid in 40 cc. of ethyl alcohol turns the plane of polarisation $\alpha_D^{20} = +37.9$. If a solution in 20 cc. of alcohol and 20 cc. of benzene be used the rotation becomes -41.1 . In the case of the higher homologues of benzene the effect is still more marked. The halogen substitution products increase the left-handed rotation, the nitro-substitution products have an opposite effect. The amido-group increases the rotation of tartaric acid. This is shown by experiments on urea and aniline. In the case of pyridine the effect reaches a maximum when about 50 per cent. of pyridine is present. It then decreases proportionately with the amount of pyridine in solution.—J. B. C.

Nitrogen Pentoxide. L. Meyer. Ber. 22, 23—24.

NITRIC anhydride prepared by distilling strong nitric acid with strong sulphuric acid mixes with phosphorus pentoxide without perceptible rise of temperature. This agrees with Thomsen's observation that P_2O_5 dissolves in water with 36,000 cals., whereas N_2O_5 dissolves with about 30,000 cals. According to Berthelot nitrogen pentoxide gives with benzene at 55° C. dinitrobenzene, and a solution of benzene and N_2O_5 in sulphuric acid yields dinitrobenzene at 160°.

—J. B. C.

Formation of Carbonyl Sulphide. C. Böttinger. Ber. 22, 306.

THE author finds that carbonyl sulphide is formed by heating a mixture of carbon and ultramarine, and the formation of this compound by analogy with the action of carbon bisulphide upon clay (see this Journal, 1889, 118) is probably due to the intermediate production of carbon bisulphide.—J. B. C.

A New Potassium Ferrocyanide Compound. F. Mahla. Ber. 22, 111—117.

THE liquor obtained by extracting the product from the gas-purifiers with water yields with ferric chloride a precipitate of Prussian blue, if after filtration a further addition of ferric chloride gives a violet precipitate, which is decomposed with caustic potash, forming a precipitate of ferric oxide. The filtrate, on evaporation, yields a crystalline potassium salt of a new iron cyanide. It contains water of crystallisation, which cannot be expelled without decomposing the salt entirely. Its aqueous solution yields with ferric chloride a violet, and with copper salts a green precipitate. The new salt has probably the formula K_3FeCy_3 .—J. B. C.

PATENTS.

Improvements in the Method of producing Aluminium Chloride. C. A. Faure, New York, U.S.A. Eng. Pat. 11,020, February 20, 1888. 4d.

THE ore is heated to redness by a direct flame, with excess of air, and is then subjected, after the air and flame have been cut off, to the action of a mixture of petroleum vapour, or other similar substance containing carbon, and a gas containing chlorine, such as hydrochloric acid. Chloride of aluminium is produced, and may be condensed in any suitable manner.—A. W.

Improvements in the Production of Sulphur from Sulphuretted Hydrogen. E. W. Parnell and J. Simpson, Liverpool. Eng. Pat. 4648, March 27, 1888. 6d.

WHEN sulphuretted hydrogen is burned with a limited quantity of air in a brick chamber with the object of effecting the reaction $\text{H}_2\text{S} + \text{O} = \text{H}_2\text{O} + \text{S}$, it has been found that the sulphur produced is always far short of the theoretical quantity, the loss being partly due to the escape of sulphuretted hydrogen and partly to the formation of sulphur dioxide and polythionic acids, which latter are found mixed with the wet sulphur deposited in the cooling chambers. The thionic acids are formed by a reverse action between the sulphur and the aqueous vapour. When sulphuretted hydrogen and sulphur dioxide are brought into contact in the presence of water, the following reaction should take place: $\text{SO}_2 + 2 \text{H}_2\text{S} = 2 \text{H}_2\text{O} + 3 \text{S}$, but in practice the simultaneous formation of polythionic acids diminishes the yield of sulphur. The sulphur formed is not precipitated in the solid form to any considerable extent, but remains in a quasi-soluble condition in the acids simultaneously formed. If these be neutralised by calcium sulphide, the sulphur separates out. If these thionates (after neutralisation) be subjected to the action of heat and pressure of steam, they are decomposed with precipitation of sulphur and evolution of sulphur dioxide. Again, if the polythionic acids be treated with sulphuretted hydrogen, decomposition ensues with formation of sulphur. These phenomena are made use of in carrying out this invention. Sulphuretted hydrogen is burned with a limited quantity of air, and the hot gases are conducted to a cooling chamber, where sulphur is deposited with polythionic acids. The gases escaping from the cooling chamber, which should still contain sulphuretted hydrogen, is treated with an aqueous solution of sulphurous acid in a scrubber, when sulphur is formed along with a certain amount of polythionic acids. The liquid thus obtained is allowed to settle, and the supernatant liquor which contains the polythionic acids returned for repeated use in the scrubber. The wet mud and the wet sulphur from the cooling chamber are agitated with a solution of an alkaline sulphide, until the mass has an alkaline reaction. The mass is then subjected to heat and steam pressure, whereby sulphur and sulphur dioxide are formed, and under certain circumstances sulphuretted hydrogen. The gases evolved are conveyed back to any suitable portion of the plant.—S. II.

Improvements in the Manufacture of Ammonia and Ammonia Salts. M. N. d'Andria, Stretford. Eng. Pat. 5762, April 18, 1888. 4d.

A SOLUTION of commercial ammonium sulphate is boiled with magnesia or magnesium hydrate, whereby ammonia is liberated and magnesium sulphate left in solution in the still, which can be obtained by crystallisation. Magnesium carbonate may be employed in a similar manner, and in this case magnesium sulphate and ammonium carbonate are obtained.—S. II.

Improvements in the Manufacture of Ammonia and its Sesquicarbonate. R. E. Chatfield, Sewardstone. Eng. Pat. 6152, April 25, 1888. 6d.

A SOLUTION of ammonium sulphate is heated with magnesia in a still, ammonia being given off and magnesium sulphate in aqueous solution remaining in the still, which can be crystallised and prepared for the market as Epsom salts. The ammoniacal gas is absorbed in water. For preparing ammonium sesquicarbonate a closed vessel is charged with a cold aqueous solution of ammonia, and carbonic acid is admitted into the upper part of this vessel above the ammonia solution, until the solution attains a strength of about 20° B. The solution is then heated, and an additional supply of carbonic acid being admitted, ammonium sesquicarbonate is sublimed from it and collected in suitable receptacles.—S. II.

Improvements in the Production of Sulphur from Sulphuretted Hydrogen. E. W. Parnell and J. Simpson, Liverpool. Eng. Pat. 6175, April 26, 1888. 6d.

WHEN sulphuretted hydrogen is burned with a limited quantity of air, thionic acids are formed as by-products. The object of this invention is the treatment of these acids so as to get sulphur from them. It has been found that the thionic acids, if brought into prolonged contact with sulphuretted hydrogen, are decomposed into sulphur and water (see Eng. Pat. 4648).—S. II.

Improved Furnace for the Production of Carbonic Acid Gas and the Burning of Calcareous Material. P. M. Justice, London. From C. Dietzsch, Saarbrück, Germany. Eng. Pat. 16,472, November 13, 1888. 8d.

THE furnace described is of the two-storied or stage pattern. Limestone is charged into the upper chamber, which forms a preliminary heater, and when the charge in the lower or burning chamber is withdrawn, the charge from the upper chamber is pushed into the lower one. The carbon dioxide given off during the process of burning passes through the upper chamber and escapes through a pipe for use. Air is admitted into the lower chamber through a channel below the furnace shaft.—S. II.

Improvements in the Process of Manufacturing Bicalcareaous Phosphate, called Precipitated Phosphate. G. C. Dymond, Liverpool. From C. E. D. Winssinger, Brussels, Belgium. Eng. Pat. 17,945, December 8, 1888. 6d.

THE object of the process is to prepare precipitated bicalcium phosphate free from iron and alumina, and completely soluble in ammoniacal citrate of ammonium. Caustic soda and gypsum are or may be obtained as by-products.

The phosphatic mineral is treated with sufficient sulphuric acid to give an impure solution of phosphoric acid (A), and by filtration a residue of impure or phosphated gypsum. The iron is precipitated from A by cautious addition of carbonate of lime and milk of lime; the filter-press mud from this process is mixed with a fresh quantity of phosphoric acid liquor A, giving on filtration a mud of impure gypsum, and a liquor to which lime is added until precipitation begins, when sulphate of soda is added in sufficient quantity to precipitate all the lime present as gypsum on boiling. After filtering off this gypsum the sodium phosphate solution is treated with enough sodium carbonate to remove the iron, which is filtered off. The filtrate mixed with lime gives a precipitate of pure phosphate of lime and a filtrate of caustic soda. This precipitate mixed with the solution of mono-calcium phosphate first obtained by the addition of a little lime to A, is converted into bi-calcium phosphate, which is filtered off and dried. The process may be shortened in various ways.—J. M. II. M.

Improvements in the Manufacture or Production of Bisulphite and Metabisulphite of Sodium or Potassium. W. B. Giles, A. Shearer, and F. G. A. Roberts, Stratford. Eng. Pat. 18,775, December 22, 1888. 4d.

SULPHUROUS acid gas is passed over or through solid sodium or potassium bicarbonate, the sulphurous acid being thereby absorbed and a bisulphite or metabisulphite produced according to circumstances. If the operation be performed at a temperature below 60° F. a bisulphite (NaHSO_3 or KHSO_3) is the product of reaction. If, however, the material acted upon be kept at a temperature between 212° and 257° F., a metabisulphite ($\text{Na}_2\text{S}_2\text{O}_5$ or $\text{K}_2\text{S}_2\text{O}_5$) is produced. If no special means of cooling or heating during the operation be taken, a mixture of bisulphite and metabisulphite will be the final product.—S. II.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

PATENT.

Improvements in Gas-fired Kilns for Burning or Heating Pottery, and for other Purposes. J. Holroyd, Leeds, and A. Wilson, Stafford. Eng. Pat. 3583, March 8, 1888. *Sd.*

HEREIN is described an arrangement of plant whereby two or more kilns may be worked with one regenerator, although, as this latter is divided into two parts, there are practically two regenerators. Attached to each kiln are two chambers which act alternately as combustion chambers and as means of outlet for the burnt gases, whilst the two halves of the regenerator alternately heat the air or gas supply, and abstract heat from the escaping products of combustion.—A. R. D.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Metallic Salts of Resin Acids for Preserving Wood. M. Kretschmar. Chem. Zeit. **13**, 31.

Owing to the rise in price of carbolic acid (phenol), both in the crude and pure form, the author recommends the substitution of metallic salts of various organic acids for the purpose of preserving timber.

Colophony in conjunction with copper or zinc is recommended by the author, and is to be applied in the following way:—1,000 parts of colophony are dissolved in 3,000 parts of a 10·5 per cent. solution of sodium hydroxide by the aid of heat. The copper or zinc salt is dissolved in distilled or soft water to a 10 per cent. solution. The solution of the metallic salt is first applied with a brush until it is no longer readily absorbed, when it is allowed to dry and the solution of the resin in soda applied. A second coating of colophony is applied after the first has become dry, but in cases of soft wood, the fibres of which are readily acted on by the sodium hydroxide, the timber is afterwards washed with 5 per cent. acetic acid. Lastly, it is recommended that in case the wood is required to remain constantly in contact with water, an excess of colophony should be dissolved in the sodium hydroxide solution, which must be done by adding the last portions of colophony in small quantities at a time. After painting the wood with it and allowing it to dry for two days, any excess adhering to the outside may be rubbed off with tow.—J. W. L.

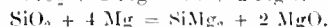
Various Chemical Wood-impregnating Substances. R. Rittmeyer. Dingl. Polyt. J. **271**, 228—239.

THIS paper is a historical description of the various methods which have been proposed and employed for impregnating wood for various purposes with preservative materials, together with a few results as to the efficiency of these materials and the methods of using them. The materials which have been used are:—Sulphates of copper, iron, zinc, and barium, chlorides of mercury and zinc, creosote, &c., and various mixtures of these substances. Tables by different authorities of the cost of impregnation are also given, as well as tables showing the quantities impregnated in one or two countries.—A. W.

X.—METALLURGY, MINING, Etc.

Silicon and Boron. L. Gattermann. Ber. **22**, 186—197.

Ir magnesium powder and quartz be heated in a test tube over the flame, a violent reaction occurs, and according to the proportions either silicon or magnesium silicide is produced—



If 1 grm. of sand and 1·5 grms. of magnesium powder be heated together and the blue half-melted product be introduced into concentrated hydrochloric acid, silicon hydride is evolved, which ignites spontaneously. If one part of magnesium powder be heated with four parts of sand, free silicon is obtained, and by fusing the product with zinc and allowing it to cool, the zinc may be dissolved and crystallised silicon obtained, or if chlorine be passed over the heated mass obtained by the above method, 100 grms. of magnesium yield 300 grms. of pure silicon chloride. Silicon bromide and iodide may be obtained in a similar manner. To obtain silicon chloroform the product of the above reaction is treated with dilute hydrochloric acid to dissolve out the magnesium oxide and then dry hydrochloric acid gas passed over the purified product; using 10 grms. of magnesium, 15 grms. of silicon chloroform are obtained. Silicon bromoform has also been prepared.

Boron may be obtained by heating anhydrous borax with magnesium powder. The product contains excess of borax, magnesium oxide, boron nitride, magnesium compounds, and boron. The first is dissolved out by water, the second with strong hydrochloric acid, and the boron may be obtained in the graphite form by dissolving in aluminium in a plumbago crucible. By passing chlorine over the crude product the trichloride of boron may be prepared; with 8 grms. of magnesium, 15 grms. of the trichloride are obtained. Magnesium powder may also be used for the reduction of other oxides.—J. B. C.

Amorphous Bismuth. F. Hérard. Compt. Rend. **108**, 293.

By applying to bismuth the method that was used to obtain amorphous antimony, amorphous bismuth has been obtained. Pure crystallised bismuth is heated to bright redness in a current of pure nitrogen; greenish vapours rise and are condensed in the cold parts of the tube in the form of a grey powder. Viewed under the microscope this powder presents the form of little beads in strings like amorphous antimony and amorphous arsenic.

The presence of nitrogen is necessary as in the case of antimony; other gases gave no result. The analytical numbers are 99·5 to 99·7 for 100 of bismuth; by taking the mean we get 99·6 for 100 of bismuth, 0·4 per cent. being oxygen. If the grey powder be heated in a current of hydrogen it loses 0·4 per cent. of its weight and a corresponding quantity of water is formed. The powder is therefore a mixture of bismuth and oxide of bismuth. This fact explains the melting point, which is 410° instead of 247°, the melting point of crystallised bismuth; but it does not explain the density obtained, which is 9·483, the density of a mixture of bismuth and oxide corresponding to the grey powder being 9·665. This makes it probable that the substance is amorphous bismuth.

The extreme state of division in which amorphous bismuth occurs makes it more sensitive to reactions than crystallised bismuth. Thus it is attacked so rapidly by nitric acid that it disappears instantaneously.—A. J. S.

On the Volatility of Iron and the Penetrating Power of its Atoms on Welding the same to Nickel. T. Fleitmann. Stahl und Eisen, 1889, 9.

THE author found that on welding iron and nickel together the iron penetrated into the nickel beyond the weld, and to such an extent that, on separating the two metals with dilute acid and dissolving off successive layers of metal from the welded side of the nickel plate with stronger acid,

it was not until three-fourths of the thickness had been removed that he found the metal contained only that amount of iron originally present. The nickel did not penetrate into the iron plate in the same manner. To ascertain the real nature of this, some nickel plates 0.7 mm. thick and 5 cm. square were placed alternately with plates of iron of the same size and 6 mm. thick, in a muffle, and heated for 64 hours to a red heat. The nickel plates were then fractionally dissolved and the iron estimated in each successive solution with the following results:—

Solution.	Weight of dissolved Metal.	Weight of Iron in Solution.	Percentage of Iron in the dissolved Metal.
1st	Grms. 0.595	Grms. 0.3236	54.4
2nd	0.590	0.0546	18.2
3rd	0.792	0.0209	2.7
4th	5.911	0.0620	1.05
5th	1.653	0.01925	1.16

The original nickel plate contained 1.10 per cent. of iron. The explanation given of the above is that iron is volatile at a temperature far below its melting point; and this is borne out by the fact that when iron is heated in the same neighbourhood with nickel, but out of contact with it, the surface of the latter becomes gradually impregnated with iron.

The ease with which a metal welds is influenced by the difference of temperature between its softening and fusing point. If a metal softens long before it melts, it readily welds; if the melting and softening temperatures be close together, the reverse is the case. Impurities which lower the weldability of a metal may do so either by lessening its softening power or by lowering its melting point and bringing it nearer the softening point. Thus the impurities of iron spoil its weldability. On the other hand, a small quantity of magnesium added to nickel raises its melting point 100° and very much increases its weldability. —A. W.

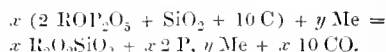
The Gold Mines of the Siebenbürgen. O. N. Witt.
Chem. Zeit. 13, 63.

THE gold of these mountains does not appear under the same circumstances as in the case of the mines of California or Venezuela. It is found here in the fissures which occur throughout the trachitic rock of this range, and which vary in width from 1—50 cm. The minerals which are contained in them do not as a rule completely fill them up, but merely coat them, the space left having been then at a much later period filled up with calcite, slowly deposited by the water which has trickled through. The gold occurs in the pure state, and also alloyed with silver, and at Nagyag as a telluride, and frequently as a double telluride of silver and gold and lead and gold. The former of these is sylvanite or "Schrifterz." The latter is called Nagyagite, and has the appearance of galena. It is a ditelluride of lead containing varying quantities of tellurides of precious metals. It also occurs in Offenbanya and Borneo.—J. W. L.

Improvements in Metallurgy. Dingl. Polyt. J. 271,
214-227.

PERINO'S method for treating copper pyrites, without roasting, with nitrate of iron for the extraction of copper, according to the Eng. Pat. 2019 of 1888, and Ger. Pat. 44,498 of 1888 (see this Journal, 1888, 389) is described. It is found that copper sulphate only goes into solution, and that the silver remains in the residue. Moreover, in the recovery of the nitric acid, only 5 per cent. of that originally employed is lost.

The method of Jurisch, precipitating basic sulphate of iron and afterwards oxide of zinc from waste liquors from copper extraction (see this Journal, 1888, 124) is also described. Mellmann makes phosphor-copper and phosphor-tin by converting in one operation alkaline phosphates, silica, and carbon into alkaline silicates, carbon monoxide and free phosphorus, which latter at the moment of liberation combines with the metal, according to the following reaction:—



A reverberatory furnace or a crucible is preferably employed, but a cupola may also be used. In the two former cases it is advisable to add some flux, such as soda or fluor spar, and in the latter clay should be used instead of silica, and the mixture made into briquettes.

In Parkes' process for treating gold and silver ores, 12 to 16 per cent. of lime or chalk and 5 per cent. of soda in the case of sulphides is found to be the best mixture. Ger. Pat. 45,013 of 1887. (See this Journal, 1887, 823.)

Rössler treats the silver obtained by cupellation with silver sulphate in order to eliminate the lead and bismuth it contains. The silver is melted in a graphite crucible, a little sand thrown on to prevent the latter being attacked, and molten silver sulphate is then gradually added. Lead passes out first as sulphate, and the bismuth towards the end of the operation. The last portions of slag are therefore kept separate and treated for bismuth.

Matthey separates gold and silver from bismuth by adding 2 per cent. of zinc to the molten bath. The noble metals rise to the surface with the zinc, leaving the bismuth pure. The scum is melted in a crucible with borax to recover gold. Lead and bismuth may be separated by a kind of Pattinson process, as the alloys of these two metals melt at lower temperatures than does the bismuth. Matthey also shows that bismuth can be purified from a small quantity of copper by melting it with bismuth sulphide. If arsenic, antimony, lead, and tellurium be present, they are separated first in the usual way. By this process pure bismuth can be obtained from material containing from 0.1 to 1.0 per cent. of copper.—A. W.

The Croselmire Zinc Process. Eng. and Min. Jour.
1889, 135-136.

THIS is a description of the practical working of Croselmire's patent which has already been described (this Journal, 1888, 678). The blende is crushed (or tailings containing blende may be used) and made into bricks with clay by an ordinary brick-making machine, each brick having three transverse holes an inch in diameter through it. These when dry are piled in a cylindrical kiln, one on the other, so that the holes form a series of flues. On the inside wall of the kiln are tiers of steam pipes, each having a number of iron nipples which project into the interior. At the base of the kiln are four fire-boxes in which the heat is generated to start the process. When the sulphur of the ore commences to burn the firing is stopped, and steam and air are introduced by means of the jets. The operation lasts about a week, the temperature all this time never being allowed to rise above a dull red heat. After the operation is complete, and when the kiln is cold, the bricks are removed and leached with hot water, when the zinc, which is in the form of sulphate, is, together with some iron, dissolved out. The liquor is decanted, the iron precipitated as oxide, and from the solution the zinc is precipitated with soda-ash. The residue from the leaching vat contains the lead, silver, and gold of the ore, and when mixed with the oxide of iron precipitate is sold for smelting. It contains, however, 4 or 5 per cent. of zinc. It is maintained that the process is easy of manipulation, and inexpensive, 1,000 lbs. of slack being used for a charge of 30 tons of tailings, containing 24 per cent. of zinc. The by-products also can be made use of, the sulphurous acid for vitriol making, and the final liquor for sulphate of soda.—A. W.

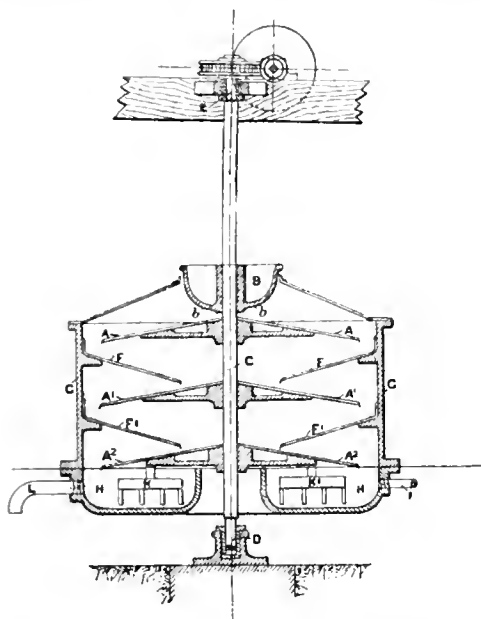
PATENTS.

Improvements in the Treatment of Refractory Gold and Silver Ores, and in Apparatus therefor. H. Hutchinson, London. Eng. Pat. 16,270, November 26, 1887. 8d.

THIS is a form of furnace for roasting or chloridising gold or silver ores. Gases from a gas-producer are made to burn in a vertical chamber through which pass a series of tubes, and the products of combustion are passed into and down another vertical chamber, in which the ore is calcined. This calcining chamber contains a series of shelves or baffle plates, from one to the other of which the ore, which is introduced at the top, falls in its passage downwards. The series of tubes, through which air passes, also open into this chamber, so that the ore in its descent is subjected to the action of heated air as well as to the heat of the burnt gases. The gases from the calcining chamber are passed into and through a large chamber, to allow the fine dust to settle, and then through flues at the top, whereby the upper surface becomes heated, and can be used as a drying plate. The calcined ores can be afterwards treated for gold and silver by any known method. Drawings are given.—A. W.

Improvements in Appliances for Amalgamating Auriferous and Argentiferous Substances. E. J. Ball and B. H. Brough, London. Eng. Pat. 16,862, December 7, 1887. 8d.

THE amalgamator consists of a series of conical plates A A' on a spindle supported at D, under and around each of



which runs a slanting circular plate F F' attached to an outside removable casing G. The pulp is fed in through the distributor B, and is washed alternately over these series of cones and plates into the chamber H, either or both of which series can be made to revolve. K and K' are sweepers, to prevent undue settling and blocking, and I is a water-supply pipe, to assist in the removal of the tailings through L. Electricity may be employed with this apparatus, and conoidal or pyramidal surfaces, with or without corrugations, are also claimed.—A. W.

Improvements in the Treatment of Zinc and its Ores. A. Watt, London. Eng. Pat. 3369, March 5, 1888. 6d.

IN a previous specification (this Journal, 1888, 328) the patentee claims the use of vegetable acids for preparing the electrolytic bath. He finds, however, that when lead is present, it interferes with the proper deposit of the zinc.

He now claims the idea of adding to the bath sulphuric acid, which precipitates the lead as sulphate. Impure zinc, containing lead, can be used as the anode in this case. When lead is present in large quantity, the ore or metal is treated first with acetic acid, which dissolves the lead, and afterwards with dilute sulphuric acid. The lead is precipitated from the acetate solution by scrap zinc, and the solution of acetate of zinc so produced added to the solution of sulphate to make up the bath for electrolysis.—A. W.

Improvements in the Manufacture of Ingot Iron and Steel. T. Wynam, London. Eng. Pat. 5084, April 5, 1888. 6d.

OXIDE of iron in any form, but not too silicious, is mixed with coke dust, and evenly placed on the hot bed of a neutral or basic-lined open-hearth furnace. This is covered with a layer of lime, upon which is charged pig-iron, which may be rich in phosphorus but not in silicon. The pig, which may be run in molten or placed in the furnace cold, should amount to not less than one-third the quantity of iron in the ore or oxide used. The charge is melted, rabeled, and worked down into ingot iron in the usual way.—A. W.

Improvements in Blast Furnaces. W. Evans, Merthyr Tydvil. Eng. Pat. 5665, April 17, 1888. 11d.

AN extra set of tuyeres, similar in construction and arrangement to the ordinary, are placed higher up in the furnace, preferably about 8 or 10 feet below the boshes. Suitable arrangements are made for governing the blast through these tuyeres. By their use it is maintained that a large yield of metal with a moderate pressure of blast is ensured, that the life of the furnace is prolonged, and that "scaffolding" is prevented, and consequently a better and more regular product obtained. Full drawings are attached.—A. W.

Improvements in the Method of and Apparatus for Reducing Ores or Compounds of Zinc, Iron, Phosphorus, Sodium, and other Substances. G. M. Westman, New York, U.S.A. Eng. Pat. 17,336, November 28, 1888. 8d.

BY an elaborate system of pipes and valves, and with the aid of a blast engine, carbonic oxide gas is drawn through a regenerator, where it becomes highly heated, into a reducing furnace, wherein are the ores to be reduced, through condensers and coolers, back again into the regenerators. Zinc or iron ores are reduced by this plant, the former being mixed with coal. The zinc is volatilised and condensed. In the case of iron, the ore is introduced alone into the furnace, and becomes reduced to a sponge. Phosphorus and sodium can also be manufactured by using mixtures of phosphate, silica and coal, and carbonate of sodium and coal, respectively. Six drawings are given, showing the general construction and arrangement of the furnaces, &c., and some of the valves used.—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Electrolysis of Cryolite. W. Hampe. Chem. Zeit. 13, 29 and 49—50.

THE author has made the following further experiments:—

When cryolite and sodium chloride are melted together at a temperature of 700°—1,000° no aluminium chloride is evolved, nor even formed in the flux, the only substances passing out of the retort neck being a small quantity of volatilised cryolite and a gas which etches glass, besides sodium chloride. The reduction experiments were carried out preferably in crucibles of retort graphite or powdered coke, to which latter a small quantity of tar was added. The current obtained from a zinc-iron battery varied from 0.5 to 50 amperes.

If pure cryolite be electrolysed at a temperature approaching to or exceeding $1,054^{\circ}$, the melting point of copper, the liberated sodium is evolved in the form of vapour. Fluorine is evolved from the anode, while bubbles of sodium form and rise from the cathode. The latter are, however, absorbed for the most part by the cryolite, a lower fluoride of aluminium being formed. This circulates through the liquid mass and becomes gradually changed again to the original fluoride by the fluorine evolved at the anode. In consequence of this reverse action taking place the amount of aluminium obtained is extremely small. In one experiment, lasting for 20 minutes, with a current strength of 2.7 amperes, 0.0875 gram of aluminium instead of 0.505 was obtained from a copper regulus of 8.829 grams.

If, on the other hand, the electrolysis of pure cryolite be conducted at a temperature but little above its melting point, sodium is deposited at the negative pole as a liquid which reduces the aluminium in the form of globules, which, owing to the lesser surface exposed to the melted cryolite, do not form the lower fluoride so rapidly, and the aluminium forms, too, a bronze with the copper, which further retards the formation of the lower fluoride. This solvent action is however by no means altogether overcome, and the amount of aluminium obtained varied up to one-fourth or one-third the theoretical quantity. The addition of common salt to the cryolite lowers the melting point of the latter, and thus enables the reduction to be carried out at a lower temperature, and a somewhat larger production of aluminium is attained. Experiments showed that another source of loss of aluminium arises towards the end of the electrolysis, when the sodium does not readily come in contact with aluminium fluoride, and an alloy of sodium aluminium is formed and rises to the surface, there burning to the respective oxides.—J. W. L.

Electric Welding. Engineering, 1888, 571.

THE process of electric welding invented by Professor Elihu Thomson has been subjected to a number of tests at the United States Arsenal, Watertown, Mass. The test pieces included wrought iron, octagonal steel, steel and wrought iron, copper, brass, brass and wrought iron, and copper and German silver. The bars varied in diameter from .25 in. to 1.74 in. The general results of the tests shows that an electric weld, like a hand-made one, may be good or bad. The proper conditions for constant success do not appear yet to be understood, but the experiments, so far as they have been made, justify the expectation that the new method will become of great practical value. The apparatus used is of two forms. Either the current is supplied to the bars by the aid of an alternate current transformed, or directly from an alternate current dynamo. The bars to be welded are held by clamps, so that the ends to be welded are in contact. When the bars are in connexion with the source of current, the metal softens at the joint, and the clamps holding the bars are fed forward so as to force the two surfaces together. The process is complete in a time varying from a fraction of a second to two minutes. With the large bars, the current employed amounts to thousands of amperes.—W. W. H. G.

Electric Welding. Eng. and Min. Jour. 1889, 136.

A NUMBER of illustrations are given contrasting the welds made by hand and by the Elihu Thomson electrical method. They show that the line of junction for electrically welded iron bars is stronger for an equal sectional area than the original bar, apparently owing to the elimination by the process of fusion of the cinder present in all wrought-iron bars. If the welded bar be filed down to the centre line to obtain a section of the joint, the microscope will show that the iron at the weld is denser and more homogeneous in structure than the other parts of the bar. With an ordinary hand-made weld, the actual separation of the surfaces supposed to be welded may be seen without the aid of a microscope.—W. W. H. G.

Apparatus for obtaining Aluminium. Centr. für Electro-techn. 1888, 10, 844.

THE apparatus as used by the Schweizer metallurgischen Gesellschaft in Neuhausen is thus described. Two dynamos giving together 12,000 amperes at 20 volts produce the necessary current, the magnets of which are excited by means of a small dynamo. Each armature possesses two collectors of considerable length, on which six sets of six brushes each are caused to rub. The convolutions of the armatures are presented to the collectors alternately, so that two separate armature convolutions are, as it were, on one centre. The brushes of similar polarity on each collector are connected with the centre of the collector by means of strong cables. The dynamos make 180 revolutions per minute, the motion being transmitted by means of a turbine, itself worked by the flow of the Rhine. The reduction is carried out in a cube-shaped carbon crucible, which is bound round by a metal casing, and which is connected with the negative pole of the dynamo. The positive pole consists of a bundle of carbon plates, which are let into the crucible. Aluminium bronze and ferro-aluminium are the products of the Héroult process.—J. W. L.

The Disintegration of Anodes by Electrolysis. E. Wohlwill. Dingl. Polyt. J. 271, 222—223.

THE author discusses the so-called disintegration of copper regulus anodes, and explains the action in the following manner:—It is known that cupric sulphate takes up metallic copper from the anode of a copper-refining bath with the formation of cuprous sulphate, this being afterwards decomposed into cupric sulphate and metallic copper again. So also in the case of the regulus the compound richer in copper is produced at and around the anode, and becomes decomposed again directly it gets outside the sphere of formation. It is to the copper derived from this decomposition that the phenomena observed are due, and not to any real disintegration of the regulus itself. It is found that the action diminishes with the density of the current employed.

—A. W.

PATENTS.

Improvements in the Method of and Means for Separating Matters in Solution by Osmose, Dialysis, or Diffusion, or by Electrolysis, or by a Combination of those Processes. J. Marx, Ulm, Germany. Eng. Pat. 2367, February 16, 1888. 8d.

IN the processes of separating matters in solution by dialysis, diffusion, or electrolysis, or by a combination thereof, as hitherto conducted the soluble bodies sooner or later cause a stoppage of the process. The author removes "the prime cause of this evil" by precipitating the soluble bodies after the reaction has commenced but before it could be stopped again by the increasing accumulation in the solution of the soluble bodies; and the effect of the new process is greatest if the precipitation be effected by the measure of "the diffusion or production of these soluble bodies." The present invention relates to the use of a process for the precipitation of dialysed bodies, and to means and methods, by osmose and electrolysis, for treating compounds yielding soluble products under electrolytic action, and by a combination thereof. The process is preferable in which osmose is combined with electrolysis, when the electrolytic products may be led off continuously; or the osmose may be worked along with electrolysis assisted by the precipitation method. A special diagram is described, made by arranging together rods, sticks, pipes, &c., in any suitable manner.—B. T.

Improvements in Electrical Batteries and Methods of Closing the same. F. L. Rawson and W. White, London. Eng. Pat. 4593, March 26, 1888. 8d.

A STOPPER of hard wood is fixed in the outer case of the cells and acts as a stuffing-box, having a receptacle at the top to contain material such as glass or slag wool, through which the gas generated can pass easily, but through which the liquid can only pass slowly.—B. T.

Improvements in Fusible "Cut-Outs" for Electrical Circuits. A. H. Walton, Barnsbury. Eng. Pat. 5233, April 9, 1888. 8d.

Each lamp wire in a building is brought to one central position where it is attached through a fuse to a contact bar connected with the mains. Contact is made with the fuse by a spring.—B. T.

An Improvement in Plates for Voltaic Batteries. E. Hermite, E. J. Paterson, and C. F. Cooper, Dalston. Eng. Pat. 5528, April 13, 1888. 4d.

WIRE of a costly material, such as platinum, is used for battery plates, the inventors draw the material out into fine wires, and then weave these wires into a gauze, thus obtaining a large surface, able to withstand rough usage, with a comparatively small expenditure of the metal.—B. T.

The Production of Chalybeate Waters by Electrolytic Action, and Apparatus therefor. W. Webster, London. Eng. Pat. 5723, April 17, 1888. 6d.

SALTS of iron are formed in potable water containing chlorides, sulphates, &c., by immersing in the water a plate of iron and passing an electric current through it, using this iron as the positive electrode. A second plate of iron separated from the first by a porous partition may be used as the negative electrode.—B. T.

Improvements in and relating to the Preparation of Non-Metallic Porous Surfaces for Electro-Metallurgical Deposits. H. Steinach, Munich, Germany. Eng. Pat. 5790, April 18, 1888. 6d.

THE surfaces are immersed in melted tar which has been purified by means of sulphuric acid and soda lye and to which 10 per cent. of paraffin has been added. To remove any superfluous tar, the objects are exposed to a blast of hot air or dry steam.—B. T.

Improvements in the Manufacture of Depolarisers for Electric Batteries. M. Leclanché, Paris, France. Eng. Pat. 8354, June 7, 1888. 6d.

A SOLUBLE pulverulent material, such as potassium carbonate or copper sulphate, is added to the depolarising mixture before it is moulded, and is afterwards dissolved out, leaving the agglomerate body very porous.—B. T.

Improved Machines for Making Battery Plates. O. E. Madden, Boston, and A. F. Madden, Newark, U.S.A. Eng. Pat. 15,252, October 23, 1888. 8d.

THIS apparatus consists of a die and plunger for stamping out battery plates of the desired form, and includes an arrangement for shaving off and removing the surplus metal. The plunger has a serrated face to prevent spreading of the metal.—B. T.

Improvements in Secondary Batteries. P. A. Fichet and A. Nodon, Paris, France. Eng. Pat. 15,369, October 25, 1888. 8d.

IN the construction of their reversible batteries, the authors, to obtain simple reactions indefinitely reversible, give preference to primary combination taking place by two elements only, e.g., combination of a metal and a halogen, chlorine, bromine, or iodine, with formation of a metallic chloride, bromide, or iodide. The halogen is employed in a state of chemical combination from which it may be easily taken as required to be furnished to the metal. Several combinations of halogens with alkaline or alkaline-earth metals may be employed, and to increase the stability of these in the presence of water, they are dissolved in a solution of a salt which has combined with water with great evolution of heat. The single element is composed of a recipient and two electrodes separated by a porous diaphragm. If in series, one side of a carbon plate may be used as the positive electrode, and the other side as the negative electrode. The carbon plates are impregnated with paraffin which has been subjected to the action of chlorine.—B. T.

Improvements in or relating to Secondary or Storage Batteries. W. P. Thompson, Liverpool. From C. H. Thompson, Detroit, U.S.A. Eng. Pat. 16,048, November 6, 1888. 8d.

MOLTEN lead is poured into a mould of suitable size filled with a soluble, coarse, granular salt, able to stand a high temperature, and the whole mould is heated to ensure that the lead shall fill all interstices. When cool, the lead is cut into plates of the desired thickness and the salt dissolved out, leaving a very porous lead plate, the pores of which may be filled with the salts of lead proper to a secondary battery.—B. T.

Improvements relating to the Generation of Electricity and the Simultaneous Production of Zinc Chloride and other By-Products. L. Paget, New York, U.S.A. Eng. Pat. 17,225, November 27, 1888. 8d.

CHLORINE gas is generated by the action of sulphuric acid on bleaching powder and is then passed into a galvanic cell, where it acts as the excitant. The by-products obtained by this process are valuable commercially.—B. T.

Improvements in Electro-Depositing Cells. P. M. Justice, London. From E. L. Smith, Ansonia, U.S.A. Eng. Pat. 17,340, November 28, 1888. 8d.

THE copper to be deposited is cast in plates of the proper size and form, these plates being suspended in layers horizontally in the solution. The bottom layer rests at the ends on two strips of wood, the upper layers being held the right distance apart likewise by strips of wood. Cotton cloth is stretched from strip to strip between each layer to separate and save the insoluble foreign substances obtained, pure copper only being deposited on the upper surface of the plates. The top layer is used as the anode and the bottom as the cathode, the spaces between the layers forming separate cells in series. Thus copper is deposited from the under surface of the top layer upon the top surface of the second layer, and so on through the series, until the original copper of each plate has been deposited upon the plate below.—B. T.

Improvements in Apparatus for Indicating the Completion of the Charging of Secondary Galvanic Batteries. S. C. C. Currie, Philadelphia, U.S.A. Eng. Pat. 17,645, December 4, 1888. 8d.

THE spray rising from accumulators in which the liquid is in a state of ebullition, is deposited on plates arranged over the cells, where it collects in drops, and in this state bridges over two pieces of metal arranged close together, thus completing an electric circuit and ringing a bell to attract attention.—B. T.

Improved Apparatus and Connections for Charging and Discharging Storage Batteries. W. P. Kookogey, Brooklyn, U.S.A. Eng. Pat. 319, January 8, 1889. 8d.

BY means of an automatic commutating device, when lamps are being lighted from the storage battery, the cells are all connected in series and disconnected from the charging system, but, when no lights are on, the storage cells are connected in parallel and are in circuit with the charging system, but disconnected from the lamp circuit.—B. T.

Dry Galvanic Cells. C. H. Mehner, Berlin, Germany. Eng. Pat. 434, January 9, 1889. 4d.

INSTEAD of sponge, saw-dust, &c., being used as the vehicles for absorbing the liquid excitant, a "mineral gelatin" consisting of crystallised hydrated basic chloride of magnesium is employed, which is itself an exciting agent.—B. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Refuse from Olive-Oil Factories. Sestini and O. Tobler. Chem. Centr. 1888, 634.

In Italy, the water used in pressing the crushed olives passes through a series of tanks, and the deposit which collects in the last tanks of the series is used as a manure, and is known as "morchione."

Two samples of "morchione" from a good mill were found by Sestini to have the following composition per cent. :—

From	Undried Mud.	Air Dried.						
	Water.	Water.	Ash.	Organic Matter.	Fat.	N.	P ₂ O ₅ .	K ₂ O.
Last tank but one :.....	68.20	20.10	20.33	59.57	0.59	2.01	0.17	0.10
Last tank :.....	71.26	27.82	7.52	64.65	1.51	2.18	0.17	0.12

whilst a sample from another mill with fewer tanks contained H₂O, 7.87; oil, 11.28; organic matter, 76.21; ash, 4.64; and N, 1.63 per cent. respectively.

Tobler points out that these residues are not economically employed as manure or fuel, since, owing to the large percentage of fat and albuminoids they contain, they form a good food for cattle. Taking the nutritious value of hay at 6.5 frs. per 100 kilos., these residues have a value of 11.95 frs., and they cost on the spot only 7 frs. per tonne (20 ctrs.).—D. A. L.

PATENTS.

Improvements in obtaining Fatty Acids and Glycerin from Fats and Oils. J. Lewkowitsch, Leeds. Eng. Pat. 5985, April 21, 1888. 6d.

The fats and oils are decomposed by superheated steam in the usual manner, but the whole process is conducted in a partial vacuum ("a minus pressure of 10 to 13 lb.") at about 460° F., instead of 600° as usual. The supply of steam may be less, and the temperature may vary within much wider limits than in the ordinary process as conducted at atmospheric pressure.—W. L. C.

An Improved Soap. T. S. Saunders, London. Eng. Pat. 5981, April 21, 1888. 4d.

Small quantities of unsaponified fat are incorporated with finished soap to neutralise the free alkali and the alkali set free when the soap is dissolved in water in its ordinary use.—W. L. C.

Method of Extracting or Winning Wool-Oil ("Lanolin") in a Mechanical Way. A. J. Boulton, London. From O. Korschelt, Zittau, Germany. Eng. Pat. 6669, May 4, 1888. 6d.

The dirt is separated from the previously warmed washwaters by a centrifugal machine with several concentric drums, and the waters are then conducted into a series of separators. The greasy emulsion here obtained is put into settling reservoirs, where the wool-oil rises to the surface.—W. L. C.

Method of Extracting or Winning Wool-Oil ("Lanolin") in a Mechanical Way. A. J. Boulton, London. From O. Korschelt, Zittau, Germany. Eng. Pat. 6671, May 4, 1888. 4d.

The wool emulsion, previously freed from dirt, is subjected to continuous agitation in a mechanical agitator. The lanolin separates on the surface in small particles, which rapidly agglomerate.—W. L. C.

An Improvement in the Manufacture of Soaps. J. Taylor, Leith. Eng. Pat. 7830, May 29, 1888. 4d.

MELTED paraffin, or petroleum seal or wax, is incorporated with the soap as it is removed from the soap-pan.—W. L. C.

Improvements in or relating to the Treatment of Oil-Bearing Substances during the Expression of the Oil, and in Presses applicable for Receiving and Discharging such Substances without intermission. W. P. Thompson, Liverpool. From M. Crawford, Brooklyn, U.S.A. Eng. Pat. 14,526, October 9, 1888. 8d.

This press is continuous in its action, and the material under treatment is heated while in the press. It consists essentially of two steam-jacketed cylinders, mounted eccentrically, so that when they are revolved the material between them is subjected to a gradually increasing, and finally enormous, pressure. End plates prevent the escape of solids, while the expressed oil runs away through porous material. No claim is made for any single individual piece of mechanism, but for the combination forming the machine. Drawings are given.—W. L. C.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Egyptian Blue. F. Fouqué. Compt. Rend. 108, 325—327.

This is a blue colouring matter which was used by the Romans in the first few centuries of the Christian era, but ceased to be manufactured about the time of the invasion of the barbarians. It figures in several beautiful frescoes in the Vatican, and has also been found at Pompeii. The author has discovered the composition to be that of a double silicate of calcium and copper, CaO, CuO, 4 SiO₂, devoid even of traces of alkali. The substance is crystal-

line, and is hardly attacked by any chemical reagents, which explains the perfect state of its preservation in the paintings for which it was employed 1,900 years ago. It may be prepared at a bright red heat, but this temperature must not be exceeded, as it is then decomposed into cuprous oxide, wollastonite, and a clear light-green glass. The higher the temperature the more of the latter is formed, and finally wollastonite disappears entirely. By the old method of preparation, described by Vitruvius, fine sand and soda are intimately mixed with copper filings, then moistened with water, formed into cakes, and the latter dried. The cakes are then fused in an earthen pot until the blue colour is produced. The author finds this method practicable, but uses potassium sulphate in preference to soda as a flux. He has not found it possible to replace chalk or lime by magnesia. The ancient Romans employed a large excess of silica, whilst the author employs more basic mixtures, finally purifying the product with hydrochloric acid. The exquisite colour of this mineral body, the fact that it is absolutely unaffected by moisture, light, and most chemical reagents, as well as the facility and the low price of production, render it desirable that its manufacture should be again resumed.—A. R.

On the Optical Properties of Genuine and Spurious Amber. G. Weiss and Erekmann. *Compt. Rend.* 108, 376–377.

IMITATION amber is now largely manufactured from shavings of natural amber, presumably by strong pressure. Real amber shews double refraction since light is transmitted through two Nicols placed in opposite positions by interposing a segment of amber. This light varies on turning the amber, and there is total extinction for two positions of 90°. Imitation amber is also doubly refracting, but instead of the shade of the transmitted light being uniform the same phenomena are observed as with a segment of rocks containing crystals lying in different directions. For all practical purposes it is only necessary to examine the piece of amber in polarised light by means of an analyser and magnifying glass to see at once whether the article be genuine or spurious.—A. R.

PATENTS.

Improvements in the Manufacture of Enamel and other Paints or Varnishes. F. Fisher, Belfast. *Eng. Pat.* 5878, April 20, 1888. 6d.

THE patentee heats the "spirit, shellac, and varnish, or other solvent," until 25–35 per cent. of it has evaporated, "and all the volatile oil has been driven out of the crude spirit, and a perfect mixture of the solvent completed," and adds, after cooling, the necessary pigments or resinous substances, then continues the cooling to as near 32° F. as possible, transfers the mixture to cans capable of being closed air-tight, introduces a few drops of some perfume, seals the vessels and shakes to effect perfect admixture.

—B. B.

Compositions for the Coating and Preservation of Iron, Steel, or Metal Structures from Corrosion, and Apparatus for the Application of the same. E. F. Wailes and E. J. Dove, Newcastle-upon-Tyne. *Eng. Pat.* 6012, April 23, 1888. 8d.

A SOLUTION is made of 1 cwt. of natural or manufactured asphalt, together with 28 lb. of "grease or oil," in 20 gallons of "spirits of naphtha." The metal structures to be treated are coated with this, used slightly warm, and when dry, one or more coats of a composition consisting of 1 cwt. of natural or manufactured asphalt, 50 lb. of pitch, 25 lb. of chalk, 35 lb. of Portland cement, 1 gallon of oil, and 7 lb. of resin, are put on hot. To conveniently effect this, the mixture, after being melted in one main cauldron near the place where it is to be used, is distributed to the work in steel cans provided with an outer casing and heated by spirit or oil lamps, or by coke or charcoal. Drawings of the paint-can are given.—B. B.

An Improved Composition or Varnish for the better Protection of Iron Plates, Tanks, Ships, and the like from the Action of Petroleum and similar Substances. A. Andrews, New Southgate, Eng. *Pat.* 12,827, September 5, 1888. 6d.

Six lb. of shellac are dissolved in 16 lb. of methylated spirit, 1 lb. of boiled oil added, and 2 lb. of oxide of iron stirred in; the proportions may be varied and gum mastic and graphite used in addition. The novelty claimed is the use of the boiled oil to give elasticity to the product.—B. B.

Improvements in the Manufacture and Application of Waterproof Fabrics. D. Nicoll, London. *Eng. Pat.* 13,971, September 28, 1888. 6d.

THE patentee mixes anthracene or some similar hydrocarbon with two of the ingredients mentioned in *Eng. Pat.* 2480 of 1867, viz., "cotton foots' pitch" and "epurée" (purified pitch) of Trinidad in the proportion of 15 parts of the first to 200 of the second and 85 of the third, producing a composition that can be used for waterproofing any suitable woven fabric, which can be then manufactured into tubes, troughs, pontoons, tarpaulin, &c.—B. B.

New or Improved covering Composition applicable for Protecting Ships' Bottoms and the like. F. J. Binns, Ripon, and R. J. Paris, Liverpool. *Eng. Pat.* 17,946, December 8, 1888. 6d.

SIXTY to 80 per cent. of zinc in powder is mixed with 20 to 40 per cent. of carbon in the form of graphite or gas carbon, and made into a paint with any suitable vehicle such as oil, tar, or varnish. An appropriate pigment may be added if desired. The composition when applied to ships' bottoms is said to prevent the formation of marine growths thereon, a result attributed to electric currents set up by the action of the salt water on it.—B. B.

Improvements in the Manufacture or Production of Lead Pigments. J. Y. Johnson, London. From A. G. Fell, New York, U.S.A. *Eng. Pat.* 722, January 15, 1889. 6d.

THE pigment patented is a basic lead sulphite, which may be produced by the action of sulphur dioxide on any suitable salt of lead, such as the basic acetate. In general the process is carried out as follows:—"The lead in a granulated or spongy condition is placed in a series of suitable vessels (e.g., wooden tanks), and the first of these filled with dilute acetic acid containing about 2.5 per cent. of the anhydrous acid; digestion is allowed to proceed for about 30 minutes, when the liquid is drawn off into the second vessel, where it remains for the same length of time, and so on to the end of the series (three vessels are generally found sufficient). The lead, after the acid liquor is drawn off, oxidises by contact with the air and yields more acetate on passing the liquor over it again; the final product has a density of 15°–20° B., and consists of a solution of basic lead acetate. Through this solution, contained in deep tanks, sulphur dioxide is forced, precipitating lead sulphite, which is filtered off and steamed either when in the press or afterwards; the steaming probably removes a portion of the combined sulphur dioxide and leaves a basic lead sulphite, which is dried and ground in oil ready for use. In the case of a lead salt less soluble than the basic acetate being selected, it is treated in the form of a paste in shallow troughs with the sulphur dioxide.

The advantages claimed for the pigment are its great "body," comparative resistance to the action of sulphuretted hydrogen, and the certainty of the manufacture as compared with that of white lead. Further, the acetic acid can be used repeatedly, being recovered in the form of the filtrate from the lead sulphite.—B. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENTS.

Improvements in and relating to the Tanning of Hides and Skins. G. W. Rhodes, North Finchley. Eng. Pat. 1818, February 7, 1888. 8d.

A TANK is used divided into compartments or channels communicating at their ends in such a way that a continuous current of tan liquor can be sent through by means of a suitable motor. The hides are hung in rows in this pit and electrodes are placed in between them in such a way that the anodes and cathodes follow each other alternately. The cathodes are of copper and the anodes of platinum gauze or carbon, and are placed in porous diaphragms. The electric current should be used intermittently. Any tanning liquor may be used, and the tanning is much helped by warming to 96° F. A drawing is given, and for further particulars the specification must be consulted.—B. II.

Improvements in the Treatment of Bones and Animal Waste or Refuse generally for the Purpose of rendering the same more suited for Fertilising Purposes, and for obtaining Gelatin, Glue, and Size. A. H. Hobson, London. Eng. Pat. 4765, March 28, 1888. 6d.

THIS invention is for rendering bones and other animal refuse more suited for use as a manure, and also for obtaining glue or size therefrom. For the production of manure only the bones in the form of powder are heated with about 10 per cent. of their weight of caustic potash, or equivalent of other alkali, and an equal weight of water to 180°–210° F. for 9–10 hours. The mixture may be used either as liquid manure or evaporated to dryness before using. When size and manure are both wanted the bones are heated with about 3 per cent. of caustic potash for 5–15 hours at 180°–200° F. The solution is separated from the sediment, and evaporated at about 160°–180° F. to a suitable consistency for use as size, &c. More potash may then be added to the sediment and the heating continued till all the nitrogenous matter is dissolved.—B. II.

Improvements in Tanning. H. Levick, Grantham. Eng. Pat. 6491, May 1, 1888. 8d.

THIS invention is for lifting apparatus for raising the hides from the tan-pits and dispensing with the use of hooks, which often cause injury to the grain of the leather. For this purpose ropes are employed which pass beneath the bottom hide in the pit. One end of each rope is fixed near the top of the pit on one side, and the other end is brought up out of the pit on the other side. By tightening the ropes all the hides are raised and can be removed one by one by the workmen. A winch is employed to shorten the ropes when desirable. Drawings are given.—B. II.

An Improvement in the Treatment of Hides for Belting and such like Purposes. C. L. Royer, Halifax. Eng. Pat. 7007, May 10, 1888. 4d.

IN preparing hides for belting, &c. it is usual after unhairing to partially tan the hides, dry them, soak them in water, and after seasoning to grease and full them. The improvement consists in drying the hides after unhairing, "but without any tanning," steeping them in water, and then fulling them with non-oleaginous substances such as keratine, flour, glycerin, ox-gall, and soap. After fulling, the hides are soaked in water for several days, and the substance used for fulling removed. The hides are then tanned, greased, and dried, and after the excess of grease is removed the hides are ready for being cut into belting.—B. II.

A New or Improved Process for the Preservation of Extracts and Liquids Containing Tannin, and Used for Tanning Purposes, by Means of Creosol, Naphthol, Creosotic Acids, Naphthoic Acids, and their Soluble Salts, as well as a Process for Preserving Kips, Skins, or Hides by Means of Creosol, Naphthol, and their Carbon containing Acids in suitable Solution or Mixed with suitable Solvents. J. Hauff, Feuerbach, Germany. Eng. Pat. 18,307, December 14, 1888. 6d.

AFTER stating the inefficiency of phenol and salicylic acid and the objection to salts of mercury on account of their poisonous properties, the patentee states that by adding one part of creosotic acid to 2,000 parts of the liquid to be preserved, and one part of either α - or β -hydroxy-naphthoic acid to 5,000 of the liquid, complete preservation is effected. To preserve tan liquor the proper amount of the acid or of its soluble salt should be added to it with constant stirring. 100 kilos. of an extract containing 25 per cent. of tannin is dissolved to a lye of 5 per cent., and to it is added 100 grms. of the sodium salt of hydroxy-naphthoic acid. Kips or skins may be preserved by having the substance rubbed over them, or they may be treated with a solution of the substance in alcohol or glycerin.—B. II.

XV.—AGRICULTURE, MANURES, Etc.

Manurial Efficacy of Various Phosphates. J. Raulin. Comp. Rend. 108, 64–66.

EXPERIMENTS with maize in 1887, and with wheat in 1888, show that coprolites and phosphates, if finely ground, will give results comparable with those given by superphosphate and precipitated phosphate, provided that in the first year they are applied in five or six times the usual quantity. The author gave coprolites equal to 200 kilos. of P_2O_5 per hectare in the first year, and in the second year to 40 kilos. of P_2O_5 . The Crenzot slag or basic slag gave bad results, but they are attributed to the fact that the mixture employed contained ammonium salts, the ammonia being rapidly expelled by the alkaline slag.—J. M. H. M.

Early and late Varieties of Sugar Beet. C. Violette and F. Desprez. Compt. Rend. 108, 66–69.

THE rich varieties of sugar beet cultivated of recent years in France are late in habit. The authors' experiments show that by judicious selection, seed roots combining earliness and richness in sugar may be obtained. Of the 10 varieties of seed experimented with, four are classed as early and rich, four as late and rich, and two as early and poor. Those in the first category produced ripe roots in the last fortnight of September, at Cappelle (Nord).—J. M. H. M.

Absence of Nitrates in Forest Trees. E. Ebermayer. Ber. d. deutsch. botanisch Gesell. 1888, 127.

THE author attributes the absence of nitrates in forest trees to the lack of these substances in the soil. Numerous analyses of forest soils, peat moors, of waters from moors, and of springs and brooks emanating from wooded mountains, demonstrate the total absence or the presence of only extremely small quantities of nitrates. From this it is concluded that there are not nitrifying organisms in forest and peaty soils, and that conditions are unfavourable in soils containing only vegetable humus. The decomposition of the nitrogenous plant constituents seems in such cases to end with the formation of ammonia, from which it is inferred that forest trees are only capable of taking up their nitrogenous nutrition in the form of ammonium salts or amides.—D. A. L.

Indian Wheat. T. Dietrich. Landw. Versuchsstat. 35, 309—318.

THREE hard varieties, 1—3, four soft, 4—7, and some other samples, were examined with the following results. The

hard wheats yielded a good gluten, the gluten from the soft varieties was not so good. The albuminoids are higher in the hard than in the soft varieties, but nevertheless the percentage in the latter is nearly equal to the percentages obtained in similar wheats cultivated in Germany.

No.	Variety of Wheat.	Original Wheat.				In 100 of Dry Matter.						
		Weight of 100 Grains in Grains.	Water per Cent.	Albuminoid-N x 6.25.	Crude Fat.	N free Extract.	Crude Fibre.	Ash.	Soluble Nitrogen Combined.	Sugar.	Dextrose.	Starch.
1.	Yellow piecy.....	1.35	13.00	11.93	2.11	78.90	2.87	1.66	3.66	8.77	12.19	57.94
2.	Laskari.....	1.20	12.60	13.00	2.33	80.40	2.65	1.50	3.00	5.35	10.92	64.13
3.	Hard red.....	3.80	12.37	13.54	2.39	80.11	2.12	1.51	3.21	7.05	10.21	62.88
4.	Club 1.....	1.50	12.11	11.09	2.34	85.28	1.74	1.55	2.27	6.80	10.36	66.12
5.	Soft white Kurachee.....	3.20	12.00	10.92	2.54	82.17	2.20	1.87	2.06	1.77	7.33	70.37
6.	Soft red Kurachee.....	3.30	12.62	10.79	2.68	82.21	2.11	1.88	6.00	6.82	11.26	64.13
7.	Soft red Bombay.....	3.65	13.27	12.38	2.07	81.88	2.02	1.65	1.75	5.20	3.97	72.71
8.	Russian original.....	2.20	13.25	17.43	2.60	75.04	2.71	2.13	3.31	..	..	..
9.	Russian after cultivation.	3.40	11.19	13.16	2.70	79.33	2.76	2.05	2.35	..	..	..
10.	Flour:—Indian White ...	..	13.50	10.84	1.15	86.84	0.35	0.52	..	8.61	6.09	72.14

—D. A. L.

Percentage of Starch and Nitrogen in Bohemian and Moravian Barley of the Years 1884, 1885, 1886. J. Hanemann. Zeits. f. d. gesammte Brennwesen, 1887, 203—204.

The following are some of the results of numerous analyses. The numbers are on 100 parts of dry matter:—

Kind of Barley.	Starch.			Albuminoids (N x 6.25).		
	Max.	Min.	Mean.	Max.	Min.	Mean.
Basthorn.....	68.25	66.20	67.11	9.62	8.50	8.87
Imperial.....	69.19	66.66	68.01	12.04	9.50	11.24
Hanna.....	68.02	65.07	66.70	10.37	9.00	9.57
Pfauen.....	69.25	65.80	67.50	12.56	8.06	9.84
Probstei.....	66.43	65.27	65.85	10.21	9.75	9.97
Hallet's Pedigree....	..	..	65.82	..	..	10.06
Austral.....	..	..	67.55	..	..	10.56
Annot.....	66.93	65.52	66.34	14.18	9.25	10.75
Prima donna.....	..	..	67.00	..	..	10.96
Moravian.....	..	..	68.02	..	..	11.37
Swedish Highland...	70.13	67.34	68.73	12.95	10.10	11.52
Gold.....	68.10	64.17	66.63	13.17	10.50	11.50
Chevalier.....	73.96	63.90	67.38	14.35	8.00	11.66
Alsation Chevalier...	..	..	70.25	..	..	12.31
Oregon.....	67.90	66.30	67.09	15.27	9.06	12.18
Jerusalem.....	..	..	65.00	..	..	12.64
Golden Melon.....	61.85	61.66	61.75	14.70	12.06	13.38
Scotch Highland.....	68.02	66.08	67.30	17.50	11.96	15.84
Bohemian.....	..	..	68.02	..	..	11.25

Where single results only are given in the original paper, they are in the "mean" column in the above table.

—D. A. L.

Detection of Nitrates in Soils. Kreusler. Landw. Jahrbuch, 1888.

See under XXIII., page 306.

Humus Substances of Arable and Peaty Soils. C. G. Eggertz. Bied. Cent. 18, 75—80.

The study of previous work on this subject has led the author to infer that humic and ulmic acids as obtainable from carbohydrates, &c., by the action of acids, do not exist ready formed in peat or similar decomposing matter, but that they are products of laboratory reactions. He also considers as doubtful the existence of the indifferent and insoluble substances ulmin and humin. Crenic and apocrenic acids are, however, regarded by him as existing as distinct compounds, although their composition is not definitely decided.

From the author's experiments it is shown that the products of the decomposition of vegetable matter consist of insoluble indifferent bodies, and soluble acids, the latter being of greatest interest, have been carefully investigated by the author.

The substances obtained from the decomposing matter direct, or from soil previously extracted with dilute hydrochloric acid, by extracting them with ammonia or potash, and subsequently precipitating with acid, are called by the author "mullkörper," to distinguish them from the "humuskörper" obtained from carbohydrates, &c. by the action of acids.

The mull and humus substances have many reactions in common:—They are alike soluble in water, alkalis, in ammonium carbonate, oxalate and phosphate, and in sodium and potassium carbonates, but are insoluble in acids, in ammonium chloride, sulphate and nitrate, and in potassium sulphate and phosphate. Their alkaline solutions are precipitated by most acids, but not by carbonic or boric. The calcium compounds are insoluble in water and alkalis, but dissolve to some extent in ammonium chloride, better in nitrate, and better still in sulphate; they also dissolve in ammonium sulphate without precipitation of calcium phosphate; they are, however, decomposed by ammonium oxalate and carbonate, also by sodium and potassium sulphate, with the formation of soluble alkali compounds. One great difference has been observed by the author: the ammoniacal solution of mull substances leaves, on evaporation over the water-bath, a residue perfectly soluble in cold

water: humus substances under similar circumstances leave a residue almost perfectly insoluble in that medium.

The author concludes from his experiments that the mull substances contain besides carbon, hydrogen, nitrogen, and oxygen, other elements, such as sulphur, iron, phosphorus, combined in the organic atomic complex. The composition of 13 of the samples analysed varied as follows:—

C, 40.86–56.18; H, 4.33–6.63; O, 25.09–37.98;

N, 2.59–6.43; SiO_2 , 0.37–10.47; P, 0.15–7.58;

S, 0.55–2.09; Al_2O_3 , Fe_2O_3 , 0.38–3.90.

Both mull and humus substances contain ash constituents which can scarcely be regarded as mere inorganic impurities, inasmuch as such impurities, when added, can be removed with comparative facility by washing. Besides the nitrogen present as ammonium mull salts, mull substances contain nitrogen which is not removed by repeated solution in alkali and precipitation with acid, although the mull substance by such treatment itself undergoes partial decomposition each time, which extends not only to the inorganic, but also to the organic matter, some of the latter becoming more soluble in acids. Experiments were made with eight samples of mull substances containing at the outset from 5.8 to 10.7 per cent. of nitrogen, and at the termination from 2.12 to 5.30 per cent. was retained in combination. Humus substances from starch or pure cellulose form soluble ammonium salts with ammonia, which are decomposed in the usual way by hydrochloric acid, but if they be exposed to a temperature of 110°C ., or if dry humic acid be treated with gaseous ammonia, then some of the nitrogen becomes combined with the organic matter. The same thing occurs when mull substance is treated with ammonia. Sulphur, iron, and phosphorus, are also shown to be integral constituents of the organic atomic complex of mull substances. The first two can only be detected after decomposing the mull substance, whilst the presence of the latter element cannot be attributed to adhering phosphoric acid, inasmuch as neither mull nor humus substances absorb that acid.

Silica is probably present as ammonium silicate, and any alkalis or alkaline earths present may be regarded as impurities.

On dialysing a sample of mull substance, organic as well as inorganic matter diffused, the former, after diffusing, being of different composition to that of the mull substance itself. With reference to the analyses, the author points out that dilute acids extract larger quantities of some constituents from the soil than strong acids do from the ignited soil; this is the case with silica and may happen with small quantities of potash, lime and magnesia. Partial ignition so as just to char the organic matter is objectionable, as constituents of the soil become soluble which were not previously directly assimilable by plants. The author finds even with phosphoric acid the amount soluble in dilute acid is increased by partial ignition. Roots can only assimilate directly those proportions of the plant foods in the soil which are extracted by cold dilute about 4 per cent. hydrochloric acid, and in most cases these quantities are too great and require to be divided by 2 or 3 if the true amount of assimilable constituents is to be ascertained, since hydrochloric acid, however dilute, can always dissolve more of these substances than the weak root-acids. A soil extracted with 4 per cent. hydrochloric acid would hence be quite sterile, although analysis might indicate the presence of plenty of plant nutrition. In fact those constituents of the soil which are in organic combination only become assimilable by the aid of oxidation; and in the author's opinion the constituents derived from the oxidation of mull substances are more important as a natural source of nutrition for cultivated plants than the mineral phosphates and silicates. Oats, which require relatively small quantities of mineral matter, can exist on the matter rendered assimilable during the oxidation of one season. Ordinary modes of working the land aid this oxidation; the favourable action of ammonium salts may in part be attributed to the mull substances being partially decomposed by them and so becoming more susceptible to oxidation. Lime would set free ammonia, which would then act as just described, and its favourable action can be, in part, explained in this manner.—D. A. L.

Onions as a Field-Crop in Australia. R. W. E. Macivor. Chem. Centr. 1888, 638.

Onions were cultivated in some districts in Australia; the harvest soon began to fall off, but was restored to previous abundance by dressing with ammonium sulphate, blood meal, superphosphate, and potash. Superphosphate alone exerted only a slight action. The onions contained, per cent., 89.48 of water, 10.10 of combustible matter, 0.237 of nitrogen, and 0.42 of ash. An average harvest of eight tons removes from the soil in lb. per acre—

N	K_2O	Na_2O	CaO	MgO	Fe_2O_3
42.48	29.36	1.88	6.52	2.70	0.30

P_2O_5	Cl	SO_3	SiO_2	Total.
10.88	0.80	22.90	1.72	119.54

—D. A. L.

PATENTS.

Improvements in the Process of Manufacturing Bicalcareous Phosphate, called Precipitated Phosphate. G. C. Dymond, Liverpool. From C. E. D. Winessinger, Brussels, Belgium. Eng. Pat. 17,945, December 8, 1888. 6d.

See under VII., page 284.

An Improved Process for Desiccating Blood and other analogous Substances. W. Barnsdale, Auckland, New Zealand. Eng. Pat. 18,429, December 17, 1888. 6d.

Blood, fish, or other animal matter is boiled by a steam coil, and passes down an inclined gutter between the spikes of a "masticator" or disintegrating roller, and thence between a pair of squeezing rollers, by which the liquid is expressed. The pressed solids are then spread on trays and dried in a special desiccating chamber heated by a steam coil and also by circulation of the furnace gases.

—J. M. H. M.

Improved Method of Manufacturing Nitrogenous Fertilisers. P. M. Justice, London. From W. J. Williams, Camden, New Jersey, U.S.A. Eng. Pat. 18,906, December 27, 1888. 4d.

Wool waste, hair, blood, tankage, or other nitrogenous matters are treated with sulphuric acid of 50° to 60° . Calcined and pulverised phosphate of iron or phosphate of alumina, or a mixture of both, is mixed with water, and the mixture added to the sulphuric acid and nitrogenous matter. The mixture is allowed to dry below 180°F . The quantity of water used should be just sufficient to allow the mass to set or harden on drying.—J. M. H. M.

XVI.—SUGAR, STARCH, GUM, Etc.

Improvements in the Manufacture of Starch, Dextrin, and Glucose. Dingl. Polyt. J. 271, 185–189; 329–336 and 363–374.

Glucose from Jerusalem Artichoke.—The composition of the artichoke is given by Petermann-Gembloux (*Revue Univer. de la dist.* 1886) as follows:—

	Per Cent.
Water.....	77.68
Carbohydrates convertible into sugar	14.33
Other carbohydrates.....	5.37
Fat	0.18
Protein.....	1.35
Ash	1.10
Total nitrogen	0.22
True albuminoids	0.79

Champy & Fils (Ger. Pat. 35,825 of 1885) treat the juice of the artichoke, or the tubers cut in pieces, at the boiling temperature with gaseous sulphurous acid in a series of communicating vessels. The levulin and inulin contained

in the juice are thus converted into glucose, and the solution is at the same time decolourised. The sulphurous acid is then removed by a current of steam. In case solid glucose is required the small quantity of sulphuric acid formed by oxidation from sulphurous acid is removed by means of barium carbonate.

M. Boudonnoir and G. Forêt have designed an apparatus for the preparation of sugar from starch-containing substances (Ger. Pat. 12,519 of 1887). The apparatus is similar to the diffusion battery used in beet-sugar manufacture, and consists of a series of extraction vessels fitted with false bottoms, with raised heaters between them. These consist of cylinders in which are set conical globes. Inside the globes are steam coils by means of which the fluid may be heated and caused to rise in the tube at top. Very dilute sulphuric, oxalic, or hydrochloric acid circulates over the starchy material, such as peeled maize, rice, rye, barley, oats, &c. contained in the extraction vessels, and converts the starch into glucose without changing the original shape of the grains. The exhausted materials are said to contain the bulk of the nitrogenous bodies originally present. The acid extract is worked up for glucose in the usual manner.

A. Schumann has patented a process for the manufacture of dextrin free from sugar, and similar in its properties to gum-arabic, and to be used as a substitute for it. (Ger. Pat. 41,931 of 1886, and 43,146 of 1887.)

Starch is mixed to a thick cream with cold water and treated with 1 per cent. of its weight of sulphuric, hydrochloric, or nitric acid. After 24 hours the mixture is washed free from acid. The prepared starch is either dried or again mixed with water to a cream, and heated in an oil-bath or by means of superheated steam to 160–170° C. till all the starch is converted into the soluble form. The solution is then refined and evaporated to dryness or to any desired consistency.—H. T. P.

The Estimation of Starch and Sugar in Feeding Materials.

E. F. Ladd. Amer. Chem. J. 10, 49.

Five grms. of the material to be examined are washed on a filter with distilled water till the washings measure 200 cc. The residue is dried and serves for the starch estimation. In the filtrate (10 cc.) the sugar is determined by Fehling's solution. Another portion is inverted by heating on the water-bath for half an hour with hydrochloric acid, neutralised with sodium carbonate, and "Fehlingised." The increased reduction represents substances soluble in water inverted by hydrochloric acid.

In the dried residue from above the starch is estimated. It is heated in an Erlenmeyer flask of 250 cc. capacity with 150 cc. of water and 5 cc. of strong hydrochloric acid for 12 hours at 100° C. on the water-bath. The flask is fitted with a cork and long glass tube to act as condenser. After heating it is allowed to stand 12 hours longer, filtered, rendered slightly alkaline with carbonate of soda, diluted to 200 cc., and "Fehlingised."—H. T. P.

The Composition of Iodide of Starch.

F. Seyfert. Zeits. f. angew. Chem. 1888, 15.

Assuming the starch molecule to consist of $C_{24}H_{40}O_{20}$, the formula of iodide of starch is $(C_{24}H_{40}O_{20})_6I_7$, or a multiple of it.

The author likewise describes the following rapid method of estimating starch in commercial starch powders: 1 gm. of starch is treated with 100–150 cc. of hot water and heated on the water-bath at 100° C. till perfectly gelatinised. The paste is washed into a 500 cc. flask and 50 cc. of an iodine solution, containing but little potassium iodide and about 12–13 grms. of iodine per litre, added, as well as 20 cc. of strong hydrochloric acid. The solution is diluted to 500 cc., well shaken, and allowed to settle. Two lots of 50–100 cc. are then pipetted off and titrated with sodium thiosulphate. Iodide of starch, according to the above formula, contains 22.865 per cent. of iodine. The iodine absorbed by the starch, multiplied by 4.37, will therefore give the quantity of starch.

Reference is made to the researches of F. Mylius (Zeits. f. phys. Chem. 11, 306) (see this Journal, 1888, 397) which assign to iodide of starch the formula $(C_{24}H_{40}O_{20})_6I_{11}$. This compound contains 24.489 per cent. iodine.—H. T. P.

Invert Sugar.

E. Jungfleisch and L. Grimbart. Compt. Rend. 108, 141–146.

The rotatory power of pure levulose varies considerably from the value obtained by calculation from the optical activity of invert sugar, considered as a mixture of equal parts of levulose and dextrose. This is shown in the following table:—

Temperature.....	0	5	10	14	20
(α) _D for pure levulose.	101.22	98.12	95.62	93.38	90.02
(α) _D for the levulose of invert sugar...	108.54	105.34	102.14	99.58	95.74

The authors ascribe these differences to a peculiar modifying influence of the strong acids on levulose. Dextrose added to a solution of levulose, in quantity equal to the levulose present, does not modify its specific rotatory power. Acids, however, have a powerful influence. A solution of pure levulose with 10 per cent. of HCl gave, at 12° C., (α)_D = –94.66°; after heating for half an hour to 68° C. with 5 per cent. of hydrochloric acid, (α)_D = –96.78°. Sulphuric acid used in a similar manner yielded (α)_D = –99.78°. The readings were not affected by neutralisation of the acids. This action of strong acids is exerted instantly and even at ordinary temperatures. Hydrochloric acid added in the cold to a levulose solution gave (α)_D = –96.50°. Oxalic acid has a similar action on heating. Acetic and formic acids employed at the rate of 5–10 per cent. have no influence on the specific rotatory power of pure levulose. The optical activity of dextrose is not influenced under any of the above conditions. Cane sugar inverted by Clerget's method (heating with one-tenth of HCl to 68° C. for 10 minutes) gives as the value for levulose at 12° C. (α)_D = –101.30°; when only one-twentieth of its bulk of HCl is used, and the time of heating prolonged to 30 minutes, (α)_D = –96.52°. This number corresponds very nearly with the value for pure levulose under the same conditions, (α)_D = –96.78°. When cane sugar is inverted by heating with 5–10 per cent. of formic or acetic acid to 100° C., the levulose of the resulting invert sugar possesses the specific rotatory power of pure levulose. Thus under conditions where pure levulose gave (α)_D = –94.66°, the levulose of invert sugar gave (α)_D = –94.75° (inverted by 5 per cent. acetic acid, 30 mins. at 100° C.), (α)_D = –94.48° (5 per cent. acetic acid, 60 mins. at 100° C.), (α)_D = –94.00° (10 per cent. acetic acid, 60 mins. at 100° C.), (α)_D = –94.80° (5 per cent. of formic acid, 30 mins. at 100° C.). On addition of HCl to the solutions thus inverted the readings were increased as before.

The authors come to the conclusion that:—

1. Strong acids modify the rotatory power of levulose more or less according to circumstances.
2. The levulose of invert sugar made by the ordinary process is not identical with pure crystallised levulose, but is a modification of it.—H. T. P.

The Extraction of Sorbite.

C. Vincent and Delachanal. Compt. Rend. 108, 147–148.

The authors indicate several methods by which an increased yield of sorbite may be obtained from the service-berry. Sulphuric acid and alcohol are employed to eliminate the potash and lime (which hinder the crystallisation of the sorbite) from the extract, in the shape of insoluble sulphates.

The fermented juice of the service is concentrated in vacuo to a third of its volume. A portion (10 grms.) is ignited with the addition of excess of sulphuric acid, and a determination of sulphuric acid made in the residual ash.

The quantity of sulphuric acid necessary to combine with the bases present is thus known. The calculated quantity of sulphuric acid, diluted with its own volume of water, is

added to the remainder of the extract, and then two volumes of alcohol. The precipitate is filtered off, the alcohol removed from the filtrate by distillation, and a slight excess of barium hydrate added. The clear liquid is treated with basic acetate of lead, followed by sulphuretted hydrogen; it is then concentrated in vacuo. The syrup yields a large amount of sorbite, but slowly. This slowness of separation is due to the influence of the barium salt of a certain acid or acids present in the extract, which are not precipitated by basic acetate of lead or the alkaline earths, are soluble in water, but nearly insoluble in alcohol. On this latter observation a method of separation is based. The liquid, treated as above, is exactly saturated with barium hydrate and evaporated in vacuo to a thick syrup. The syrup is extracted with boiling alcohol of 95 per cent., which dissolves out the sorbite only. By the evaporation of the alcohol a syrup is obtained, which, in the course of a few days, deposits an abundant crop of sorbite in long needles.

Mémier has shown that sorbite forms, with benzaldehyde, an acetal insoluble in water. A method for the determination of sorbite may be based on this fact. The authors proceed as follows:—The juice of the service, concentrated to a third of its volume in vacuo, is treated with basic acetate of lead in excess, followed by sulphuretted hydrogen, and then evaporated in vacuo to a thick syrup. The syrup is treated with its own weight of sulphuric acid (50 per cent.) and 80 per cent. of its own weight of benzaldehyde. The mixture soon solidifies, owing to the formation of the acetal. After 24 hours the mass is powdered and washed with water by decantation. The weight of the washed and dried precipitate is a measure of the quantity of sorbite present in the substance. The sorbite may be obtained from it thus:—The precipitate is heated with water containing a few tenths of sulphuric acid and benzaldehyde. After completion of the reaction, the aldehyde is distilled off in a current of steam. The residue is saturated with barium hydrate, filtered, and the excess of barium exactly precipitated by sulphuric acid. After cooling, the liquid is agitated with ether to remove the small quantity of benzoic acid formed by oxidation from the benzaldehyde. The liquid is then evaporated in vacuo and decolourised by means of a little animal charcoal. In a few days it deposits a considerable amount of sorbite in the shape of long brilliant needles.—H. T. P.

On Sorbite and its Presence in Fruit of the Family of Rosaceae. C. Vincent and Delachanal. *Compt. Rend.* 108, 354—356.

Sorbitol is contained in pears, apples, and Brittany cider. It is best separated and purified by means of the compound it forms with benzaldehyde. The specific rotatory power of pure sorbite is -1.73 for the ray D, at 15° . It is, therefore, twelve times as active as mannite in turning polarised light. Oxidised with potassium permanganate an acid and a reducing sugar are formed. Nitrosorbite is obtained by the action of fuming nitric acid and sulphuric acid in the cold. It is an oily liquid which burns when brought in contact with a fuse and explodes violently by concussion.—A. R.

Extraction of Raffinose from Raw Sugar and Raw Sugar Syrup. G. Burkhard. *Neue Zeits. f. Rübenzuck. Ind.* 1888, 16.

The raw sugar or raw sugar syrup dried with sawdust is extracted with methyl alcohol. The methyl alcohol is distilled off, the residue diluted with water and boiled for 20 minutes with sufficient strontium hydroxide to cause the separation of granular raffinose-saccharate, and yet to leave a visible excess of the hydroxide on the surface. The precipitate is separated, washed with boiling strontium solution, and decomposed by means of carbonic acid. The solution is evaporated down, and on warming with alcohol raffinose crystallises out.—D. A. L.

Compounds of Phenylhydrazine with the Sugars. E. Fischer. *Ber.* 22, 87—97. (Compare this Journal, 1888.)

The sugars yield with phenylhydrazine compounds known as "osazones," and these decompose with strong hydrochloric acid into oxidation products and phenylhydrazine. Thus phenylglucosazone yields a compound—



and phenylhydrazine. The author has given to these oxidation products the name "Osone." The above compound is therefore "glucosone." These bodies react with the primary and secondary hydrazines and *o*-diamines like glyoxal, and are reduced with zinc dust and acetic acid to levulose. This reaction is generally applicable, and has been studied by the author in the case of glucosazone, galactosazone, sorbosazone, lactosazone, maltosazone, α - and β -arabosazone, formosazone, arabinosazone, and the osazone of isodulcitol. Erythrosazone, glycerosazone, and glyoxal-phenylsazone act otherwise, and the osazones of the ketone acids are even more stable in presence of strong hydrochloric acid. Glucosone is obtained by adding strong hydrochloric acid to powdered phenylglucosazone at the ordinary temperature. It is shaken and warmed for a short time, and quickly cooled. It is filtered from phenylhydrazine, washed with dilute hydrochloric acid, excess of lead carbonate added to neutralise the acid and precipitate colouring matter. The filtrate is neutralised with baryta, and the osone precipitated with lead hydroxide. The lead is precipitated with sulphuric acid, &c., and the solution of the free glucosone evaporated in vacuo. It forms a solid amorphous mass; reduces Fehling's solution, turns polarised light faintly to the left, and does not ferment. With phenylhydrazine it readily unites to form phenylglucosazone, and with methylphenylhydrazine to form glucosomethylphenylhydrazine, $\text{C}_6\text{H}_5\text{N}(\text{CH}_3)\cdot\text{N}(\text{CH}_3)\cdot\text{C}_6\text{H}_5$. If an excess of methylphenylhydrazine is employed in acetic acid solution methylphenylglucosazone is obtained. It differs from phenylglucosazone by its greater solubility in alcohol and benzene.

The formula for this substance is doubtless—



Glucosone also combines with *o*-tolylenediamine in aqueous solution to form a compound of the formula $\text{C}_{13}\text{H}_{16}\text{N}_4\text{O}_4$. With hydrochloric acid it decomposes, yielding levulinic acid. Reduced with zinc and acetic acid it gives levulose, which with sodium amalgam, yields mannite.—J. B. C.

Synthetic Experiments on the Sugars. E. Fischer and J. Tafel. *Ber.* 22, 97—101.

ACROLEINBROMIDE yields with the alkalis or baryta a sugar, $\text{C}_6\text{H}_{12}\text{O}_6$, which combines with phenylhydrazine, forming the compound α -arabosazone. On reduction with zinc and acetic acid a base is obtained, which, with nitrous acid, gives a non-nitrogenous amorphous product to which the authors give the name of α -arose. α -Arabosazone behaves with conc. hydrochloric acid like glucosazone, and gives an "oson" corresponding to glucosone, and which is therefore called α -arosone. With phenylhydrazine arabosazone is regenerated, and it combines likewise with *o*-tolylene-diamine. Hydrochloric acid converts it into levulinic acid. With zinc dust and acetic acid a sugar is produced, which ferments with yeast, and with the exception of its inactivity on polarised light has all the characteristics of the glucoses. (Compare this Journal, 1888, 128.)—J. B. C.

Acrose from Formaldehyde. E. Fischer and F. Passmore. *Ber.* 22, 359—361.

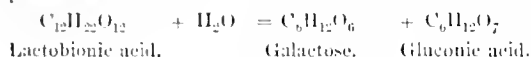
By the action of lime-water on formaldehyde, a mixture of aldehyde or ketone-alcohols is obtained. One of these compounds combines with phenylhydrazine to form α -arabosazone from which acrose may be prepared. The following is an outline of the method adopted. A 3 per cent. solution of formaldehyde is converted by lime-water into Loew's

formose. The latter compound is treated with phenylhydrazine and acetic acid (50 per cent.) and heated on the water-bath. The product is treated with benzene and ether, and finally with water, which leaves a small residue of aerosazone. This, after recrystallisation, is converted by concentrated hydrochloric acid into the osone, which may be converted into the osazone. It is only in this way that the osazone can be purified. The substance is identical with the compound obtained by the action of phenylhydrazine upon aërose.—J. B. C.

Oxidation of Milk Sugar. E. Fischer and T. Meyer.

Ber. 22, 361—364.

If 1 part of milk sugar dissolved in 7 parts of water be treated with 1 part of bromine at the ordinary temperature, the greater part of the bromine disappears. The excess of bromine is driven off by a current of air, and the hydrobromic acid removed by lead carbonate and silver oxide. The aqueous solution contains the new acid lactobionic acid, which remains as a syrup on evaporating the liquid. If the syrup is triturated with cold glacial acetic acid impurities are removed and lactobionic acid is obtained in the form of a white amorphous mass. It does not reduce Fehling's solution. It is soluble in water, but not in alcohol, ether, or acetic acid. It is split up with dilute mineral acids into galactose and gluconic acid. This decomposition may be expressed as follows:—



—J. B. C.

Mannose. E. Fischer and I. Hirschberger. Ber. 22, 365—376.

MANNITE on oxidation with dilute nitric acid yields mannose. After neutralising the product with carbonate of soda, phenylhydrazine dissolved in acetic acid is added. The phenylhydrazone crystallises out. The compound is recrystallised. The yield is about 10 per cent. of the mannite.

Dissolved in four times its weight of hydrochloric acid (sp. gr. 1.19), phenylhydrazine hydrochloride separates out. The solution contains mannose, which after purification forms a colourless syrup. The yield is about 60 per cent. of the phenylhydrazone. The syrup may be precipitated by ether in the form of a white flocculent substance; but has not yet been crystallised. Mannose ferments with yeast as readily as dextrose, and may be reduced to mannite with sodium amalgam. It reduces copper solution and turns the plane of polarisation to the right. The specific rotatory power is $(\alpha)_D = 192.96$. Tested by Fehling's solution 1 cc. is equivalent to 3.307 mgrm. of mannose. Of all the different sugar-producing substances tested, the authors only succeeded in confirming the presence of mannose first discovered by Tollens and Gans in salep gum.

Mannose when heated in aqueous solution to 140 decomposes, yielding furfural; with concentrated hydrochloric acid, levulinic acid is formed.

Like other sugars it combines with hydrocyanic acid. Fifty grms. of mannose, 250 grms. of water, and 18 cc. of anhydrous hydrocyanic acid are mixed together in a stoppered flask and left at the ordinary temperature. A solid compound separates, which is the amide of mannose carboxylic acid. The solution contains the ammonium salt of the acid.

The latter readily forms salts. The free acid immediately passes into the lactone—a crystalline compound of the formula $\text{C}_7\text{H}_{12}\text{O}_7$. Mannose carboxylic acid reduced with hydriodic acid and phosphorus yields an oily liquid with acid properties having the composition of heptylic acid.

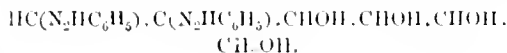
Mannose combines with phenylhydrazine to form an azone, which is identical with glucosazone from dextrose.

From the various reactions which mannose undergoes it is considered as an aldehyde of a constitution similar to

dextrose. The difference is due to geometric isomerism, there being four asymmetric carbon atoms in the formula for dextrose.



This explains the formation of the osazone in the case of both isomerides. It will therefore be best represented by the formula—



—J. B. C.

The Formation of Carbohydrates from Formaldehyde. O. Loew. Ber. 22, 470—478.

THE condensation of formaldehyde to formose depends upon the strength of the base, and the concentration of the formaldehyde solution. If the base is either too strong (caustic soda) or too weak (magnesia) no condensation occurs. Lime and oxide of lead produce condensation, as also metallic lead. The fact that bases affect condensation and not acids may be ascribed to the formation of intermediate compounds with the bases. A compound of this character is formed with lead oxide. In spite of numerous trials with a variety of bases no natural carbohydrate has been detected in crude formose. The author finds the best yield of fermentable sugar may be attained as follows:—10 grms. of formaldehyde are dissolved in 4 litres of water, 0.5 gm. of magnesia and 2—3 grms. of magnesium sulphate added, and the solution heated with 350—400 grms. of granulated lead to 60° for 12 hours.

The liquid may be evaporated at 50° to a syrup extracted with 80 per cent. alcohol, and the sugar precipitated with ether. This process is repeated and the precipitated formose redissolved in water and evaporated. The residual syrup has an intensely sweet taste and reduces Fehling's solution. It ferments readily with yeast, giving alcohol. The author considers formose to be allied more closely to levulose than to dextrose, as, like the former, it is decomposed by a 7.5 per cent. solution of hydrochloric acid. It yields a glucosazone similar to Fischer's phenyl glucosazone. From the osazone the sugar may be regenerated. The author considers this a distinct substance and calls it "methose."

—J. B. C.

Notes on Formose. O. Loew. Ber. 22, 478—482.

FISCHER has found that formose is not a simple substance. The author confirms this, and finds that from it three osazones may be prepared:—

1. An osazone readily soluble in ether, called formosazone. It is present to the extent of 75—82 per cent.
2. 16—12 per cent. of an osazone with difficulty soluble in ether, readily soluble in alcohol.
3. 3—4 per cent. of an osazone insoluble in ether, with difficulty in cold alcohol.

In preparing formose in very dilute solutions, with thin milk of lime in place of the thick paste, and using a 1 per cent. solution of formaldehyde, the amount of osazone decreases to 48—53 per cent. Formose, which name the author retains for the principal product of the reaction, is decomposed with hydrochloric acid, yielding furfural, and humus substances, but no levulinic acid. It undergoes the lactic but not the alcoholic fermentation. It is more rapidly attacked by bromine than levulose, but less rapidly than dextrose. It does not yield on oxidation an acid with six carbon atoms, and on this account the author regards it as a ketone alcohol, like levulose and sorbinose.

The rest of the paper is devoted by the author to vindicating his claim to be the first discoverer of artificial sugar.

—J. B. C.

PATENTS.

Improvements in and connected with Defecators or Eliminators for Saccharine and other Liquids. R. Harvey, Glasgow. From T. S. Cornish, Demerara. Eng. Pat. 6030, April 23, 1888. *Sd.*

This invention has reference to a modified form of pan for evaporating sugar or other solutions either in vacuo or at atmospheric pressure. The pan is of elongated rectangular shape in its horizontal section. Through one end of this pan passes an iron pipe capable of revolving on its axis. The vertical section of this pipe is of a B shape, thus forming two tubes in one. Steam is supplied into the upper tube, and after passing through a number of smaller tubes which branch off therefrom, returns into the lower tube, from which the condensed water escapes. The branch tubes pass through the length of the pan at an angle slightly inclined to the horizontal, dipping away from B, and then return, with a similar downward inclination, to the lower tube of the B. Thus the whole system of pipes through which the steam circulates is capable of revolving on B as an axis, and can be submerged in the liquor or revolved out of it at will. Moreover the part of the pan about B is the hottest part of the pan, and is the deepest, the other end shallowing off towards a lip, over which the scum escapes. For drawing off the clear liquor, there is another short pipe attached to the bottom of the pan by a swivel motion, so that the mouth of the outlet pipe may be lowered or raised to any particular level from which it is desired to draw off the liquor. Full drawings are given in illustration of the invention.—A. J. K.

Improvements in the Manufacture of Starch. H. Kiel, Bremen, Germany, and R. Stoltenhoff, London. Eng. Pat. 6778, May 7, 1888. *6d.*

In this process the starch-bearing grain is acted upon by caustic lye in vessels from which the air has been exhausted, and the vessels are arranged in series, the lye passing from one to the other in regular order. The cells of the grains are burst by the action of the vacuum, so that the lye is

able to operate more readily on their contents. It is also stated that by the absence of air and of carbonic acid contained therein, a re-precipitation of gluten, generation of fungi, and fermentation are practically prevented. The treatment is finished in about six hours. From the saturated lye the protein is precipitated by an acid, preferably by carbonic acid, and the precipitate contains about 90 per cent. of pure protein.—A. J. K.

Process for Manufacturing Crystallised Maltose. O. Lenz, Berlin, Germany. Eng. Pat. 75, January 2, 1889. *4d.*

Pure potato-starch or other starch is dissolved in water in proportion of 1 to 4, under a high pressure, and cooled at once to 40° C. 20 per cent. of malt is now thrown in, and the whole is cooled down to 20° C. At this point the mixture is well agitated and allowed to stand. After three hours all the starch has disappeared, and after 24 to 36 hours the whole of the dextrin is converted into maltose. The solution is now filtered mechanically, heated to 70°, and again filtered mechanically. Subsequently it is diluted and filtered through bone black. The filtered syrup is concentrated by evaporation, and finally crystallised with addition of a few crystals of pure maltose, previously prepared. The essential point in the process is the low temperature at which the conversion takes place.—A. J. K.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Malt of Barley of 1888. O. Reinke. Wochenschr. f. Brauerei 1888, 5, 1013.

NOTWITHSTANDING the wet summer and late ripening of the barley, the malt obtained proved to be of good quality, and the amount was large. The following analyses are the maximum and minimum of 43 malts of German and Austrian origin, and also of three malts which the author considers of normal quality:—

	Water.	Extract in Malt.	Extract in Dry Substance.	Ratio—maltose to non-maltose.	Time of Sugar Formation in Minutes.	Ce. N. ₁₀₀ Iodine Solution used.
		Per Cent.	Per Cent.			
Maximum	10.73	74.78	77.20	0.575	40	2.90
Minimum.....	1.71	62.48	68.68	0.279	15	1.0
I. Moravian.....	2.62	71.03	67.02	0.501	23	2.60
II. Thuringian	4.76	71.77	75.36	0.399	23	1.90
III. Moravian	6.08	72.20	76.87	0.327	22	1.20

—J. W. L.

Wheat and Wheat-malt. R. Heinzelmann. Wochenschr. f. Brauerei 1888, 5, 1033.

The following analyses of wheats are published by the author:—

	Starch calculated for 10 per Cent. H ₂ O present.	Gluten N × 6.25 calculated for 10 per Cent. H ₂ O present.
Egyptian wheat, Sadi superieur, crop of 1887	66.34	8.84
Egyptian wheat, Sadi superieur, crop of 1888	65.68	9.98
Egyptian wheat, Sadi superieur, crop of 1888, red	66.19	10.56
Egyptian wheat, Sadi superieur, crop of 1888, white	68.06	8.76
Californian cr. p. 1885.....	66.20	9.57
„ „ 1886.....	64.80	10.50

	Starch calculated for 10 per Cent. H ₂ O present.	Gluten N × 6.25 calculated for 10 per Cent. H ₂ O present.
Soft red Bombay	65.70	10.68
Chilian	66.27	10.27
Canadian	64.40	11.40
Australian	64.63	12.12
Oregon	68.73	9.30
Danubian.....	64.92	11.76
Roumanian .....	..	12.51
Ozina Odessa.....	63.17	15.21
Red American winter wheat	64.90	13.08
„ „ summer wheat ...	65.30	12.50
Persian wheat	64.00	11.35

The extract from 15 wheat malts, calculated for 10 per cent. of water, varied from 71.40 to 76.0 per cent., whereas average barley malt contains 66.1 per cent. of extract. Comparative experiments on the fermenting of wheat and barley malt showed that from 100 grms. of wheat-malt 60.08 grms. of starch had been converted to alcohol, whereas from the same quantity of barley-malt only 52.03 grms. of starch had been converted to alcohol.—J. W. L.

Recent Advances in Brewing. Dingl. Polyt. J. 271, 375—383.

The Causes affecting the Consistency of the Endosperm of Barley. T. Adametz. (*Allgem. Brauer- und Hopfenzeit.* 28, 2182).—Glassy and steely barleys are distinguished by a close formation of the endosperm, and narrower spaces between the starch cells, while in mealy corns the texture is more open and consequently more air is contained in them. Sections of the endosperm of mealy corns, immersed in water, appear darker and less transparent than those of steely corns. On adding alcohol, far more air is expelled from mealy than from steely barley. Steely barley also contains a larger proportion of nitrogenous bodies. This factor is, however, not of much importance, since it depends not only on the mealy or steely condition of the grain, but also on soil, climate, manure, and the species of barley.

There is, further, a connexion between the shape of the corns and the percentage of nitrogen. The broader and

rounder the corns, the less nitrogen they contain; the specific gravity of the barley rises at the same time, and the heaviest barley contains least nitrogen. The nitrogen also diminishes with the increase of the absolute weight of the grains. Flat-grained barley also yields more chaff than round-grained barley.

The Bitter and Resinous Constituents of the Hop. Hayduck. (*Wochenchr. f. Brauer.* 5, 937.) See this Journal, 1889, 129—130.—H. T. P.

Effect of Drying on the Composition of the Malt, Wort, and Beer. P. Matz. (*Allgem. Brau- u. Hopfenzeit.* 1888, 2043—2044.

The barley employed in these experiments was white, thin-husked, with full and floury grains; 97.3 per cent. germinated and 1,000 grains weighed 49.32 grms.; it contained per cent. H_2O , 13.1; N, 1.29; albuminoids, 8.07; P_2O_5 , 0.83; ash, 2.65. A few grains were specked, but otherwise it was an excellent malting barley. On the floor the germinating average increased 2.7 per cent.; the temperature of the steeping water was 75° C.; of the steeping chamber, 125° C.; the steeping lasted 100 hours. It was 9 days 10 to 17 hours on the floors, the highest temperature being 12.5° C. The growth was long and uniform and the odour good. The effects of various modes of drying are seen in the following tables:—

Conditions of Drying.	Malt.					Wort.							
	Water.	Extract.	Maltose in Extract.	Duration of Saccharification.	Appearance of Wort.	Sp. gr. at 17.5° C.	Maltose.	Dextrose.	Ash.	N.	Extract.		
	Per Cent.	Per Cent.	Per Cent.	Mins.			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Hot pipes, at 81.25° C., draught closed ..	1.00	76.90	71.57	30	Clear, pale yellow.	1.05327	9.55	2.07	0.218	..	72.37	..	..
Direct heat, at 81.25° C., draught closed ..	3.80	77.30	68.19	30	Bright, pale yellow.	1.05330	9.31	..	0.22	..	71.61	..	1.68
81.25° C., draught closed, 1 hour	3.06	78.10	71.50	30	Bright, pale yellow.	1.05325	9.58	1.98	0.22	0.06	73.44	..	..
81.25° C., draught open	3.42	78.20	69.85	30	Clear, pale yellow.	1.05338	9.55	2.06	0.22	..	72.37	..	..
81.25° C., draught closed $\frac{1}{2}$ and increasing initial temperature	3.20	76.31	71.40	30	Clear, pale yellow.	1.05385	9.37	..	0.22	..	71.0	..	1.63
87.5° C., draught closed	3.37	77.47	66.08	40	Bright, amber	1.0532	9.29	2.19	0.22	..	71.2	16.82	1.75
87.5° C., draught open	3.58	77.30	67.30	53	Bright, amber	1.0535	9.28	2.20	0.22	..	70.84	17.48	1.73

Conditions of Drying.	Beer.										Fermentation Degree.		Condition.
	Extract.	Alcohol.	Maltose.	Dextrose.	Acid (Lactic.)	N.	Ash.	P_2O_5 in Ash.	Sp. Gr.		Apparent.	Actual.	
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.					
Hot pipes, at 81.25° C., draught closed ..	5.00	4.00	1.43	2.49	0.09	0.07	0.21	42.11	1.0134		73.8	60.7	Taste winey, moderately full, very sparkling.
Direct heat, at 81.25° C., draught closed ..	4.95	4.04	1.47	2.46	0.08	0.06	0.21	42.57	1.0130		74.5	61.2	
81.25° C., draught closed, 1 hour	4.95	3.86	1.40	2.57	0.09	0.06	0.20	42.39	1.0132		73.4	60.1	
81.25° C., draught open	5.00	4.00	1.43	2.55	0.09	0.06	0.21	42.15	1.0131		74.2	60.7	
81.25° C., draught closed $\frac{1}{2}$ and increasing initial temperature	5.25	4.06	1.66	2.47	0.08	0.06	0.21	42.44	1.0142		72.9	59.9	
87.5° C., draught closed	5.28	3.92	1.43	2.75	0.09	0.06	0.22	41.22	1.0144		72.0	58.9	Full flavour, very sparkling.
87.5° C., draught open	5.40	4.00	1.46	2.85	0.09	0.50	0.21	40.65	1.0147		71.8	58.8	

Condition of the worts is also described.—D. A. L.

The Prevention of Foaming Fermentations. Honig. Zeits. f. Spiritusind. 11, 135.

THE author recommends the addition of a small quantity of mineral lubricating oil (25 cc. per 2,200 litres) to the potato mash at 50° C. and previous to the addition of the larger quantity of malt.

For the same purpose, *Christek* (*ibid.* 11, 203) strews a mixture of 10 kilos. of oat-malt grist with 0.5 kilos. of sulphuric acid previously diluted with a few litres of water, over the foaming tun. The foam completely disappears in 5–10 minutes, and active fermentation sets in, accompanied by rapid evolution of carbonic acid. It is necessary to repeat the treatment several times at intervals of 1–2 hours. After several repetitions the main fermentation proceeds normally, followed by an active after-fermentation. The spirit and wash are satisfactory in every way.—H. T. P.

The Influence of the Concentration of the Nutritive Media on the Propagation of Alcoholic Ferments and on Attenuation.

THIS question has been examined by *J. Archleb*; and *Windisch* quotes the results obtained in the *Zeits. f. Spiritusind.* 11, 243 and 248. The experiments were made with maltose solutions containing from 1–25 per cent. The temperature in all cases was the same, likewise the quantity of pitching yeast. After fermentation the alcohol and yeast were determined. The author draws the following conclusions from his results:—

1. The increase of yeast in nutritive media, containing from 1 per cent. to 25 per cent. extract, is not proportional to the strength of the solutions.
2. Certain concentrations seem to favourably influence the multiplication of the yeast; and several maxima can be found.
3. In solutions containing from 1–5 per cent. extract the yeast crop increases with the concentration. In a 5 per cent. solution the yeast is multiplied 6.6 times.
4. Between concentrations of 5–10 per cent. only a slight increase of yeast reproduction takes place. In a 10 per cent. solution it is 7.37 times. At 7 per cent. concentration it is only multiplied 5.96 times.
5. In media containing 10–14 per cent. extract the reproduction of yeast is most active, and rises rapidly from 7.37 to 14.2 times the pitching yeast, in 14 per cent. extract solutions.
6. The maximum of reproduction takes place in a 14 per cent. medium.
7. Between concentrations of 14–19 per cent. the amount of yeast production again falls, and in a 19 per cent. medium is 10.1 times that of pitching yeast.
8. Between 19–25 per cent. extract there is an increased yeast crop. At 25 per cent. the yeast is multiplied 12.53 times; at 24 per cent. extract, 12.84 times.
9. It is probable that in stronger worts the reproduction of yeast will be much less; for in such media diffusion can only take place slowly. An extract of 36 per cent. is probably the limit.

From these results it follows that in the manufacture of pressed yeast, the most suitable wort concentration is 14 per cent. The results also explain why a strength of 10–11 per cent. is best for the production of sound beers. For at these concentrations the yeast reproduction is greatest and, consequently, the bulk of those nitrogenous bodies which influence the stability of beer are removed.

Caution is recommended in the use of artificial wash as a feeding material (*Zeits. f. Spiritusind.* 11, 144) owing to the fact that out of 70 cattle which were fed with hot dilute wash, nine grew ill after the third day and one died. An examination of the dead animal indicated alcoholic poisoning. It is strongly insisted upon that the wash must only be used fresh, and that as high a temperature as possible should be employed during the mashing process, followed by boiling. The malt added must also be restricted to its lowest limit. If not employed at once it should be kept at a temperature of 56°–63° C., or at least boiled before use. The cleanliness of all the apparatus is also of extreme importance. When these precautions are attended to, the use of artificial wash or sweet mash is quite without danger. The amount of wash given to cattle should not exceed a quantity equal to 15 kilos. potatoes per 500 kilos. live weight.—H. T. P.

The Duty-Free use of Spirit for Technical Purposes.

THIS question was discussed before the German Federal Council on June 21st, 1888. The following decisions were arrived at.

40 grms. of oil of lavender or 60 grms. of oil of rosemary may be added to each litre of the general denaturising material, by those who are licensed to make it. In particular cases 5 per cent. of wood spirit alone may be used. The employment of animal oil, turpentine, sulphuric ether, and shellac for denaturising is permitted in certain instances. For the manufacture of vinegar, spirit may be denaturised by means of 200 per cent. of 3 per cent. vinegar, or 30 per cent. of vinegar containing 6 per cent. of acetic acid, 70 per cent. of water, and 100 per cent. of beer. 100 per cent. of wine may be substituted for the beer.

The general denaturising agents must conform to the following rules:—

(1.) Wood spirit. It must be colourless or only slightly yellow. On distilling 100 measures at 760 mm. pressure, 90 volumes must pass over at 75° C. No sensible turbidity must be produced on dilution with water. The amount of acetone must exceed 30 per cent. It must contain at least 1 per cent., but not more than 1.5 per cent. of bodies, decolourising bromine.

(2.) Pyridine bases. They should be colourless or only slightly yellow. The water must not exceed 10 per cent. On distilling 100 volumes at 760 mm. pressure, at least 90 volumes should pass over under 140° C. No appreciable turbidity must be caused by dilution with water, and the sample should contain no ammonia. The analytical examination of the various denaturising materials is then described in detail.—H. T. P.

The Microscopic Examination of Yeast. P. Lindner. Wochenschr. f. Brauerei 5, 450.

THE author recommends the treatment of the yeast, previous to examination, with potash or soda solution of about normal strength. By this means particles of resin and nitrogenous matter are dissolved, and conglomerations of yeast cells separated, while cells of other yeasts, especially *Pediococcus*, are unchanged. The author points out that mistakes are often made owing to the crushing of yeast cells under the cover-glass. The protoplasm is divided into small particles, which vibrate, and look very similar to small bacteria. The motion is, however, not progressive, but a lateral one, the so-called Brownian movement. The author further points out that errors frequently occur in testing for dead cells by means of an aniline colour, owing to the use of too strong solutions of dye, or owing to the addition of too little colour to a given amount of yeast. It is best to use a weak solution of the staining agent, and to add so much yeast that about 50 cells appear in each field.—H. T. P.

PATENTS.

An Improved Process of and Plant for Treating Cereals, Starchy or Farinaceous Substances for making Alcohol, Vinegar, and other like Products. E. Manbré, Garston. Eng. Pat. 3510, March 7, 1888. 8d.

IN this process the cereals or other starchy substances are first crushed between rollers, and the crushed meal passed through a convenient sieve, by which means from 15 to 20 per cent. of the bran is separated. The meal is then ground into flour and conveyed to a closed wooden mash-tun, where a sufficiency of water as well as a mixture of sulphuric, sulphurous, and nitric acids are added in the proper proportions. Steam is then turned on and the mixture kept boiling for about half an hour. It is then rapidly run into a high-pressure converter, where a temperature of 350° F. is gradually reached; as soon as conversion is complete the mixture is run off into a wooden receiver and neutralised, then filtered, cooled, and conveyed to the fermenting tubs, and yeast together with a mixture of cream of tartar and phosphate of potassium added. When the fermentation has ceased the wort so obtained is passed through an ordinary Coffey's still combined with a rectifier,

whereby continuous distillation and rectification are carried on in the one operation. For the production of vinegar a similar process of saccharification is adopted, yeast alone is, however, added at the fermenting stage, different earthy phosphates being added during the oxidation of the alcohol and its conversion into vinegar.—J. H.

An Improved Apparatus for ascertaining the Degree of Maceration of Barley when Malting. K. Berneruther and W. Kumpfmiller, Munich, Bavaria. Eng. Pat. 4616, March 26, 1888. 8d.

This apparatus consists of a small vessel formed of perforated sheet metal, the top and bottom being fitted with moveable covers of a conical or pyramidal form. A moveable rod is provided to screw into the upper cover and a handle is fitted to the rod. A certain quantity of barley is placed in the vessel, which can, on account of its form, be readily slipped into the malt in any desirable part and to any depth. When the vessel is withdrawn (the rod and handle being removed) it is carefully weighed, the increase in weight showing the relative amount of water absorbed.

—J. H.

Improvements relating to the Pasteurisation of Beer, Wine, and other Liquids. W. Kuhn, Clermont-Ferrand, France. Eng. Pat. 15,261A, October 23, 1888. 6d.

This invention claims that: 1st. The heating is effected in a uniform manner and without division of the material, so that no part of the beer shall at any moment be raised to a higher temperature than the final temperature at which the operation takes place, in order to obviate the unpleasant flavours imparted to the material by a change in the overheated parts. 2nd. No part of the beer shall remain at a lower temperature than the final degree at which the operation takes place, in order to obviate the ulterior fermentations that would be caused by the ferments which have not been rendered insensible and which are contained in these insufficiently heated fractions. 3rd. The beer is raised to the highest temperature which can be obtained in the shortest time possible, in order to obviate the flavour which the beer receives by exposing it too long to a high temperature. 4th. Nevertheless the heating agent must be of a temperature which differs as little as possible from the final temperature at which the operation takes place, and for this purpose it is necessary to provide for as large a surface of contact as possible between the liquid treated and the heating agent. 5th. The displacement of carbonic acid from one part of the beer to another is obviated in order that the elements which could be decomposed and remained present in the same proportions shall be able to re-constitute the compounds, thereby obviating one of the principal causes of the flavour of pasteurisation. 6th. The employment, as a cooling agent, of incongealable liquid or any other source of artificial cold susceptible of reaching -10° and capable of effecting a sudden decrease of temperature, which facilitates the re-constitution of the compounds.

—J. H.

Improvement in Rice-product and Process for preparing same. E. V. Donelson, Baltimore, U.S.A. Eng. Pat. 15,959, November 5, 1888. 4d.

See under XVIII. A., this page.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A)—CHEMISTRY OF FOOD.

Adulteration of Linseed Meal. E. Eidam. Landwirt. 1888, 475.

It has been noticed that cattle frequently refuse to eat linseed meal; at other times they have sickened or even

died after eating it. On examination some samples of linseed meal were found to contain besides ordinary impurities castor oil and hemp seeds as adulterants. The former contains a strongly poisonous constituent, and would account for the disastrous results referred to. The press residues of castor oil seed are only fit for manuring purposes. The microscopic appearance of the two adulterants is described.—D. A. L.

PATENTS.

The Manufacture of a Carbonated Oxygen Water. The Brin's Oxygen Company and P. B. W. Goble, London. Eng. Pat. 3530, March 7, 1888. 4d.

CARBONATED oxygen water is produced by charging the water with oxygen and aerating it with carbonic acid gas by any suitable means. The receptacles to contain the water must be filled with oxygen gas so as to exclude atmospheric air.—E. E. B.

An Improved Composition and Devices for Facilitating the Use thereof, chiefly Designed for Preserving Animal and Vegetable Substances. H. H. Lake, London. From S. F. Van Choate, Boston, U.S.A. Eng. Pat. 12,774, September 4, 1888. 8d.

This preservative composition consists of equal parts of caustic potash, chloride of potash, oxide of manganese, and chloride of potash with which a mixture of gum tragacanth and hydrogen peroxide may be incorporated to impart adhesiveness. The mixture is placed in conical moulds, of which the bottom and lower part of the sides are perforated, and the moulds then placed in pans of water in the chambers containing the articles to be preserved. The compound dissolves in the water, and when this evaporates the food, &c. becomes impregnated with the preserving vapour. "Partially decayed matter" is almost instantaneously restored to a condition of "absolute freshness" by dipping it into a solution of the compound.—E. E. B.

Improvements in Rice-product and Process for Preparing same. E. V. Donelson, Baltimore, U.S.A. Eng. Pat. 15,959, November 5, 1888. 4d.

THE rice grain is submitted to a moist heat to loosen the outer covering of cellular tissue, and afterwards passed through a pair of ordinary "burr" stones which remove the outer casing without breaking the grain. The grain is now again subjected to a straining process to thoroughly develop the soluble starch, dextrin, and sugar, still without destroying the form of the grains. Immediately on completion of this cooking process the hot grains are suddenly cooled by cold water or a blast of cold air to harden the outside of the grain. The cold grains are now "subjected to the treatment of rolls or mill," and the product dried. The product is wholly soluble, may be kept for any length of time, and is easily handled. It is useful for brewers and as an alimentary substance.—A. J. K.

(B)—SANITARY CHEMISTRY.

Purification of Effluent Waters. Comparative Purifying Effect of Caustic Lime and other Substances. H. Schrieb. Chem. Zeit. 13, 17—18 and 30—31.

IN the former experiments made by the author (this Journal, 1888, 862) the purifying effect of caustic lime alone on the organic matters of effluent waters was determined. The comparative effect of this reagent in conjunction with other substances was now tried, with the following results, representing the amounts of organic matter precipitated by the various reagents.

Purification with :—

—	Lime alone.	Lime and 0·2 Grm. of Siliceous Material per Litre.	Lime and 0·2 Grm. of Water-Glass per Litre.
	Megms. per Litre.	Megms. per Litre.	Megms. per Litre.
1	600	530	602
2	455	485	515
3	610	605	560
4	540	490	533
5	672	705	680
6	1,075	1,250	1,290
Average..	659	678	697

Purification with :—

—	Lime alone.	Lime and 0·2 Grm. of Aluminium Sulphate per Litre.	Lime and 0·2 Grm. of Ferrous Sulphate per Litre.
	Megms. per Litre.	Megms. per Litre.	Megms. per Litre.
7	500	535	545
8	550	530	295
9	210	205	260
10	247	252	220
Average..	342	330	330

Purification with :—

—	Lime alone.	Lime and 0·2 Grm. of Aluminium Sulphate per Litre.	Lime and 0·2 Grm. of Magnesium Sulphate per Litre.
	Megms. per Litre.	Megms. per Litre.	Megms. per Litre.
11	765	787	815
12	475	525	455
13	180	152	123
14	765	712	787
Average..	546	544	545

From these results the conclusion may be drawn that lime alone affects as great a purification as when the other substances named are used in conjunction with it. The author believes this to have been attained thus. The purifying quality of lime is due to the formation of precipitates, which cohering together in flocculent masses, carry down with them other suspended matters. These pre-

cipitates with lime consist of salts of organic acids and proteids. In addition to these precipitates it appears necessary that sulphate or carbonate of lime or both shall be formed in order that the precipitation shall be rapid and effectual, and for this reason the addition of such substances as ferrous and aluminium sulphates have been recommended in addition to the lime. The author however points out that the amount of inorganic sulphates and carbonates already present in the waters are quite sufficient in almost all cases (and he points out here that no general rule for the purification of affluent waters can be given) for the formation of the necessary precipitate to carry down the organic precipitates readily.

The objection to an excess of free lime in the clarified waters is met by the argument, that, in the majority of cases, this quantity is reduced to such an extent on the effluent joining and mixing with the main stream, that it cannot have any injurious effect on fish, &c., and that further a portion, if not all, of this excess of lime is precipitated rapidly by the carbonic acid and sulphates in the river water. Nevertheless the necessary amount of lime to be added and whether other salts such as sulphates should be added too, must be in each separate case determined.—J. W. L.

PATENTS.

An Improved Process for Softening and Purifying Water. R. E. Phillips, London. From F. S. Harwood, Carcavellos, Portugal. Eng. Pat. 2761, February 24, 1888. 8d.

THE lime, earthy, and organic matter held in suspension are precipitated by passing the water over non-oxidisable electrical conductors through which positive electricity is discharged into the water. The hydrogen gas evolved may be collected and utilised as required.—B. T.

An Improved Process for Disinfecting and Purifying Sewage. R. E. Phillips, Carcavellos, Portugal. Eng. Pat. 2762, February 24, 1888. 8d.

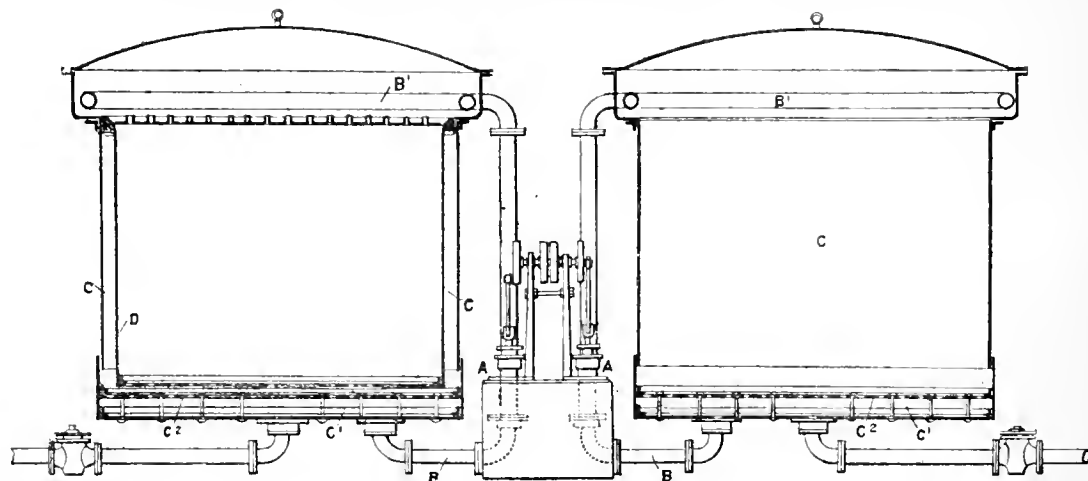
A CURRENT of positive electricity is passed through the sewage. The "ozonized oxygen" thus produced oxidises the organic matter and causes it to subside whilst the hydrogen which is liberated at the same time is collected in suitable receivers and utilised for heating or lighting purposes. The arrangement of the apparatus is shown in a drawing.—E. E. B.

XIX.—PAPER, PASTEBOARD, Etc.

PATENTS.

Improvements in Apparatus for Use in Boiling Esparto Grass and other Fibrous Materials. J. Turnbull, junior, Glasgow. Eng. Pat. 4931, April 3, 1888. 6d.

INSTEAD of causing circulation of the alkaline liquors through esparto by means of vomiting pipes as ordinarily, the



inventor attains the same result by means of the pumps A. In this way a partial vacuum is created in the chamber formed by the plates C² and C¹. The liquor is drawn away by the pipes B, and is discharged and spread over the grass by the pipes B². The boilers may be charged in the usual way, or the grass may be filled into cages D, which are then let down into the boiler.—E. J. B.

An Improved Process of Treating Fibre-bearing Plants and Fibrous Materials. S. S. Boyce and P. P. Steele, New York, U.S.A. Eng. Pat. 16,081, November 6, 1888. 6d.

This invention relates to the treatment of flax, hemp, china grass, &c., for the preparation of finer and stronger fibres than by the present methods of retting.

The dried stems are first crushed by passing them between fluted rollers. They are then treated in a bath of hot soft water for about five minutes, and afterwards passed again through rollers to expel the softened or partially dissolved glutinous matters.

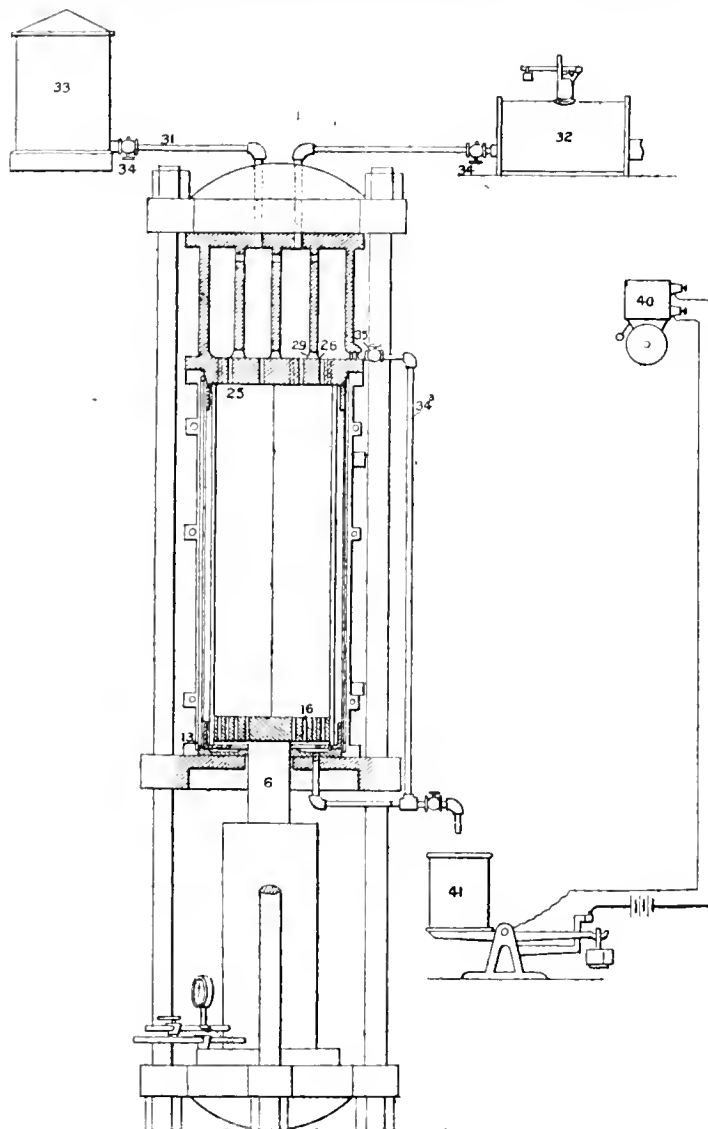
The next step is to boil the material for about five minutes in an emulsion made by mixing alkali with any fixed animal, vegetable, or mineral oil—preferably the

natural oil derived from plants similar to those undergoing treatment. The material is then washed and dried. The last process consists in passing it through rollers for the purpose of removing extraneous matters, and separating the fibres.—E. J. B.

Improvements in Printing Designs upon Pyroxyline Compounds to be used for the Production of Collars, Cuffs, Shirt Fronts, Cards, and other Articles. O. Imray, London. From J. R. France, New York, U.S.A. Eng. Pat. 17,691, December 4, 1888. 4d.

For the purpose of producing indelible designs, sheets of celluloid in the "green" or "unseasoned" condition are printed in an ordinary printing-press, with any desired pattern, an ink being employed "in which chemicals or alcohols having an affinity for celluloid are mixed with a dye such as will mix with these chemicals and with the solvents contained in the celluloid." After being allowed to season for several days the sheets are pressed between "steam tables," at a temperature of 150° to 200° F., and at a pressure of from 1,500 to 2,000 lbs. to the square inch. The heat and pressure serve to incorporate the solid matter of the ink into the body of the sheet, and render the surface plastic and even.—W. E. K.

Improvements in the Manufacture of Celluloid and similar Compounds, and Apparatus therefor. O. Imray, London. From J. R. France, New York, U.S.A. Eng. Pat. 17,692, December 4, 1888. 8d.



The object of this invention is to enable the manufacturer to dry nitrocellulose expeditiously and safely. For this purpose the wet material is packed in the chamber of the press. The ram 6 is then raised by hydraulic pressure and maintained at a pressure of 400 lb. per sq. in. for one hour. The water thus expressed is removed by the perforations 16 at the bottom, and through the head 25 and pipe 34. The air cock 34 is then opened and compressed air allowed to enter from the receiver 32. By this treatment a further quantity of moisture is removed. The cock 34 is then closed and 95 per cent. alcohol is allowed to flow in through the pipe 31. In this way the remainder of the water is driven out into the vessel 41, placed on the weighing machine, which is so arranged that as soon as the weight 39, which is equal to the amount of water in the pulp, has been counterbalanced the electric bell 40 is caused to ring. When this happens the receiver 41 is changed for one to collect the alcohol, which is driven out of the press by means of compressed air. The nitrocellulose is then ready for treatment with solvents.—E. J. B.

Improvements in and relating to Boilers for Use in Treating Wood or other Fibrous Matters with Acid Solutions.
A. Lundberg, Northfleet, Kent. Eng. Pat. 17,376, December 7, 1888. 8d.

The inventor employs a lining composed of a thin backing sheet d of zinc, iron, copper, or copper alloy, coated with a layer of lead or lead alloy, &c.

The lead must be fused on to the backing so as to secure perfect metallic contact, for this purpose the surface should be previously tinned. The method of applying the coating is shown in Fig. 2, which is drawn half natural size. At 4

Fig. 1.

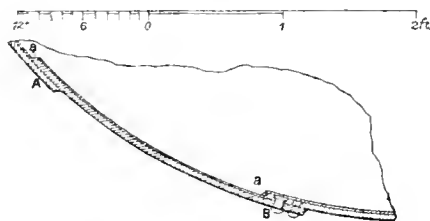
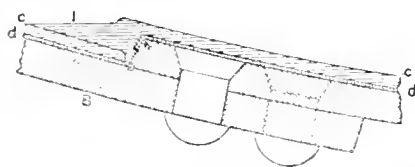


Fig. 2.



the backing plate is bent over the edge of the boiler-plate, and its lead coating hammered down as at *l*. The construction of the boiler and the way in which the coating is applied are also shown in Fig. 1.—E. J. B.

An Improved Manufacture of Paper and Cardboard.
A. Diana (formerly Lewis) Lesa, Italy. Eng. Pat. 18,658, December 20, 1888. 4d.

This invention relates to the manufacture of sheets of paper having two faces of different colours or qualities. The usual method of preparing such paper is to employ two wire cloths, one placed above the other. The two kinds of paper thus separately made are united together as they pass through the wet press. The present method consists in causing pulp in a liquid condition to flow on to the already formed sheet of paper before it leaves the wire cloth, the most suitable place being between the suction-boxes.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Report of New Discoveries and Applications of Medicinal Chemicals. Merck's Bull. 1, [6].

Camphoric Acid.—(This Journal, 1888, 865.)

The topical applications which showed styptic action on the mucous membranes within two minutes were in some instances as weak as $\frac{1}{2}$ per cent. The special cases for which particular strengths of solutions for topical application were recommended (Rep. of Berlin Med. Soc.) are as follows:—

In *Acute Angina*, *Acute* and *Sub-acute Pharyngo-Laryngitis* and *Trachitis*, *Acute Bronchitis*, and *Cystitis*. It is defined as a mild, non-irritant antiseptic.

Chromic Acid.—Described and recommended as a *Local Anti-diaphoretic*. Used by Official decree in the Royal Prussian War Department, as the best and most harmless preventive of foot-sweat in the case of marching troops. A 10 per cent. solution of the acid is used.

Bismuth Salicylate.—A true basic compound, in order to possess the properties desirable for its specific medical uses, especially the capability of being borne by the stomach without irritation, must be a definite chemical compound, not a mixture of an acid salicylate with bismuthous oxide. Its salicylic acid must therefore be so chemically united to the base that no solution of the acid can be effected by such solvents as ethylic alcohol, ether, or chloroform.

Basic Bismuth Salicylate (Merck), containing 63 per cent. of bismuthous oxide, all combined with salicylic acid, is recommended (E. Ehring) for the various gastro-intestinal complaints of infants. It is recommended, not in the form of powder, but as a mixture, and is described as an *astringent* and an *energetic disinfectant*.

Cerium Oxalate has proved a useful sedative in sickness, hysteria, and an astringent in gastro-intestinal catarrh. It exerts a peculiarly sedative action on the sympathetic nerves. No ill effects were observed from its use, even when doses as large as $1\frac{1}{2}$ grms. were repeated several times a day. Dr. Gardner, of New York, has pronounced it the best specific against sea sickness that has so far been made known.

Ephedrine Hydrochloride occurs in colourless needles, melting at about 210° C., easily soluble in water, less so in alcohol, but insoluble in ether. Its aqueous solution was found by Miura, of Tokyo, to be permanent under the influence of light. The simple alkaloid, discovered by Nagai, which is the base of the above salt, is also obtained in colourless crystals. From other species of *Ephedra* than that yielding *Ephedrine*, Merck has obtained a different alkaloid, termed by him *Pseudo-ephedrine*. Its hydrochloride is very readily soluble in water and in alcohol. From the ether-alcohol solution it crystallises in colourless needles, melting at 174–176° C.

From the evidences afforded by many experiments on the human subject, Miura infers that ephedrine hydrochloride is a convenient *mydriatic*, and a good substitute for homatropine in examinations of the fundus of the eye. The *Kava-resins* (from the root of *Macropiper methysticum*) are characterised by a peculiar sedative and benumbing effect. The root referred to is well known to the Polynesian natives, who produce from it an intoxicating liquor. Contact with the root causes a biting sensation on the tongue, which afterwards leaves that organ almost devoid of sensation for a certain time. Though the organic principle in the root producing the sedative and benumbing effects referred to may be different from that to which the diaphoretic and diuretic effects are due, yet the fact has been established that the various medicinal virtues of the kava-root are pretty fully concentrated in the two peculiar resins first isolated by Lewin, and termed *Alpha-kava-kava resin* and *Beta-kava-kava resin*. These resins present all the specific effects of the crude drug kava as local anæsthetics. Yet the crystalline, odourless and insipid neutral principle

Kavakin or *Methysticin*, isolated from the same root, is reported by Lewin as possessing no physiological action. It occurs as silky white needles, soluble in alcohol and in ether, and melting at 130° C. C. Pomeranz, in 1888, established its chemical individuality as that of a derivative of the methyl ether of catechol (pyrocatechin).—W. S.

Apiol. G. Ciamician and P. Silber. Ber. 22, 119—121.

If apiolic acid be heated with alcoholic potash to 180 in sealed tubes it yields a crystalline product with a smell of phenol, boiling at 298° and melting at 105—106°. It has the formula $C_6H_{10}O_4$. With ferric chloride it gives a dark violet colouration changing to brown. This body has probably the constitution $C_6H_2(OH)_2(OCH_3)_2$. The presence of two methoxyl groups was determined by Zeisel's method. (Compare this Journal, 1888, 399 and 583.)

—J. B. C.

γ- and δ-Isotropic Acid. C. Liebermann. Ber. 22, 124—130.

From a by-product from cocaine the author has isolated two acids, which from their similarity to Fittig's α- and β-isotropic acid, he calls γ- and δ-isotropic acid. The former can be converted into a new acid of the same composition, which is therefore named ε-isotropic acid. The γ-acid on distillation yields cinnamic acid and a small quantity of an oily by-product. The γ-acid also gives cinnamic acid on distillation, though in smaller quantity. On boiling the acids with acetic anhydride and sodium acetate the anhydrides are formed. The anhydride of the γ-acid yields on heating with an alkali the ε-acid. With cone. sulphuric acid, the sulphonic acids of γ- and δ isotropic acid are formed.

—J. B. C.

The Cocaines. C. Liebermann. Ber. 22, 130—133.

By bringing together 2 parts of ecgonine, 1 part of water and 2 parts of γ-isotropic-anhydride and heating on the water-bath, isotropyl-ecgonine is formed, which after drying may be mixed with isotropic acid, dissolved in methyl alcohol and saturated with hydrochloric acid gas. On evaporating off the methyl alcohol and the acid, dissolving in water and shaking out with ether, the ethereal solution leaves on evaporation isotropyl-cocaine of the formula $C_{19}H_{23}NO_4$. This substance is identical with the natural product.

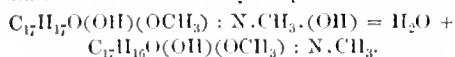
By the same process the author has prepared anisyl-ecgonine and anisyl-cocaine.—J. B. C.

Occurrence of Cinnamic Acid among the Decomposition Products of Crude Cocaine. H. Franfeld. Ber. 22, 133—134.

THE crude cocaine is exhausted with boiling water, which takes up the greater part of the free acid. From the residue a cold dilute solution of alkalis dissolves γ- and δ-isotropic acid. The residual ethereal salts are decomposed by a boiling solution of caustic alkali and the γ- and δ-isotropic acids dissolve. The first aqueous extract contains cinnamic acid which may be isolated by means of its calcium salt.—J. B. C.

Morphine. L. Knorr. Ber. 22, 181—185.

METHYLMORPHINE-METHYL IODIDE is decomposed on boiling with silver oxide into methylmorphimethine—



This latter body decomposes into an amine and non-nitrogenous substance, which appears to be an anthracene derivative.

The methyl iodide of methylmorphine is treated in aqueous solution with silver oxide, which removes the iodine, and the hydroxide is evaporated in a distilling flask connected with a receiver containing hydrochloric acid. The contents of the flask gave up to ether a crystalline substance of the formula $C_{15}H_{10}O_2$. The receiver contained the

hydrochloride of trimethylamine. Methylmorphimethine, when heated with acetic anhydride to 160—200°, yields four different bodies, viz., acetylmethylidoxypheanthrene, an oil with basic properties, an oily ethereal salt, and a volatile base which was identified as dimethylamine.—J. B. C.

The Alkaloids in Cocaine. A. Einhorn. Ber. 22, 399—402.

THESE investigations were limited to the by-products in the preparation of ecgonine hydrochloride from cocaine. The cocaine is decomposed with concentrated hydrochloric acid into ecgonine, which is precipitated by the addition of alcohol and ether. The filtrate on evaporation leaves a syrupy liquid. The syrup is dissolved in water, filtered, and caustic soda added, which precipitates a light coloured compound. This precipitate when dry partly dissolves in alcohol, from which a crystalline substance is obtained. The new product has probably the formula $C_{20}H_{25}N_2ClO$. The filtrate from this compound, after acidifying with hydrochloric acid, yields on evaporation crystallised anhydro-ecgonine. This substance is decomposed by hydrochloric acid at 270° into hydrocarbons, methyl chloride, ammonia, methylamine, and also basic substances, one of which yields a nitroso compound and the other is unchanged by the action of nitrous acid, but forms a double chloride with chloride of gold. Both bases when distilled with zinc dust yield oils smelling of pyridine.—J. B. C.

The Salicylates of Cresol. H. Nencki. Compt. Rend. 108, 254—255.

THESE bodies are prepared by the same method as salol. Three well crystallised salts may be obtained insoluble in water, and with difficulty soluble in alcohol, viz., the derivatives of ortho-, meta-, and para-cresols melting respectively at 35°, 74°, and 39°. Their odour is not quite so strong as that of salol. The ether of o-cresol has a slightly burning taste, the para-compound is absolutely tasteless. Not only by the pancreatic juice, but also by the muscles, these substances are decomposed into their constituents, and their antiseptic action is identical with that of ordinary salol. The p-cresol produced thus by the decomposition of the corresponding salicylate, is partly eliminated from the body, combined with sulphuric acid, and partly oxidised to benzoic acid.—A. R.

Phenylpropionic Acid and Phenylacetic Acid. C. T. Williams. Pharm. Journ. and Trans. 1889, 701.

Phenylpropionic Acid, $C_9H_{10}O_2$, is described as occurring in acicular crystals of reddish-white colour, insoluble in water but soluble in spirit (1 : 6), and having a feebly acid reaction. The solution has a not unpleasant sour aromatic taste and a pleasant aroma. The alcohol solution was administered in 10 minim doses diluted with an ounce of water, which were generally increased to 20 minims in two ounces of water, three times a day. As a rule the medicine caused neither nausea, vomiting nor anorexia, except in two cases in which the nausea was overcome by further dilution of the medicine with water. As a result of the treatment, 13 cases improved, four remained stationary, and three became worse, and it was inferred that phenylpropionic acid exercises more influence on suppuration than on tuberculation. In the improved cases, there was decided increase of appetite and gain of weight, colour, and vigour.

Phenylacetic acid tastes like the foregoing, but has a more acid reaction. It dissolves in alcohol (1 : 6), and in this condition is taken up by a small quantity of water. The alcoholic solution was given in doses of 10 to 20 minims three times a day, to 19 cases of phthisis, for periods ranging from 21 to 29 days, and in no case gave rise to unpleasant symptoms. Thirteen of the cases improved greatly, four deteriorated, and three remained stationary, the improvement consisting in gain in weight, strength, and colour, partly due to diminution of cough and expectoration. From the general results of the experiments with the two compounds, it is concluded that phenylpropionic and phenylacetic acids given in phthisis promote appetite,

digestion, and assimilation, and are well tolerated in considerable doses; also that the use of phenylacetic acid is more indicated in cases of tuberculation and that of phenylpropionic acid in excavation cases.—W. S.

PATENT.

Improvements in Apparatus for the obtainment of Oxygen and Nitrogen Gases from Atmospheric Air. E. B. Ellice-Clark and L. Chapman, London. Eng. Pat. 3880, March 13, 1888. 1s. 1d.

THESE improvements relate to apparatus used in Brin's process, Eng. Pat. 157 of 1885. (This Journal, 1885, 568, and 1886, 34.) They comprise 11 claims bearing upon the shape, arrangement, luting and connexion of the retorts, the heating chamber or furnace, the water chamber, supports for the baryta, and other details of construction, for particulars of which the specification and sheets of drawings must be consulted.—B.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

PATENT.

A Method for producing Photographic Emulsions not requiring a Base or Support as Photographic Films. E. S. Williams, Dublin. Eng. Pat. 4874, March 31, 1888. 6d.

THE sensitive emulsion itself forms the film and does not require to be placed upon any temporary or permanent support. The melted emulsion, containing a somewhat large proportion of gelatin, is thoroughly mixed with some chromium compound, preferably ammonium or potassium dichromate, and spread in the usual manner upon a levelled glass plate or some other suitable smooth support. When the emulsion has set, the support with the emulsion upon it is immersed in a solution of sulphurous acid or its salts until the dichromate is completely reduced. It is then thoroughly washed with water, dried, and the emulsion stripped from the support and cut up. The dried emulsion forms a perfectly insoluble film, which may be exposed from either side, and the resulting negative may be printed from either side without loss of sharpness.—C. H. B.

XXIII.—ANALYTICAL CHEMISTRY.

The Meldometer. J. Joly. Industries, 1889, 20.

THE meldometer is designed for the purpose of ascertaining the melting and boiling points of small quantities of substances. It consists essentially of two pairs of forceps mounted on a stage and carrying between them a thin platinum ribbon. Through this ribbon an electric current may be passed, the strength of the current being regulated by a carbon-mercury rheostat. The apparatus is mounted on the stage of a compound microscope, provided with a one-inch objective. The substance to be examined is placed in focus on the platinum ribbon, and then the current is gradually increased until the substance is melted or volatilised. Experiments made in this way show interesting phenomena, sufficiently characteristic in many cases to identify a substance at once. By arranging side by side different fragments it is easy to find their order of melting points with greater exactness than can be the case when the blow-pipe is employed.

The meldometer is also of value in studying sublimates. A piece of glass is held over the heated strip, and upon this the sublimate deposits. A long series of trials have led to the conclusion that the appearances so obtained are excellent as tests to the mineralogist and chemist.

—W. W. H. G.

Detection of Nitrates in Soils. Kreusler. Landw. Jahrbuch, 1888.

B. FRANK observed that certain quartz granules gave a blue colouration with diphenylamine even after repeated washing with water. This he attributed to a special surface attraction which enabled the granules to retain nitrates. The author of the present note points out that the blue colouration is produced in all cases where manganic or ferric oxides are present in a soil or sand, and suggests that Frank was most likely dealing with these oxides and not with nitrates.

—D. A. L.

Test for Glass by Colour Reactions. F. Mylius. Ber. 22, 310—314.

THE presence of free alkali in glass may be determined by the blue iodide of starch reaction. As the blue colour is produced only in the presence of an iodide, starch solution, mixed with an aqueous solution of iodine and a few drops of silver salt, to precipitate any free iodide, is added to the glass. The presence of alkali, by forming a soluble iodide, is indicated by an immediate blue colouration. The intensity decreases with different kinds of glass, in the following order:—

Lead glass.
Thuringian glass.
Thermometer glass.
Bohemian glass.

Another method is to place the glass in moist ether. The glass absorbs water, which, in its turn, dissolves alkali. If the ether be now replaced by an ethereal solution of free eosin or eosin iodide (not the alkaline salt), the dissolved alkali frees the colouring matter on the surface of the glass, and the intensity of the colour depends on the quantity of free alkali.—J. B. C.

Action of Chlorine on Carbon Dioxide. R. Lucien. Chem. Zeit. 13, 32.

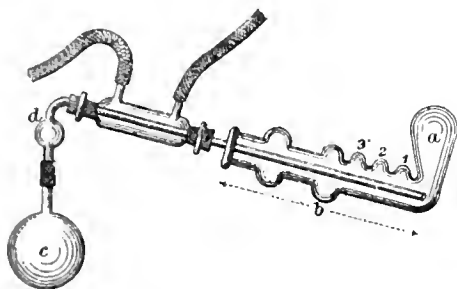
EXPERIMENTS conducted in a variety of ways showed that chlorine has no action on dry carbon dioxide. In the presence of moisture chlorine disappears from the mixture of gases when passed through a red-hot tube, not in the form of carbonyl chloride, but as hydrochloric acid. Although it would seem as though the carbon dioxide did not take any part in the reaction, it was found that on passing a mixture of damp air and chlorine through a red-hot tube less chlorine united with the hydrogen of the water than when the mixture consisted of damp carbon dioxide and chlorine, the relative volumes remaining the same.—J. W. L.

Analytical Notes. C. La Harpe and F. Reverdin. Bull. Soc. Chim. 51, 163—165.

Detection of Carbon Monoxide in the Air.—The presence of carbon monoxide in the air can be detected as follows:—A moderately slow stream of the air to be tested, previously filtered through cotton or glass-wool, is passed to the bottom of a fractionation flask containing pure dry iodic acid and placed in an oil-bath heated to 150°C; the side tube is bent downwards into a vessel containing a solution of starch in distilled water. The carbon monoxide is thus oxidised to carbon dioxide, iodine is liberated, and the starch solution coloured blue. It was proved by experiment that an appreciable colouration is produced when 9 litres of air containing only 1 to 2 parts of carbon monoxide in 100,000 were passed in the course of about 20

minutes; it is probable that this gas could be detected when present in even smaller quantities provided a larger volume of air was employed. Any other reducing substances present in the air to be tested must of course be previously removed in the usual manner.

Modifications of Bausen's Apparatus for estimating Manganese and Chromates.—In estimating manganese or chromates by Bausen's method the bulb (a) often becomes filled with air or inert gas at the commencement of the operation. The liquid is thus driven back into the bulb (b), and there becomes heated. In order to obviate any such action and to prevent the liquid in the flask (c) from being carried over into the bulb-tube, the author employed the following apparatus:—



The tube *d* is provided with a small bulb, very loosely plugged with glass-wool and passes through a small condenser into the bulb tube *a*, which is provided with three hemispherical bulbs 1, 2, 3. At the commencement of the operation the inert gas, containing only small quantities of chlorine, is passed into *b* just above the bulb 1, so that it circulates from one bulb to the other and passes out free from chlorine. As soon as the gas evolved is completely absorbed the tube is pushed to the bottom of *b* and the operation concluded as usual.

In analysing chromates it is advantageous to add a little manganese dichloride as well as hydrochloric acid, as reduction then takes place much more quickly.—F. S. K.

Separation of Zinc from Nickel. II. Baubigny. *Compt. Rend.* 108, 236—238.

WHEN dilute solutions of zinc sulphate are treated with H_2S , all zinc is precipitated even in presence of six times the quantity of free acid contained in the sulphate. Thus 0.06 gm. of $ZnSO_4$ dissolved in 200 cc. of water containing 0.27 gm. of SO_3 is nearly completely precipitated as sulphide in eight hours, only 0.0015 gm. of $ZnSO_4$ remaining in solution. Likewise the presence of considerable quantities of acetic acid does not prevent the precipitation of zinc from solutions of zinc sulphate. This may serve as a means of separating zinc from nickel. Thus 0.3 gm. of the mixed sulphates is dissolved in 100 cc. of water containing about 10 per cent. of glacial acetic acid and treated at ordinary temperatures with H_2S . After standing a few hours, the ZnS is filtered off, and to the filtrate sodium acetate is added, and NiS precipitated by passing H_2S into the solution heated to 70° — 75° . Nickel sulphide should always be washed with water containing 1—2 per cent. of acetic acid, otherwise the wash-water runs off turbid. The sulphides are converted into sulphates, and dried at 400° . The numbers found in these experiments agree very closely with the quantities taken. When the mixture contains less than one-third nickel salt, it is superfluous to add acetic acid, since the free acid formed from the sulphate of zinc by the sulphuretted hydrogen suffices to keep the nickel sulphide in solution.—A. R.

On Cobalt and Nickel. G. Krüss and F. W. Schmidt. *Ber.* 22, 11—15.

IN determining the atomic weights of cobalt and nickel, the authors find that if the method of weighing the equivalent of precipitated gold by bringing the respective metals into a neutral solution of gold chloride or the sodium double salt be employed, small quantities of nickel and cobalt are left with the gold. The gold may be freed from nickel and cobalt by redissolving in aqua regia and precipitating with sulphurous acid. On washing the precipitate free from cobalt, the pink colour due to the cobalt gradually pales and then takes a greenish shade. This green solution on evaporation leaves a residue, which dissolves in hydrochloric acid with a green colour. The same kind of residue is obtained in the case of nickel. Larger quantities may be prepared by washing precipitated nickel sulphide with ammonium sulphide until the ammonium sulphide is no longer coloured brown. The oxide of the new substance may be also obtained by fusing cobalt and nickel oxides with an alkali, in which the former dissolves. The new element has the following properties:—The acid solution of the chloride is not precipitated by sulphuretted hydrogen, but by ammonium sulphide in a neutral solution, and forms a black powder. It yields with ammonia a white flocculent precipitate insoluble in excess of the precipitant. Caustic potash produces a similar white precipitate insoluble in excess. The oxide does not yield Thénard's blue, and is soluble in hydrochloric acid after strong ignition. It forms a colourless anhydrous chloride, which in solution changes to green. The metal obtained by reducing the chloride in a current of hydrogen or by electrolysis of the chloride is black.—J. B. C.

A New Acid of Tin. W. Spring. *Bull. Soc. Chim.* 51, 180—182.

A NEW acid is formed when a saturated aqueous solution of stannous chloride, containing sufficient hydrochloric acid to prevent decomposition, is treated with excess of pure barium dioxide at the ordinary temperature. The turbid liquid which is obtained contains a compound of tin in the colloidal condition and does not become clear, either on filtering or standing. The barium chloride in solution is completely removed by dialysis and, on evaporating the solution, a white solid substance is obtained. This compound, when dried at 100° , has the composition $2 SnO_3 \cdot H_2O$. The oxygen and the water were both estimated directly.—F. S. K.

Detection of Mineral Phosphates in Bone-Meal. N. v. Lorenz. *Oesterr.-Ungar. Zeits. f. Rubenzuck. Ind.* 1888, 270—272.

BONE-MEAL is first moistened with 1 : 1 sulphuric acid, but dissolved bones is treated direct with concentrated sulphuric acid. The evolution of hydrofluoric acid indicates the presence of mineral phosphates, as the latter generally contain calcium fluoride. It is stated that the addition of 10—20 per cent. of phosphoric acid to bone-meal can be detected by this means. The calcium fluoride in the bones takes no part in the reaction, and is found by the author to be present in much smaller quantities than is generally supposed.—D. A. L.

New Reaction of Acetanilide. M. Denigès. *Arch. Pharm.* 1888, 529.

MINUTE quantities of acetanilide boiled with a small quantity of sodium hypobromite in alcoholic solution cause the formation of a yellow-red precipitate, while at the same time the smell of methyl-cyanide becomes perceptible. All anilides which form salts and free aniline when boiled with an excess of free alkali react in this way, the free aniline reacting with the hypobromite with formation of the red precipitate.—J. W. L.

On the Estimation by Weight of Glycerol by oxidising it with Potassium permanganate in Acid Solution. H. Grünwald. Zeits. f. angew.Chem. 1889, 34.

PLANCHON'S method for the estimation of glycerol was found by the author to yield very good results. The glycerol is oxidised by potassium permanganate in the presence of sulphuric acid to carbonic acid according to the equation $C_3H_5O_3 + 7 O = 3 CO_2 + 4 H_2O$. The absorption of carbonic acid took place, however, in caustic potash instead of soda lime, as Planchon recommends. The steam was retained by a calcium chloride tower, with which was connected a calcium chloride tube. The acid mixture was heated in a round flask on a wire gauze, and the experiment does not require more than one hour. A number of analyses is given which speak for the excellence of this method.—A. L.

On the Estimation of Resins. Zeits. f. angew. Chem. 1889, 35.

THE most complete examination of resins has been made by M. v. Schmidt and F. Erban. They took three factors into consideration. (1.) How many milligrammes of caustic potash 1 grm. of resin requires for saturation. (2.) How many milligrammes of caustic potash is fixed by boiling 1 grm. of resin with an excess of alcoholic caustic potash (Köttstorfer's number). (3.) How many per cent. of iodine resin is able to fix (Hubl's iodine number).

Experiment No. 1 is made in the following manner:—1 grm. of the finely crushed resin is boiled under reversed condenser with alcohol of 95 per cent., filtered if necessary and phenolphthalein added to the solution. It is then titrated with caustic soda. To obtain Köttstorfer's number, 1 grm. of resin is boiled with 25 cc. of alcoholic caustic potash for 5 to 15 minutes under reversed condenser; then 100 cc. of alcohol are added, and the excess of alkali is titrated, after once more boiling, with hydrochloric acid and phenolphthalein. The third number is obtained by dissolving 1 grm. of resin in hot alcohol, and adding, after cooling, 25 cc. of iodine solution. If the solution be soon discoloured, a fresh portion of iodine solution is added until the mixture remains reddish-brown after prolonged standing. After 24 hours the excess of iodine is ascertained by back titration. The following table contains the three numbers of some of the most important resins used for technical purposes:—

Resins.	No. 1. Acid Number.	No. 2. Kött- storfer's Number.	No. 3. Hubl's Number.	
			With Residue.	Without Residue.
Colophony.....	146.5	168.2	..	116.8
Sandarac.....	141.4	174.4	..	66.8
Benzoin.....	136.3	164.7	..	57.4
Storax.....	130.6	205.6	64.7	58.6
Copal of Angola, white, melted	93.6	118.8	44.9	41.6
India-rubber.....	81.2	..	70.9	70.0
Venetian turpentine.....	70.1	102.6	..	145.3
Shellac {	65.1	213.3	8.3	6.0
		211.6	..	..
Mastic.....	64.5	193.8	64.4	53.2
Dammar.....	33.0	47.1	63.6	64.1
Copal of Angola, red, melted.	30.5	119.7	34.8	22.3
Elemi.....	22.3	25.1	..	85.1
Dragon blood.....	..	..	72.4	55.5
Copal of Angola, red.....	..	148.0	..	..
Amber.....	..	145.0	..	..
Copal of Angola, white.....	..	132.2	..	..
Copal of Zanzibar.....	..	92.4	..	..
Amber, melted.....	..	38.2	4.8	3.3
Copal of Zanzibar, melted...	..	36.8	12.6	7.6
Asphaltum.....	..	8.1	22.2	3.5

When the resins were dissolved in alcohol or turpentine, the solvent was distilled off with steam. The remaining resins, however, show nearly always a lower acid figure and a lower Köttstorfer's number, part of the acid having been removed by the steam, as the following table shows:—

Resin.	Acid Number.	Köttstorfer's Number.	Iodine Number.		Solvent.
			With Residue.	Without Residue.	
Sandarac.....	139.7	167.8	..	90.1	Alcohol.
House Colophonium.....	130.4	146.8	..	109.6	Turpentine.
Copal of Angola, white, melted.....	81.8	106.1	58.2	56.9	Turpentine.
Venetian Turpentine.....	81.0	110.3	..	103.6	..
Mastic.....	53.5	76.5	81.0	62.4	Turpentine.
Shellac.....	35.7	209.1	8.5	7.9	Alcohol.
Copal of Angola, red, melted.....	32.0	72.3	54.4	47.0	Turpentine.
Elemi.....	29.6	43.3	..	40.9	Alcohol.
Dammar.....	27.7	40.5	66.1	57.4	Turpentine.
Copal of Zanzibar, melted.....	20.3	65.6	52.8	51.3	Turpentine.
Amber, melted.....	..	37.9	20.7	16.4	Turpentine.
Asphalt.....	..	52.1	28.7	16.3	Turpentine.

R. Williams, who has probably no knowledge of this research, estimated the whole quantity of the required caustic potash by boiling for half an hour with half normal alcoholic potash and by titrating the excess with half normal hydrochloric acid and phenolphthalein. For esti-

imating the acid the resin was boiled with strong alcohol and titrated with half normal caustic potash. Hubl's iodine number was found in the usual way. The loss of weight in drying was estimated by heating to 100° C.

Resins.	Total Potash.	Potash for Neutralising Free Acid.	Iodine.	Loss of Weight at 100° F.
Amber.....	8.68	1.54	62.10	1.05
Anime Zanzibar.....	7.36	1.82	135.25	0.18
Gum Arabic.....	8.10	0.84	0.51	8.13
.....	5.67	0.28	0	11.32
.....	8.97	0.22	0	12.44
Asphaltum, Syrian...	2.37	0.89	54.08	2.24
Benzoin.....	14.84	0.80	76.45	1.66
Copal, Manilla.....	18.44	13.16	137.79	0.79
Bornea.....	17.67	14.14	138.04	2.24
Singap.....	19.44	12.88	123.31	2.41
Purified Sierra Leone	12.00	8.40	138.04	0.91
Crude.....	13.85	7.28	133.35	1.04
Acera crude.....	13.16	4.62	121.66	1.48
Angola white.....	13.30	5.74	129.66	0.57
Pure red.....	13.62	6.62	136.90	0.40
Unknown.....	12.22	5.74	112.24	0.98
Danumar, Batavia....	3.64	2.24	117.67	0.33
Unknown.....	3.11	2.06	162.24	0.85
.....	4.07	2.10	130.24	0.71
Dragons blood unknown	15.34	1.12	98.42	0.34
Elemi.....	2.86	1.57	175.39	3.50
Mastrix.....	7.34	5.04	158.62	0.97
.....	7.91	5.60	159.00	1.46
Colophony, refined...	18.74	17.92	115.31	0.13
.....	19.57	17.78	114.80	0.14
Colophony, ordinary..	17.64	16.94	112.01	0.32
.....	19.01	16.66	113.28	0.34
Sandarac unknown..	15.54	15.40	..	1.88
.....	15.70	14.56	134.30	1.44
Senegal.....	10.42	0.28	5.59	23.70
Shellac, medium.....	20.33	6.30	24.62	1.06
" Garnet.....	21.26	5.60	28.70	0.72
" Orange.....	20.64	6.44	17.52	1.23
" Good II.....	21.07	4.76	20.40	0.88
" Light II.....	21.14	5.60	19.81	1.01
" Bad II.....	19.44	5.74	19.05	1.41
Tregasarth unknown	11.05	6.14	..	16.86
.....	11.98	6.14	1.16	13.52

To test for resin, a small quantity of it is dissolved in acetic anhydride, and to the cold solution one drop of sulphuric acid is very carefully added. The solution is coloured dark red to blue violet. The colourations disappear however, and the solution appears finally brownish-yellow and fluorescent.—A. L.

On the Determination of Organic Nitrogen by Kjeldahl's Method. C. Violette. *Compt. Rend.* **108**, 181—183.

THE author has determined the nitrogen of the product which remains after the fermentation of maize, and which is characterised by the difficulty of its combustion according to the methods of Dumas, Varentrapp, Will, and Kjeldahl; the results agree closely. The latter method was slightly

modified by the author, Nordhausen acid being employed instead of ordinary sulphuric acid, 25 cc. for 2 grms. of the substance under examination. Mercury, while favouring the reaction, renders the results very inexact, part of the nitrogen being retained.—A. R.

On Nitrogen Determinations by Kjeldahl's Method. E. Aubin and Alla. *Compt. Rend.* **108**, 246—248.

A comparison is drawn between Varentrapp-Will's and Kjeldahl's method, and the latter is found to be the better of the two. In the former the greatest importance attaches to the proportions in which the substance to be analysed is mixed with soda-lime, as well as the temperature employed. Thus with 1 gm. of linseed cake and a bright red heat, 7.53 per cent. of N were obtained; with 2 grms. and the same quantity of soda-lime: at a dull red heat 6.89 per cent.; at a bright red heat 4.62 per cent. The author therefore always employs 25—30 grms. of soda-lime for every 0.5 gm. of organic substance.

The best proportions in Kjeldahl's method are: 0.5 gm. of organic substance, 20 cc. H_2SO_4 of 66° B., and 0.5 gm. of mercury. The time occupied for complete decomposition is at most $1\frac{1}{2}$ hours, and the liquids obtained are perfectly colourless and limpid. By adding phosphoric acid the time of transformation is much abridged. There is no loss of ammonia whatever. For estimating nitrogen in soils the method is invaluable. As large a quantity as 1,000 grms. were employed for one determination.

A table is appended which shows that this method always gives slightly higher results than Varentrapp-Will's. An advantage of the former is the fact that the substance under examination need not be powdered, and if not homogeneous a large sample may be made into a paste with sulphuric acid and an aliquot part taken for the determination.—A. R.

Estimation of Fat in Butter-Milk by Soxhlet's Areometric Method. J. Sebelien. *Landw. Versuchs-Stat.* **35**, 335—337.

THE fat was determined in 19 samples of butter-milk from sour cream and in 12 samples from sweet cream, by the author's gravimetric method and by Soxhlet's areometric method. With the sour milk the Soxhlet method was in one case 0.3 per cent. too low; in three cases the error was greater than 0.1 per cent., and in the remaining 15 less than 0.1 per cent. of fat. With the sweet milk two results were respectively 0.2 and 0.13 per cent. too high, whilst in the remaining 10 samples the error was less than 0.1 per cent.—D. A. L.

The Detection of Fusel Oil in Alcohol. L. v. Udranszky. *Zeits. f. Phys. Chem.* **12**, 355.

THE author recommends the furfural reaction. He has examined the behaviour of numerous substances with a mixture of furfural, water, and sulphuric acid, and has found that many bodies give characteristic reactions with this mixture. α -naphthol is particularly sensitive, and by its means 0.0000026 gm. of furfural may be detected with certainty. On the other hand, certain impurities of spirit give a colour reaction with furfural and sulphuric acid. These bodies are removed by filtration over animal charcoal. The presence of these bodies as well as furfural, in spirits is, according to the author, the cause of the browning produced on heating with strong sulphuric acid. The author considers the reaction with furfural indicative of the presence of fusel oil in most cases. Other bodies, however, give the reaction, especially such as are extracted from the cask during storage.—H. T. P.

A Simple Method for the Detection of and Estimation of Impurities in Commercial Spirit. M. L. Godefroy.

THE method only varies from the usual one of adding strong sulphuric acid, in the addition of a little benzene, which strengthens the colourations. Windisch (*Zeits. f. Spiritusind.* **11**, 145) condemns this method altogether. For quantitative purposes it is quite useless, and for qualitative

purposes it possesses no advantages over other methods, but, on the other hand, may lead to errors. Windisch draws attention to the researches of F. L. Eckmann, as regards the fusel oil contained in corn brandy, and its detection. The author has shown that fusel oil contains of the higher alcohols, between ethyl and amyl alcohols, only normal propyl and isobutyl alcohols. The composition of fusel oil is—

Per Cent.

3—12 of propyl alcohol.

15—47 of butyl „

44—71 of amyl „

5—7 of remainder, volatile with difficulty.

—H. T. P.

PATENTS.

Improvements in and Apparatus for determining Temperatures and Barometric Pressures. J. G. Wiborgh, Stockholm, Sweden. Eng. Pat. 2673, February 22, 1888. 11d.

See this Journal, 1889, 214—215.

Improvements in Means or Apparatus for ascertaining the Specific Gravity of Liquids. J. J. Hicks, London. Eng. Pat. 4139, March 17, 1888. 8d.

The specific gravity of liquids is ascertained by dipping into them a glass tube open at top and bottom, and containing a number of loosely superposed glass bubbles carefully calibrated to different specific gravities, the heavier ones below, the lighter above. Upon the tube being inserted into the liquid, those bubbles which are of less specific gravity than the liquid will float, and thus indicate that of the liquid with an accuracy sufficient for many purposes.

Fig. 1.



Fig. 2.



Fig. 3.



Fig. 4.



Figures 1 and 2 show one modification, the glass tube being flattened in cross section, with bubbles to correspond. The instrument is provided with a hook at the side for suspension, and has sundry holes in its length for facilitating the entry and exit of the liquid. The bubbles may be marked with figures, or be made in different colours or shapes to indicate different gravities. The tube may also be used as a "pipette," in which case the upper opening is reduced in size and the intermediate holes are omitted. Another arrangement is shown in Figures 3 and 4, where the bubbles are held within a space formed by three upright glass rods instead of within a tube.—B.

Improvements in Clinical and other Thermometers. J. J. Hicks, London, and T. P. Salt, Birmingham. Eng. Pat. 4212, March 19, 1888. 8d.

CHEMICAL and other thermometers, under this patent, are made with a layer of ruby or other coloured glass behind the bore, backed by a layer of opaque enamel, through which means the contents of the bore as well as the divisions on the glass are more readily made visible and the instrument becomes more ornamental.—B.

New Books.

TECHNISCH-CHEMISCHES JAHRBUCH, 1887—1888. Ein Bericht über die Fortschritte auf dem Gebiete der Chemischen Technologie, vom April 1887 bis April 1888. Herausgegeben von Dr. RUDOLF BIEDERMANN. Zehnter Jahrgang. Mit 328 in den Text gedruckten Illustrationen. 1889. Berlin: Carl Heymanns Verlag. London: H. Grevel & Co., 33, Covent Garden.

OCTAVO volume bound in cloth and containing Table of Contents, List of Journals quoted from with abbreviated names, 558 pages of Subject-Matter copiously illustrated with 328 engravings, and a List of New Books on Physics, Chemistry, Chemical Technology, Mineralogy, Geology, and Botany; also Miscellaneous Subjects during the year. A full index of authors and of subject-matter closes the work.

The subjects treated of are as follows:—I. Iron and Steel. II. The Alkali Metals, Magnesium, and Aluminium. III. Gold and Silver. IV. Copper. V. Lead. VI. Zinc. VII. Tin. VIII. Nickel and Cobalt. IX. Manganese and Chromium. X. Antimony, Arsenic, &c. XI. Chlorine and Hydrochloric Acid. XII. Sulphur and Sulphuric Acid. XIII. Oxygen, Hydrogen, Carbonic Acid, &c. XIV. Soda. XV. Potassium Compounds. XVI. Ammonia. XVII. Alkaline Earths. XVIII. Alumina. XIX. Glass. XX. Earthenware and its Production. XXI. Cements. XXII. Artificial Stone. XXIII. Explosives. XXIV. Illuminating Agents. XXV. Fuels and Furnaces. XXVI. Sugar, Materials and Production. XXVII. Starches and Starch Sugar. XXVIII. Wine. XXIX. Beer. XXX. Spirits. XXXI. Fats, Resins, and Soaps. XXXII. Water. XXXIII. Foods. XXXIV. Manures. XXXV. Tanning and Leather. XXXVI. Organic Acids. XXXVII. Alkaloids. XXXVIII. Colouring Matters and Dyes. XXXIX. Textile Fibres, Bleaching, Dyeing, and Calico Printing. XL. Paper. XLI. Photography. XLII. Apparatus. XLIII. New Books.

CHEMISCH TECHNISCHES REPERTORIUM. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und Industriellen Chemie mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. EMIL JACOBSEN. 1888. Erstes Halbjahr. Zweite Hälfte. Berlin: R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder. London: H. Grevel & Co., 33, Covent Garden.

OCTAVO volume in paper cover; the second issue for the first half-year of 1888. It contains 178 pages of subject-matter plentifully illustrated with wood engravings, and in these the following subjects are treated:—Food Stuffs; Paper; Photography; Manures, Refruses, &c.; Soaps; Explosives and Matches; Preparation and Purification of Chemicals; Chemical Analysis; Apparatus, Machinery, &c. Appendix. New Books.

Together with the foregoing is issued the GENERAL INDEX of the CHEMISCH TECHNISCHES REPERTORIUM from 1882 to 1886.

THE LIXIVIATION OF SILVER ORES WITH HYPOSULPHITE SOLUTIONS WITH SPECIAL REFERENCE TO THE RUSSELL PROCESS. By CARL A. STETEFELDT. The Scientific Publishing Company. New York: 27, Park Place.

IN this volume is described the Lixiviation process of treating ores. The work commences with the preface and table of contents, after which follow 223 pages of subject-matter, two plates containing plans of the Lixiviation plant and apparatus, and a carefully arranged alphabetical index. The text is embellished with 30 engravings and is sub-divided as follows:—Introduction. PART I. The Chemistry of the Lixiviation Process. Chap. I. The Chemicals. II. The Chemical Reactions. The Reactions of Sodium Hypo-sulphite solutions. Solubilities of Metals and Various Compounds in Sodium Hypo-sulphite Solutions. III. The Reactions of Extra-solutions. (i) Reactions of Extra-solutions with Caustic Soda and Sodium Carbonate. (ii) Decomposition of Extra-solution by heating. (iii) Decomposition at Ordinary Temperature. Solubilities of Silver, Gold, Lead, Silver Sulphide, and Gold Sulphide in Extra-Solution. The Effect of Extra-solution on Silver Ores and on Ores that have been subjected to a chloridising-roasting. IV. The Extraction of Gold. V. The Chemistry of the Wash Water. VI. The Chemistry of Sodium and Calcium Sulphide. VII. Laboratory Work. Lixiviation Tests with Extra-Solution. PART II. THE LIXIVIATION PROCESS IN ITS PRACTICAL EXERCISE.—Chap. XI. The Lixiviation Plant. XII. The Solutions. XIII. The Charging and Discharging of the Lixiviation Vats. The Second Wash Water. General Rules for Handling the Lixiviation Solutions. XIV. The Treatment of Roasted and Raw Ores.

Treatment of the Silver-bearing Wash Water. The Lixivation. XV. Through-Lixivation. XVI. The Precipitation of the Metals from a Lixivating Solution. XVII. The Construction, Cost of Erecting, and Expense of Running a Lixivating Mill. A. Notes on Construction. B. Estimated Cost of Mill Plant. C. Estimated Cost of Running a Lixivation Mill of 80 Tons Capacity per Day. XVIII. The Russell Process compared with Ordinary Lixivation and with Amalgamation.

The volume is strongly bound in cloth and is furnished with a supplement inserted in the book. It contains also a table of Errata.

HANDBOOK OF PATENT LAW OF ALL COUNTRIES. By W. PHILLIPS THOMPSON, C.E., F.C.S., Member of the Institute of Mechanical Engineers, &c., &c. Eighth Edition, Revised, 1888. London: Stevens and Sons, 119, Chancery Lane. New York: D. van Nostrand, 23, Murray Street.

SMALL 8vo, volume, bound in cloth, with table of contents, preface, and 154 pages of subject-matter.

With regard to British Patents, the following subjects are clearly and concisely treated of: Varieties of Protection; What can be Patented; Who can Patent; General Rules relating to Patents; First Step in Patenting; Procedure and Cost of obtaining Patent; Subsequent Taxes; Prolongations; Amendments; Revocation of Patents; Infringement of Patents; Legal Proceedings; Licenses and Assignments. The next class of subjects similarly dealt with is comprised under "General Hints." What Inventions are Profitable; How to Sell a Patent; Caution to Investors in Patents; How to Safely Invest in Patents; Searching. Then follows the important subject of the Registration of Designs, and finally, a concise and well-subdivided treatise on the Foreign Patent Laws.

BOOK OF CHEMICAL LABORATORY LABELS. Compiled by W. H. SYMONS, F.R.M.S., F.C.S., F.I.C. Henry Kimpton, 82, High Holborn, London, W.C.

THE labels in this book are printed with bold type in accordance with modern Chemical nomenclature. The size is such that the whole label may be seen from the front of most bottles. The name of the substance only is given, so that the same label may be used for crystal, powder, or solution. The type being uniform in character, the halves of two labels may be combined to furnish a label for an uncommon compound. As an experiment, labels for some of the most corrosive chemicals have been printed on parchment as well as on paper. The formulae and formula weights are given separately, and can be added to the label when they are required in this position. There are also a number of additional slips for use in special cases.

The set is published in three parts:—

PART I. contains 160 labels for common reagents, and 130 additional slips, together with sheets of formulae and formula weights. It is intended to supply the wants of the average student.

PART II. comprises about 400 labels, it includes special reagents and other substances required by the practising chemist.

PART III. contains 160 large labels suitable for stock bottles, volumetric solutions, &c.

Price for each Part, 1s.; for the set of three Parts, 2s. 6d.

A TREATISE ON MANURES, OR, THE PHILOSOPHY OF MANURING. A Practical Handbook for the Agriculturist, Manufacturer, and Student. By A. B. GRIFFITHS, Ph.D., F.R.S.E., &c., Lecturer on Chemistry in the School of Science and in the Grammar School, Lincoln, &c. London: Whittaker and Co., 2, White Hart Street, Paternoster Square, London, E.C. George Bell and Sons, York Street, Covent Garden. 1889.

THIS book forms one of the Specialists' Series issued by the above firm of publishers. It is an 8vo. volume, bound in cloth, and containing frontispiece, preface, table of contents, and including the introduction, 389 pages of subject-matter. An alphabetical index closes the work. The text is illustrated with 15 wood engravings, including the frontispiece. The following will serve to show the manner in which the subject is generally treated:—Chapter I. is principally devoted to Historic Treatment and the Rise and Development of Scientific Agriculture. II. Constituents of Plants, Root-absorption, Assimilation, &c. III. Soils and Manuring. IV. Sheep-fold, Blood, and other Animal Manures; Refuse as Manures. V. Artificial Manures. VI. Guano. VII. Coprolites and Mineral Phosphates and Fertilisers. VIII. The Manure Works and Processes. IX. Artificial Nitrogenous Manures. Their Valuation. X. Potash Manures, &c.; Gas Lime, Manganese Salts, &c. XI. Iron Sulphate as a Manure, and as a Precipitant and Disinfectant for Sewage. XII. Ville's System. XIII. Mixed or Special Manures. XIV. The Application of Manures, &c. XV. The Valuation of Manures. XVI. Analysis and Sampling of Manures. Kjeldahl's Method for Nitrogen. XVII. Conclusion. Comparative Value of Farmyard Manure, &c. "Artificiality." Agricultural Colleges.

APPENDIX.—Rotation of Crops. Useful Data concerning the Growth of Crops, about Pasture Grasses, Clovers, and allied Crops, &c., &c.

Trade Report.

(From the Board of Trade Journal and other sources.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

CLASSIFICATION OF ARTICLES IN CUSTOMS TARIFFS.

RUSSIA.

Note.—Pound = 35 lbs. avoirdupois. Rouble = 3s. 2d.

Materials for tanning known under the name of *algaborilla* and *tara*.—Category 108. Duty, 6 copecks per pound.

Saccharin.—Category 110. Duty, 2 roubles 40 copecks per pound.

NETHERLANDS.

Cocaine is taxed as soap not perfumed.

SWITZERLAND.

Note.—Quintal = 220'4 lbs. avoirdupois.

"Verdiline" (mordant used in dyeing).—Category 18. Duty, 2 francs per quintal.

Fluoride of aluminium and fluoride of sodium, analogous to cryolite.—Category 173. Duty, 60 cents per quintal.

SPAIN.

Note.—Peseta = 9'5d. Kilogramme = 2'204 lbs. avoirdupois.

Glucose is dutiable by gross weight. No matter what may be the form under which it is imported, it is subjected to duty under Category 249, viz., 30 pes. 80 cs. per 100 kilogrammes.

Subnitrate of bismuth.—Category 32. Duty, 10 cs. per kilogramme.

The product known as "Carbolineum avenarius."—Category 7. Duty, 41 cs. per 100 kilogrammes.

Nitro-benzine.—Category 32. Duty, 10 cs. per kilogramme.

Soap for household and industrial uses, but not adapted for the lubricating of machinery.—Category 206. Duty, 1 pes. per 100 kilogrammes.

UNITED STATES OF COLUMBIA.

Alterations in Import Duties.

Duty of 1 centavo.—Articles and stuffs used for refining metals by the chloric treatment.

Duty of 2½ centavos.—Quicksilver.

Duty of 5 centavos.—Dynamite for use in industry.

CUSTOMS TARIFF OF GABOON.

The following are the rates of import duty now levied on articles of chemical interest in the French Colony of Gaboon:—

Note.—Litre = 1'76 pints. Hectolitre = 22 Imperial gallons. Kilogramme = 2'204 lbs. avoirdupois.

Classification of Articles.	Rates of Duty now levied.
	Frs.Cs.
Oils, superior pure, olive and other.....	100 kilos. (gross) 6'00
Essences of turpentine, balsams, juices, &c....	Free.
Roots, herbs, leaves, flowers, fruits, and barks	Free.
Medicinal vegetables of any description, suitable for dyeing and tanning.....	Free.
Lime, cement, and plaster	100 kilos. (gross) 0'60
Pitch, tar, and coal tar.....	" " 0'50
Sea and rock salt	" " 0'40
All other chemical products.....	5 % <i>ad val.</i>
Alcoholic varnish	Hectolitre 100'00
Varnishes, other	100 kilos. (gross) 3'00
Colours of any descriptions	" " 3'00
Inks of every description	Pound 0'15
Soaps	100 kilos. (net) 20'00

Classification of Articles.	Rates of Duty now levied.
	Frs. Cs.
Alcoholic perfumes	Hectolitre 100 00
Non-alcoholic perfumes.....	100 kilos. (net) 16 00
Medicines, compounded.....	Free.
Vinegar	Litre 0 05
Manufactures of caoutchouc and gutta-percha	100 kilos. (gross) 20 00
Lucifer matches (wood)	100 kilos. (net) 12 00
Goods not otherwise distinguished.....	10 % ad val.

Note.—Goods of French origin imported in vessels of any nation benefit by a reduction of 60 per cent.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

ARGENTINE REPUBLIC.

The Drug Trade in Rosario.

According to the French Consul Rosario is, next to Buenos Ayres, the most important trade centre of the Republic. The tonnage of foreign vessels visiting the port has increased from 171,912 in 1880 to 1,032,783 in 1887. In that year the imports of prepared medicines were valued at 304,075 frs., of perfumery at 121,095 frs., and of raw drugs and chemicals at 877,080 frs. The imports of perfumery have increased elevenfold since 1880. Two-thirds of the whole is French perfumery. France also furnishes nearly one-third of the medicines, almost all patents, and about one-fourth of the chemicals. Yet there is not one single French drug-house in the town, the whole of that trade being in the hands of English, Swiss, Italian, and Spanish firms.

CHINA.

Insect Wax.

The steamer export of white wax (not bleached bees' wax, but the insect wax produced by the *Coccus Peltæ*) has increased greatly, writes the British Consul at Ichang. This curious and beautiful substance, though widely used in China, known to science, and repeatedly noticed in books on China, seems to be unfamiliar in our home market. Its dearthness has been against it, but the price has come down greatly. According to my information, the price at Kia-tzing Fu (in Szechuan, on the Min River, some 700 miles up river from Ichang) has lately been about 1s. per lb., avoirdupois. At Ichang there is at present no wholesale market for the article, but the wholesale cost, as yet for local consumption, is stated at about 1s. 3/4 per lb. Allowing for duty, freight, commissions, &c., the article might be placed on the home market at about 1s. 6d. per lb. In view of its beauty, hardness, and high melting point, it might be acceptable in the candle manufacture, to serve as a coating or otherwise.

Drug Exports.

The following are the exports of drugs from Ichang, one of the principal centres in the interior, during the last two years:—

Articles.	1887.		1886.	
	Lbs.	Value £.	Lbs.	Value £.
Galls	263,963	5,425	..	..
Medicines.....	..	63,915	1,978,363	47,794
Musk	2,900	53,469	1,180	19,696
Rhubarb	205,165	9,442	320,291	14,556
Safflower.....	111,208	12,302	75,913	8,314
Wax (Insect)	1,541,305	125,039	942,595	87,790

SIAM.

Gum Benjamin.

This gum, from the district bordering upon Tonquin, east of Luang-Prabang, is brought to the latter place by the Khmù tribe, who exchange it for manufactured goods with the Chinese dealers. The latter, in their turn, take it to Nong-Kai, the terminal point of

the trade road to the south, and from there, at great expense of carriage, to Korat, whence, by way of Sarabhoori and the Menam River, it is sent to Bangkok. In 1887 the exports amounted to 37,500 kilos., but it appears that shipments could be much more advantageously made by way of Saigon and by the Mekong River. If any French traders should penetrate from Tonquin to Luang-Prabang they will probably make gum benjamin one of their staple articles with the Laos country.

Stuck-lac.

This gum comes from the north and from the Laos country, and is sold on the Bangkok market in the same condition in which it is gathered, i.e., with the branches on which it is gathered adhering to it; the same lac, when finely broken and washed in hot water, is called seed lac. There is always a ready sale for this article on the local markets, as the Siamese dyers, who use it in their industry, compete for its acquisition with the export merchants.

SPANISH POSSESSIONS.

Patent Medicines.

A few patent medicines, notably Jaynes', Holloway's, and "Mother Seigel's Syrup," were formerly sold quite largely in Manila, but can come there no more unless the manufacturers consent to comply with the provisions of a decree issued in July 1888, which requires that the formula by which patent medicines are made shall be printed on the outside wrapper of each package, so that it can easily be read by all purchasers. This is considered by local druggists as an effectual bar to the entry of all patent medicines, as it is not probable that the manufacturers will consent to make public their formula except in very rare cases. When the supplies on hand are exhausted the medicine-takers will have to find new remedies for their ailments or give up being sick.

MISCELLANEOUS TRADE NOTICES.

EXPORT OF SICILIAN SULPHUR.

The *Handels-Museum* states, on the authority of a report by the Swiss Consul at Messina, that the price of sulphur in 1888 was slightly raised, in consequence of greater demands being made from abroad. This rise came at an opportune moment, for a maintenance of the prices paid during the last few years would have brought about the ruin of many of the proprietors of mines. There were exported from Sicily, in 1888, 350,000 tons of sulphur, as against 215,000 tons in 1887 and 330,000 tons in 1886. It is expected that the demand will continue to be in excess of the supply, and that a still greater rise in price will be the result.

The following table shows the manner in which the export of Sicilian sulphur to various parts of the world is distributed. The figures refer to the latter half of 1888. It will be observed that America takes nearly half the total export:—

	Kilogrammes.
England.....	18,921,199
France (South).....	24,490,800
France (North).....	347,700
Holland	1,741,600
Belgium.....	3,654,200
Germany (Elbe)	6,834,800
Germany (Baltic Sea)	858,900
Austria	3,957,700
Russia	12,503,200
Sweden and Norway.....	5,237,800
Australia	1,024,000
Spain	1,380,900
Portugal	231,400
Greece and Turkey	264,500
Italy	15,129,900
America	86,422,100
Other countries	186,400
Total	181,188,400

The amount in stock at Licata, Girgenti, and Catania was, at the end of December 1888, 211,905,500 kilogrammes, against 214,956,000 in 1887 and 243,237,000 kilogrammes in 1886.

CANADIAN PHOSPHATE INDUSTRY DURING 1888.

The annual report of the Canadian Department of Agriculture states, according to the *Canadian Gazette* for the 11th March last, that the total amount of phosphates shipped from Montreal during the season of 1888, according to the detailed returns furnished, was 14,432 tons, consisting of 14,392 tons in bulk, 384 bags, and 30 barrels of crude material. There were shipped to the United States 2,000 tons from the Ottawa Valley, 814 from the Kingston district, and 200 tons were used for home consumption, making a grand total of 17,446 tons. This shows a slight falling off, which is attributed by shippers to the difficulty of transportation from the mines. "I am credibly informed," says the Minister, "that an experiment was made during the past year with crude phosphate, which had been ground to an almost impalpable powder, on a field of potatoes in this district, half of it being treated

with this fertiliser and the other half with ordinary farmyard manure. The result was that the part of the field where the phosphate had been used yielded much larger and cleaner tubers than the other half, the soil in both cases being precisely the same." The above figures do not show the actual amount of phosphate mined during the year, but only what was actually shipped and consumed. The total output for 1888 is stated to be 23,200 tons, the difference between the output and the shipments being the amount left over at the mines waiting shipment next spring.

SOUTH AUSTRALIAN PIGMENT.

The *Adelaide Observer* for the 2nd February last says that about two years ago two deposits of pigment were discovered—one near Blackwood, in the hundred of Kuitpo, and the other near Wilunga. These paints have the advantage over the improved article, inasmuch as they can be mixed with oil without white-lead, and have been proved to be impervious to the action of air. The pigments were found in seams in a hole in apparently inexhaustible quantities, and there are twelve distinct shades of yellow, brown, red, and white. A company has been formed to place the colonial article on the market, and many tons of it have been sold already at a much lower cost than is paid for the imported paints. A substance similar to kalsomine has been named *australasomine*. Analysis of three samples of ochres resulted as follows:—Moisture at 100° C., 1.82, 1.92, 0.21; combined water, 6.48, 7.60, 4.00; silica, 11.20, 56.60, 65.20; oxide of iron, 38.40, 11.68, 5.76; alumina, 12.56, 19.12, 21.74.

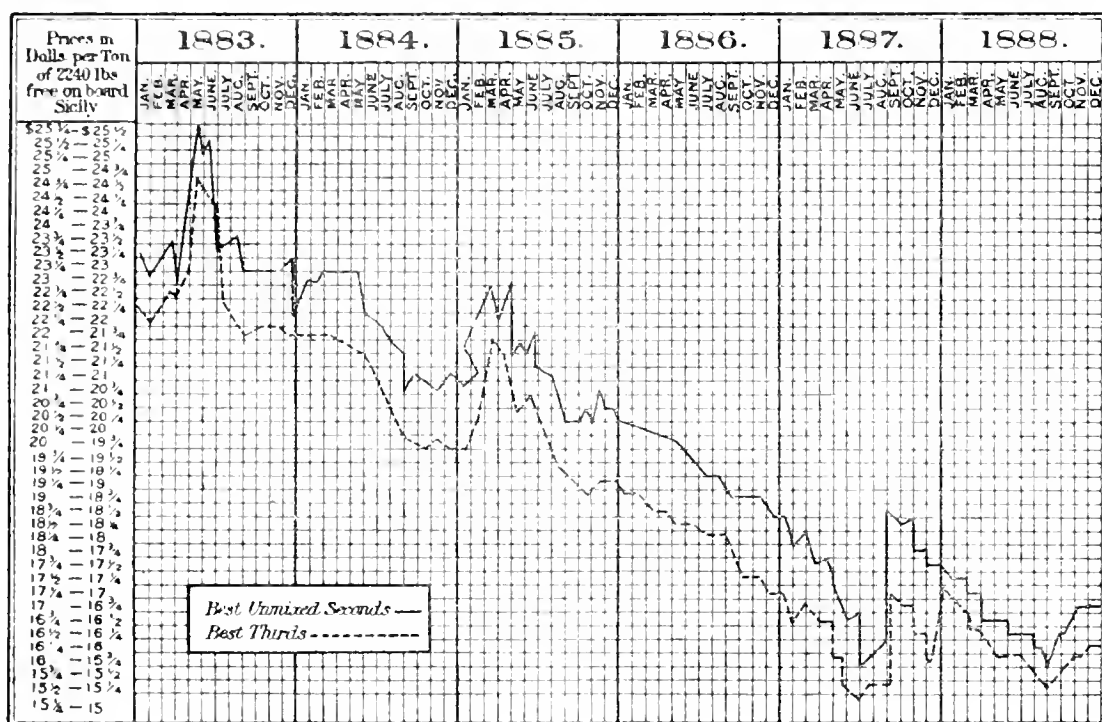
DISCOVERY OF PETROLEUM IN SOUTH AUSTRALIA.

Respecting a discovery of petroleum springs in South Australia, the *Adelaide Observer* for the 2nd February last has the following note:—

"A valuable discovery of petroleum in a crude or liquid state has been found by Mr. A. Toechi, of Yorketown, and the Government have granted to him the exclusive right to search over an area of about 90,000 acres Crown lands at Southern Yorke's Peninsula to enable him to fix the position of the spring from which his discovery flows. Should his search be successful it will prove a valuable addition to the mineral wealth of the colony. Being situated close to the seaboard within 60 miles of Port Adelaide, the facilities for working the property will be very considerable. Estimates have been given by competent borers thoroughly conversant with petroleum in all its branches as to the cost of boring 1,500 feet, which will not exceed a pound a foot, and from information at Mr. Toechi's command he is very confident that he will be able to raise at any rate the crude oil at once. When Mr. Toechi has completed his search he will be entitled to take up an area of 10,000 acres for commercial operations."

STATISTICS OF SICILIAN BRIMSTONE.

We are indebted to Mr. A. S. Maclemonson for the following interesting statistics, showing the exports and prices per ton of 2,240 lbs. of brimstone, free on board, Sicily, during the past six years. Prices have ranged as follows:—



The total export from Sicily was divided as follows:—

—	1888.	1887.	1886.	1885.	1884.	1883.	—	1888.	1887.	1886.	1885.	1884.	1883.
United States..	128,265	89,419	98,590	99,378	94,920	96,620	Spain.....	3,433	5,873	5,890	2,243	3,920	5,242
France	52,983	56,222	51,280	58,264	65,098	63,692	Belgium	6,951	5,318	6,580	9,516	6,793	7,660
Italy	47,634	48,997	48,658	49,415	56,292	69,810	Holland	2,793	1,747	2,990	1,237	696	1,256
United Kingdom	35,634	30,097	30,236	33,402	40,760	41,788	Sweden.....	3,004	1,169	1,916	328	744	1,010
Greece,	5,809	18,370	19,697	13,664	7,063	10,494	South America	95	710	..	..	..	..
Portugal	15,851	16,587	39,943	17,769	11,018	15,298	Australia	885	600	..	..	..	..
Russia.....	22,013	13,411	10,570	13,420	12,831	10,113	Denmark	464	202	..	810	..	..
Germany.....	12,402	9,700	8,698	6,103	6,622	7,292	Total tons ..	347,775	341,302	329,446	314,582	314,058	335,392
Austria.....	8,942	6,702	5,800	5,965	6,037	4,915	Stocks in Sicily, Dec. 1st	167,569	199,200	202,392	193,700	181,500	193,707
Turkey	1,457	6,238	4,398	3,977	1,285	3,913							

Of the amount shipped to the United States during 1888, 72,173 tons were best unmined seconds, and 55,092 tons best thirds, against 66,710 tons of the former and 52,709 tons of the latter shipped during 1887.—*Engineering and Mining Journal*.

PRODUCTION OF STASSFURTH SALTS IN 1888.

Statistics of the production of potash salts at Stassfurth, which have just been published, show that the year 1888 was, on the whole, satisfactory. 16,571,600 centners of carnallite and 2,528,180 centners of kainite (and schornite) were obtained, and yielded 2,619,000 centners of potassium chloride and 600,000 centners of sulphates (potassium magnesium sulphate and potassium sulphate). In addition, 4,945,967 centners of kainite were sold for agricultural purposes. Large factories are in course of erection, which are to be open in the spring for the preparation of potassium chloride and potassium sulphate from the double salts of potassium and magnesium. Experiments are being continually carried on with a view to utilise the large quantities of magnesium chloride obtained in the mines.—*Industries*.

CAYOTA, A NEW TANNING MATERIAL.

This is a reddish-brown bark obtained from Mexico, where it is used for tanning thick sole leather, to which it gives great consistency and solidity. It contains about 25 per cent. of tannin, has a resinous odour, and is easily powdered. M. Villon, who has examined this new tannin, finds it to consist of yellow scales soluble in 15 parts by weight of water, and its molecular weight is equal to that of the tannin from oak bark. Although having a resinous odour, the bark or extract contains only a trace of resinous matter, and is therefore superior to Quebrado. It can also be used as a substitute for sumac.—*Industries*.

PLATINUM.

A noteworthy discovery has been lately made. Platinum has been found in place in the nickeliferous ore of Sudbury, Canada, by Professor F. W. Clarke. This discovery was made accidentally, in the course of determinative and analytical work upon the ore, which presents other peculiarities. While the amount found is of little or no commercial importance, it has a very great scientific significance, and is certainly something new. Platinum grains have been found in secondary rocks, such as recent sandstones, conglomerates, &c., but never before, so far as we are aware, in vein stuff, although it has long been looked for, and such an occurrence was to be expected. There is, therefore, always the chance that actual veins of platinum-bearing material, so often falsely reported, may actually be found, and that perhaps some of them may be of a paying grade. The number of localities and their wide distribution in this country points to such an outcome.—*Engineering and Mining Journal*.

PRODUCTION OF QUICKSILVER AT THE ALMADEN MINE (SPAIN) IN 1888.

	Flasks.
January	8,246
February	7,972
March	7,956
April	6,856
May	1,950
October	3,318
November	7,609
December	7,965
Total	51,872

We are indebted to the courtesy of Mr. J. B. Randol, of San Francisco, for this information concerning the production of the Spanish Almaden mine in 1888. It will be observed that the total production for eight months, the usual working period of the year, was 51,572 flasks, while all our Californian mines for 12 months in 1888 made only 33,250 flasks, or 18,622 flasks less than the product of the glorious mine of Almaden, rightly entitled to be called not only "The Jewel of the Crown," but also "The Jewel of all Mines."—*Engineering and Mining Journal*.

PROPOSED POTTERY WORKS AT JUBBULPORE.

Messrs. Burn and Co., the well-known contractors of Calcutta and Ranigunge, have, it is rumoured, applied for permission to take up land on a comparatively large scale in Jubbulpore for pottery works. The kaolin there has been analysed by experts in England, and found to be of the very best quality, while the quantity available is large. Hitherto there has been a difficulty about felspar, but it appears that this has now been discovered in considerable quantity near the Umaria coal mines. A pottery at Jubbulpore would not only give employment to a large number of persons locally, but would facilitate the construction of pipes for the Benares drainage works now in contemplation, and many other projects of a similar character that will soon be aboot in Northern India.—*Indian Engineer*.

PETROLEUM WORKS IN THE PUNJAB.

The Kattan Petroleum Works have, it appears, now passed beyond the experimental stage. An agreement has been definitely entered into to supply the works at the Khojak tunnel with about 34 million gallons of the oil. The wells, which are 42 miles from the

railway, have been connected with Babar Kuch on the Sind-Pishin line. The saving to the State from the use of the petroleum on the Khojak works alone will, it is estimated, be enough to cover all the cost of the Kattan experiments, and leave a balance of over five lakhs of rupees. And there is no reason to anticipate that the benefits of the apparently inexhaustible supply should end here. On the contrary, in a country like Beluchistan, where every stick of wood is worth its weight in silver, the demand for the new fuel must be great; and in addition to other advantages its use may be expected to put a stop to the destruction of the forests, which, until recently, was going on at an alarming rate. It is now intended to replace the expensive and wasteful system of camel carriage by laying a pipe-line from the wells along the Babar Kuch road; and should Government decide on sanctioning this, it may be confidently expected that the capabilities of Kattan will emerge once for all from the cold shade of neglect and scepticism in which an exaggerated idea of its remoteness has left it so long.—*Indian Engineer*.

THE EXPERIMENTS AT ROTHAMSTED.

It is satisfactory to observe that Sir John Lawes's munificent arrangement for devoting the sum of 100,000*l.* to the perpetuation of his valuable field and laboratory experiments is about to be completed. The sum will be placed in the hands of three trustees, who will have granted to them a lease of the laboratory and the experimental fields at Rothamsted, with power to purchase land for the purposes of the trust. The income of the fund will be handed over to a committee of nine persons, consisting of four Fellows of the Royal Society, one Fellow of the Linnean Society, two members of the Royal Agricultural Society, one Fellow of the Chemical Society, and the owner of Rothamsted for the time being. The committee will be appointed for five years, and will be eligible for reappointment. Sir John Thorold and Mr. Charles Whitehead have been appointed to represent the Royal Agricultural Society.

—*Standard*, 5.4.89.

CASTOR OIL v. OLIVE OIL FOR LUBRICATION.

The Italian Admiralty have recently caused to be carried out a number of experiments with a view to testing the comparative merits of castor oil and olive oil for lubricating purposes on board ship. From the results obtained they have given orders that henceforth all exposed parts of machinery are to be lubricated exclusively with castor oil, while mineral oils are to be used for cylinder and similar lubrication.—*Ironmonger*.

GERMAN METAL PRODUCTION IN 1888.

The metal production in the German Empire in the year 1888 is reported as follows:—Zinc, 133,224 tons, average value, 327 m. 9 p. per ton (1887, 130,693 tons and 280 m. 45 p.); block lead, 93,995 tons, average value, 256 m. 18 p. per ton (1887, 91,929 tons and 236 m. 99 p.); block copper, 29,872 tons, average value, 1,461 m. 11 p. (1887, 29,202 tons and 877 m. 24 p.); zinc ores, 667,760 tons, average value, 20 m. 59 p. (1887, 900,712 tons and 11 m. 13 p.); lead ores, 161,775 tons, average value, 102 m. 83 p. (1887, 157,570 tons and 101 m. 6 p.); silver, 406,527 kilos, average value, 126 m. 49 p. per kilo. (1887, 367,633 kilos, and 130 m. 99 p.); gold, 1,810 kilos, average value, 2,791 m. 13 p. per kilo. (1887, 2,251 kilos, and 2,799 m. 85 p.).—*Ironmonger*.

MANGANESE ORE IN NEW ZEALAND.

Manganese ore has been discovered in large quantities, and of splendid quality, near Dunedin, from which a valuable export trade is expected to result. A sample was sent to London, and a cable message has been received placing a value on it that leaves a large margin for profit. The quantity of this ore exported from New Zealand up to 1885 amounted to 12,000 tons, valued at £3,000*l.*, but of late years the shipments have fallen off largely. It came chiefly from the Bay of Islands, and was not nearly so pure as the present discovery, which assays 80 to 90 per cent. of pure peroxide.—*Ironmonger*.

THE YTTRIA MINERALS.

In connexion with the subject of the rarer minerals at the last meeting of the New York Academy of Sciences, Mr. George F. Kunz said that during the last year large quantities of gadolinite were sent from near Bluffton, in Llano County, Texas, 22 miles from Burnett. The occurrence of this gadolinite was somewhat similar to that of allanite in Amherst County, Virginia; it has more than ordinary interest, from the fact that it contains from 40 to 50 per cent. of yttria. About 1,000 lb. were found in a single pocket, associated with xenotime, cerussite, and xenotime. One crystal of gadolinite was exhibited weighing 11 lb.; another was found weighing 13 lb., and a group weighing 40 lb. The productions of this locality exceed in quantity and size of crystal anything yet obtained.—*Engineering and Mining Journal*.

AMERICAN PAPER GOING TO ENGLAND.

It may be considered remarkable, and it will doubtless create some excitement, and perhaps dismay, among the paper-makers of Great Britain, to learn that an English journal of importance has offered to contract with one of our leading American manufacturers of paper for its supply of paper for one year. This offer results from a trial of the paper, and is an earnest of the fact that we are able to produce goods which, as to quality and to price, will meet the competition of foreign manufacturers, even on the latter's own ground. Nor is this likely to be the only instance of such a contract, for it is intimated that one more is pending, and that still another English journal is ready to use American paper.—*Engineering and Mining Journal*.

AMERICAN OZOKERITE.

A company has been formed, under the laws of New York State, to develop large deposits of ozokerite, a natural paraffin wax existing in the Wasatch mountains of Utah Territory, about 113 miles east of Salt Lake City. These mines are said to contain the only deposits of this mineral known to exist outside of Galicia, in Austria, whence the entire world's supply of this product has, until recently, been obtained. The uses of this mineral are constantly enlarging, and in this country alone the consumption amounts to 500 tons yearly. The price of refined ozokerite, commercially known as ceresin, ranges from 20 c. per lb. for chemically pure white, down to 6 c. per lb. for crude black of a poor quality. The company proposes to mine 1,500 tons of wax yearly, and pay 7 per cent. on a capital stock of 1,250,000 dols. The first shipment from the American mines arrived in New York in January this year, and attracted considerable comment. — *Engineering and Mining Journal*.

PAPER FROM SUGAR CANE.

The *Revue Scientifique*, of Paris, states that at New Orleans, samples of bleached paper of the quality made from sugar cane are being exhibited. Having regard to the low value of sugar, and the increasing demand for paper, it might be worth while to introduce this industry into places where the sugar cane is grown.

BELGIAN PRIZES TO CHEMISTS.

The Belgian Academy of Sciences have published the list of prize queries proposed for the year 1890. The following are of interest to chemists and physicists: — (1) Establish, by means of new experiments, the theory of the reactions presented by bodies in what is called the nascent state. (2) Expose and discuss, with the help of new experiments, the works relating to the kinetic theory of gases. The prizes offered are gold medals, worth 800 frs. for the first, and 600 frs. for the second. Memoirs may be written in French, Flemish, or Latin, and must be handed before August 1, 1890, to M. Liagre, Perpetual Secretary, Palais des Académies, Brussels. The usual academic conditions—that is, the enclosure of the writer's name in an envelope marked with a motto repeated on the memoir—are of course to be observed.

CHEMISTRY IN NANCY.

By a law, published on April 11, the City of Nancy has been authorised to borrow 20,000*l.* for establishing a chemical and an anatomical institute. The rate of interest must not exceed $\frac{1}{2}$ per cent., and the principal is to be refunded within forty years.

ADULTERATION OF FOOD IN BELGIUM.

See Board of Trade Journal for April, p. 464.

SUPERPHOSPHATES AS MANURE.

Some quite unusual results were brought out in experiments on an oat crop on a hill farm near Exmoor, as described by Mr. T. D. Acland in the "Journal" of the Bath and West of England Agricultural Society. The oats were sown after four years of grass, which succeeded a root crop fed on the land. There were duplicate plots in each case, and the yield shows the average. Where no manure was used 11 bushels 23 lb. of bread corn were produced; on plots dressed with 1 cwt. of sulphate of ammonia, 40 bushels; where 1 cwt. of nitrate of soda was used, 40 bushels 7 lb.; after 3 cwt. of superphosphate, 49 bushels 32 lb.; from the application of 1 cwt. of nitrate of soda and 3 cwt. of superphosphate, 58 bushels 12 lb.; and as the result of using 1 cwt. of sulphate of ammonia and 3 cwt. of superphosphate, 60 bushels. It is clear that the land was so deficient in phosphates that no extra yield beyond that of the unmanured plots could be obtained from the use of nitrogenous manures alone. The phosphatic manure by itself gave a large increase of corn, and that increase was more than doubled when nitrogen was added. On another farm in Cornwall the same nitrogenous manures produced a small increase in the oat crop, but not sufficient to be remunerative; while the addition of 3 cwt. of superphosphate to the nitrate of soda or sulphate of ammonia brought forth double the yield of the adjoining unmanured plots, and paid well. These results, like those of the Norfolk experiments, recently referred to, show in a striking manner the need of trials of the kind in all parts of the country. — *Standard Agricultural Reports*.

STATISTICS.

BOARD OF TRADE RETURNS.

The trade and navigation returns for March are thoroughly satisfactory. An increase of 11 per cent. has taken place in the imports, and the exports have gone up 12 per cent., so that the apparent hang-back of February is now more than made good. Prices to some degree account for this improvement, but not so far as to neutralise the importance of the gain in volume which the foreign trade of the country is now showing. Among imports the

solitary class showing a decrease in value is "metals," and the falling off there is not due, as might seem probable, to the reduction in the price of copper, but to tin, which compares unfavourably, both in quantities and price, with the figures of a year ago. The export figures are uniformly good, for the slight decrease in the value of articles of food and drink exported may be let pass unnoticed. A revival is exhibited under woollen and worsted manufactures, and "metals and ironwork" and "machinery and mill work" continue to display greater prosperity than they have done for years. This prosperity is, in part, the result of the liberal lending of the country to foreign countries, and of the large amount of capital poured into South Africa by mining companies; but Continental Europe is also a better customer than it was, for steam engines at least. For the first quarter of the year the imports have amounted to 106,526,000*l.*, an increase of 9,617,000*l.*, or 9½ per cent. on the corresponding quarter of 1888; and the exports to 60,470,000*l.*, an increase of 3,847,000*l.*, or 6½ per cent. March has, therefore, done much better than the average of the quarter. Subjoining are the usual tables for the month:—

Imports.

Compared with March 1888.

	Total.	Increase.	Decrease.
	£	£	£
Animals living.....	618,755	145,441	..
Articles of food and drink (duty free)	10,917,240	1,921,447	..
Articles of food and drink (dutiable)	2,341,522	123,998	..
Metals.....	1,936,125	..	312,694
Chemicals	1,204,573	187,267	..
Raw materials for textile manufacturers.....	9,912,335	594,798	..
Raw materials for other industries	2,698,190	463,819	..
Manufactured articles	5,771,197	454,697	..
Miscellaneous articles	1,333,957	56,289	..
	36,225,883	3,947,756	312,694
		312,694	
Net Increase.....		3,635,062	

Exports.

Compared with March 1888.

	Total.	Increase.	Decrease.
	£	£	£
Articles of food and drink...	793,644	..	43,885
Raw materials	1,326,189	340,713	..
Cotton manufactures	5,392,458	260,591	..
Linen manufactures	486,392	54,919	..
Woollen and worsted manu- factures.....	1,834,386	273,899	..
Metals and ironwork.....	3,400,327	500,411	..
Machinery and millwork....	1,221,105	231,177	..
Articles of personal use	969,297	1,886	..
All other articles	5,858,929	705,409	..
	21,381,427	2,378,005	43,885
		43,885	
Net Increase.....		2,334,120	

—Standard.

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

- 4687, T. W. Duffy. Apparatus for transmitting heat to fluids, applicable also for condensing or cooling. March 18.
 5155, J. Anderton. An improved polariscope for the use of brewers, sugar manufacturers, analysts, and others. March 26.
 5156, J. W. Wailes. Improvements in liquid valves for produce and other gases and air. March 26.
 5197, J. C. Mewburn.—From La Société des Générateurs à Vaporisation Instantanée (Système Scrpellet), France. Apparatus for generating steam. March 26.
 5326, T. F. Shillington and J. A. Hanna. Appliances for heating liquids by steam. March 28.
 5373, P. W. Turner. Improvements in wooden vessels for carrying or holding corrosive substances. March 29.
 5493, M. W. Household. Apparatus for raising or forcing liquids. March 30.
 5497, M. W. Household. Apparatus for raising or forcing hot liquids. March 30.
 5539, H. Bernzer. Centrifugal separating machines. Complete Specification. April 1.
 5592, W. L. Wise.—From Escher Wyss and Co., Switzerland. Improvements in the manufacture of clear ice, and in apparatus employed therein. April 2.
 5731, G. C. Webb. An improved valve for gases under pressure. April 2.
 5752, R. W. Holden. Heating apparatus. April 4.
 6102, P. Cornish, jun. Improved means for drying or desiccating substances or materials. April 9.
 6217, W. Bergh. Centrifugal machines for the separation of fluids of different specific gravities. April 11.
 6242, R. Haig. Mechanical retorts for the treatment of animal, vegetable, and mineral matters. April 12.

COMPLETE SPECIFICATIONS ACCEPTED.*

1888.

- 4402, W. P. Thompson.—From The Porcelain Dental Art Company. Hydrocarbon furnaces. March 27.
 7061, I. S. McDougall, J. T. McDougall, R. K. Hartley, and T. Sudden. Boilers or vessels lined with lead or other acid-resisting metal or alloy. April 17.
 7411, A. Horn. Saccharometers. March 27.
 7674, H. Lane. Method and means for measuring air, gas, and other fluids. April 3.
 7768, S. Spencer and J. S. Lord. Method and apparatus for forcing and drawing chemical and other liquids. April 3.
 8053, G. Fletcher.—Partly from G. Brocklehurst. Evaporating pans. April 3.
 8064, F. W. Scott, jun.—From A. Freitag. Tubular vacuum pans. April 17.
 8078, J. Watt. Apparatus for causing or increasing circulation in liquids during ebullition, and for removing sediment therefrom. April 10.
 8290, J. Y. Johnson.—From La Société Française des Alcools purs. Apparatus for separating liquids having different boiling points. April 3.

1889.

- 5644, J. J. Meldrum. Apparatus for distributing air or gases to liquids. April 10.
 5963, W. Prickarts. Reverberatory and roasting furnaces. April 17.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

- 4686, J. S. Balfour and J. P. Houston. Improvements in the manufacture of fuel from coal slack and similar substances, and in apparatus used therein. March 18.
 4726, R. A. Gilson. Improved means of utilising the waste heat of a gas-flame for warming purposes generally, and for increasing the luminosity of the flame. March 18.
 4807, W. J. Taylor. Improvements in the art of firing furnaces and converting solid fuel into gaseous fuel, and of apparatus for the conduct thereof. Complete Specification. March 19.
 4858, J. Grossmann. Improvements in apparatus for purifying coal-gas. March 20.
 4820, D. Irving and A. Cochey. Improvements in apparatus for extracting ammonia, sulphur, and other impurities from coal gas. March 20.
 4880, J. Bead and G. C. Fowler. Improvements in night-lights and in the method of manufacturing the same. March 20.
 4942, H. H. Yates. Improvements in spirit or vapour torches for lighting purposes. March 21.
 4920, P. Tarrington and D. S. McDonald. Improvements in portable apparatus for manufacturing gas. Complete Specification. March 21.
 4955, Birt's Oxygen Company and K. S. Murray. Improvements in or connected with apparatus or means employed in producing oxygen and the like. March 21.
 5108, J. Somerville and A. Allan. An improved hydraulic main for gas manufacture. March 25.
 5332, T. H. Gray. Improvements in the treatment of mineral oils. Complete Specification. March 25.
 5334, G. H. Turnbull. Improvements in the trays or grids of gas-purifying apparatus. Complete Specification. March 25.
 5345, J. H. R. Dinsmore. Improvements in the manufacture of gas for illuminating and heating purposes, and in or connected with apparatus therefor. March 26.
 5381, W. M. Cosh. Improvements in apparatus for the manufacture of illuminating or heating gases. Complete Specification. March 26.
 5380, A. J. Boulton.—From H. G. Weber, United States. Improvements in the manufacture of artificial fuel. March 29.
 5447, W. Boggett. Improvements in obtaining light. March 29.
 5535, G. Bamberg. Automatically maintaining the internal temperature of retorts at a full red-heat, and also preventing use of temperature beyond full red-heat. April 2.
 5697, B. F. Kelly, J. H. Spencer, and H. Spencer. Improvements in fuel blocks. April 2.
 5880, W. C. Hicks. An improved apparatus for admitting oxygen, air, or other gas or gases into coal-gas main in proportion to the make of such gas, and for varying this proportion at will. April 6.
 5974, D. S. Hawks.—From E. L. Brady, United States. An improved anticorrosive lubricant and lubricating vapour for carbon-disulphide and other vapour motors. April 8.
 6079, W. Hubbard. Improvements in or relating to compressed fuel blocks. April 9.
 6090, F. H. Briggs. Improvements in or relating to apparatus for the manufacture of water-gas. April 9.
 6130, S. Fox and E. Blass. A method of and apparatus for adding volatile substances to gases. April 10.
 6131, S. Fox and E. Blass. Improvements in apparatus for and in the manufacture of water-gas. April 10.
 6263, W. Schooling. Improved means for the filtration of the products of combustion. April 12.
 6325, R. B. Main, A. P. Main, and H. Darwin. Improvements in refractory balls or humps for incandescent gas fires. April 13.
 6326, R. B. Main, A. P. Main, and H. Darwin. Improvements in gas fires. April 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

- 6019, J. Thornecloe. Manufacture of fire-lighters. April 3.
 7490, T. H. Lien.—From J. Flannery. Process and apparatus for making illuminating and heating gas from water in combination with carbonaceous substances. April 17.
 13,679, S. Pitt.—From D. Aikman. Treatment of peat. April 3.

1889.

- 411, J. S. Chapman. Appliances and compositions for lighting fires, &c. April 17.
 4124, J. Mactear. Increasing the luminosity of ignited gas. April 17.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

4825. J. Inray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, France. Manufacture of azo colouring matters. March 15.

5032. J. Inray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, France. Manufacture of colouring matters giving grey, brown, and analogous tints. March 22.

5079. B. Willecox.—From The Farbenfabriken vormals F. Bayer & Co., Germany. New or improved manufacture of periodides of phenols and salicylic acid. March 23.

5549. O. Inray.—From The Farbenfabriken vormals Meister, Lucius, and Brünig, Germany. Improved manufacture of green and bluish green colouring matters. April 1.

5695. E. de Pass.—From Messrs. Ewer and Pick, Germany. Improvement in the manufacture of azo colours. April 2.

5785. J. Y. Johnson.—From F. von Heyden, Germany. A process for the production of oxymethoxybenzoic acids. April 4.

COMPLETE SPECIFICATION ACCEPTED.

1888.

7997. H. H. Lake.—From K. Oehler. Manufacture of colouring matters. April 10.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

4991. J. Yates and G. Kay. Improvements in open soapers for dunging and soaping fabrics. March 22.

5582. A. W. Montgomery. Improvements in the treatment of sisal hemp. Complete Specification. April 2.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

1851. R. Philips. An improved apparatus for bronzing, colouring, or otherwise ornamenting and dusting paper or other material. March 20.

4865. S. Spencer and E. Barlow. Improvements in the method of and means for bleaching and dyeing or otherwise similarly treating raw, spun, or woven fibres. March 20.

1870. G. Young and F. Pearn. Improvements in mechanism or apparatus for dyeing and bleaching cotton, wool, silk, and other fibrous materials in the raw and manufactured, or partly manufactured, state. March 20.

5125. W. H. Caldwell. Improvements in and connected with the sizing of paper. March 25.

5590. E. Bentz, C. Edmeston, A. Edmeston, and E. Grether. Improvements in scouring or cleansing and bleaching textile fabrics, warps, and yarns formed of cotton or other vegetable fibres, and in apparatus to be used for the purpose. April 2.

5995. D. G. FitzGerold. Improvements in bleaching by the agency of chlorine and certain of its compounds. April 8.

COMPLETE SPECIFICATION ACCEPTED.

1888.

18773. R. P. Frist. Linings for bleaching keirs, vats, dye-tanks, &c. April 17.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

4674. D. Herman. Improvements in apparatus for use in the manufacture of sulphate of soda. March 18.

4692. W. Law. Improvements in and relating to the evaporation and concentration of caustic soda lyes and other liquids, and appliances therefor. March 18.

4701. S. Daw. A method of treating waste or spent sulphuric acid pickle produced in the manufacture of tin,terne, and black plate. March 18.

4723. F. Maxwell Lyte. The conversion of ammoniac chloride into ammonia and chlorine or hydrochloric acid. March 18.

5355. H. Kenyon. Improvements in utilising and heating Leblanc waste and other matters. March 23.

5088. J. Plummer. Improved ammonia process to manufacture soda and bleaching-powder. March 25.

5224. M. Cannon. Improvements in the manufacture of acetic acid. Complete Specification. March 26.

5225. R. Dormer. Improvements in or relating to obtaining chlorine. March 26.

5340. G. A. H. Gabet. Process of manufacture of ammoniacal calcic phosphate. March 28.

5341. G. A. H. Gabet. Process of manufacture of potassic and sodic alkalis. March 28.

5779. J. W. Kynaston and J. Sutherland. Improvements in the treatment of the recovered ash of paper mills. April 4.

6945. A. Smith. A process for manufacture of nitrate of potash from nitrate of soda. April 9.

6118. H. H. Lake.—From J. L. Alberger, H. Williams, and L. R. Alberger, United States. Improvements in apparatus for the manufacture of salt. Complete Specification. April 9.

6172. F. M. Lyte. Improvements in the production of magnesic chloride and of magnesic oxychlorides. April 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

5086. W. J. A. Donald. Manufacture of chromates. April 3.

5371. G. J. Geary.—From A. Keiller. Manufacture of sulphide of zinc for pigments or other purposes. April 17.

5353. L. G. G. Daudenart. Extracting magnesia from sea water, and apparatus therefor. April 10.

5351. G. S. Page. Process and apparatus for obtaining anhydrous liquid ammonia. April 17.

9763. J. S. Rigby and A. McDonald. See Class IX.

9858. J. Lowe. Manufacturing sugar of lead. April 17.

17,969. H. H. Lake.—From O. B. Peck. The desulphurisation of ores, and decomposition of metallic salts and similar compounds. April 3.

1889.

1189. E. Augé. Manufacture of salts of alumina. March 27.

4286. J. Winskill, jun. Kiln for burning limestone. April 17.

4325. G. E. Carleton. Method and apparatus for calcining limestone. April 17.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

4759. J. R. Kempe. Improvements in the method of and apparatus for moulding fireclay and earthenware closet pans, lavatories, baths, sinks, urinals, syphons, gullies, stretch-traps, basins, jugs, and other fireclay and earthenware articles. March 19.

5048. D. Rylands. Improvements in moulds for forming bottles by the pressing and blowing process. March 23.

5138. A. W. Turner and G. Tomkinson. See Class X.

5691. J. A. Edwards. An improved method and apparatus for supporting articles of earthenware or porcelain whilst being fired. April 2.

5775. J. D. Denny. An improvement in facing bricks, tiles, terracotta, &c., in various patterns and colours, glazed or otherwise, and appliances for making the same. April 4.

5922. J. Rhodes. An improvement in the manufacture of china and earthenware saucers. April 8.

6088. J. Gimson and C. Challinor. A connecting socket pin for supporting china, earthenware, and tiles in glost ovens and enamelling kilns. April 9.

6247. J. Howie. Improvements in enamelling or glazing pipes, traps, and like articles made of earthenware or clay. April 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

3598. C. E. Mumford. Tiles for malt-kiln floors. April 10.
 6905. J. M. Day. Manufacturing glass bottles. April 17.
 8518. A. E. Letalle and P. Billing. Photographic stained glass. April 17.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

4683. H. Edis. Fireproof and noncombustible asbestos wall and ceiling papers. March 18.
 4806. Sir E. J. Harland, Bart. Improvements in the manufacture of elastic tiles. Complete Specification. March 19.
 4848. T. Hydes. Improvements in the manufacture of cement. March 20.
 4946. R. R. Clinis. Improvements in bricks. March 21.
 5133. C. J. Howe. The production of a cement or plaster suitable for rapid fireproof plastering, and for all other purposes for which Keen's and other similar cements or plasters are used, and which is capable of being produced at about the price of ordinary plaster of Paris. March 23.
 5157. J. W. H. James. Improvements in the manufacture of cement. March 26.
 5185. H. Ghurshkovitch. Improvements in cement pipes and apparatus for making the same. March 26.
 5190. St. G. T. C. Bryan. Improvements in and relating to the treatment of slag for a variety of important uses, such as making it cellular for pavements, walls, and the like. Complete Specification. March 26.
 5205. H. L. Boulton and S. H. Leech. Improvements in the manufacture of blocks of terra-cotta and like materials, and in machinery for that purpose. March 26.
 5363. B. Rhodes. An improved non-corrosive material, suitable as a cement packing or covering to resist acids. March 28.
 5412. T. K. Ferguson. Improved combination of ingredients for use as mortar, plaster, and the like for building purposes. March 29.
 5919. W. S. Lea and H. M. Lynam. Improvements in the manufacture and composition of refractory or fire-resisting cement or cements. April 6.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

5808. A. C. Ponton. Manufacture of artificial stone. April 10.
 6807. P. Stuart. Pavements. April 10.
 7456. J. S. Rigby. See Class XVI.
 7618. W. Ross. New form of brick for building purposes, called "the Culloden partition brick." April 10.
 7915. A. Fleiner, H. Haenschild, and A. Bauermeister. Manufacture of Portland cement and apparatus therefor. April 10.
 7925. H. T. Holloway and H. Holloway. Block floors or pavements. April 3.
 8879. T. C. Fawcett and T. Castle. Combination of machinery for mixing or making cement. April 17.
 9763. J. S. Rigby and A. MacDonald. Manufacture of cement from the calcium sulphide waste of Leblanc soda manufactories. March 27.

1889.

2632. J. Sugden. Artificial building materials. March 27.
 2919. C. C. Gilman. Fireproof ceilings. April 3.
 2921. C. C. Gilman. Fireproof floors and roofs. April 3.
 2922. C. C. Gilman. Fireproofing wood or iron posts or columns. April 3.
 2923. C. C. Gilman. Construction of fireproof floors and ceilings. April 3.
 2926. C. C. Gilman. Pavements or side walks. April 3.
 3288. E. Prime. Apparatus for grinding cement, &c. March 27.
 3875. R. Haddon. --From S. E. Haskin. Seasoning or preserving woods. April 17.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

4719. T. R. Jordan. Improvements in machinery or apparatus for the extraction of gold and silver from their ores. March 18.
 4731. W. C. Roberts-Austen, E. J. Ball, and A. Wingham. Improvements in the purification of iron and steel. March 18.
 4765. T. H. Johns. Improvements in tinning and finishing tin andterne plates, and an appliance used therefor. March 19.
 4832. T. Sharp. Improvements in and connected with the manufacture of sheet iron. March 20.
 4836. T. Doughty. A new and improved method of casting and treating steel ingots. March 20.
 4882. P. C. Gilchrist. Improvements in the manufacture of copper. March 20.
 4956. C. Jones. Improvements in the treatment of steel. Complete Specification. March 21.
 5027. G. W. Webber, J. T. Niblett, and T. A. B. Carver. Improvements in the extraction of mercury from its ores. March 22.
 5037. D. Owen. Improvements in means or apparatus for the purification of molten tin or its alloys. March 23.
 5078. A. E. Barthel. Improved process for the production of fixed or detachable deposits of homogeneous iron in any form, size, or thickness from iron ores or steel, or iron in any form. March 23.
 5082. E. C. Miller. --From The Magnolia Anti-friction Metal Co., United States. Method of preparing or treating metals for the manufacture of compositions or alloys for anti-friction purposes. March 23.
 5089. J. Smith. Improvements in rollers for rolling iron, steel, or other metals. March 23.
 5138. A. W. Turner and G. Tomkinson, Birmingham. Improvements in annealing furnaces. March 26.
 5195. J. Lones, C. Vernon, E. Holden, and R. Bennett. An improvement or improvements in the manufacture of buffer iron or steel for the buffer cylinders of railway carriages, trucks, and waggon. March 26.
 5224. E. B. Parnell. Improvements in the extraction of metals from their ores and in apparatus therefor. March 26.
 5351. J. Lones, C. Vernon, E. Holden, and R. Bennett. Improvements in making box piles for the production of blooms and bars and other forms of iron or steel, or mixtures of iron and steel. March 28.
 5358. M. Scott. Improvements in casting ingots or other masses of metal, and apparatus for that purpose. March 29.
 5578. J. H. Pollok. Improvements in the wet method of extracting gold. April 2.
 5639. F. Knaffle. An improved process and apparatus for the manufacture of steel ingots. Complete Specification. April 2.
 5667. J. H. Darby. Improvements in the manufacture of ingot iron or steel, and the simultaneous production of a highly phosphoric slag. Complete Specification. April 2.
 5669. C. M. Hall. The production of aluminium. Complete Specification. April 2.
 5670. C. M. Hall. The production of aluminium and alloys thereof. Complete Specification. April 2.
 5914. R. E. Green. The production of aluminium. April 6.
 5938. W. S. Simpson. Improvements in connexion with the casting of metals, and in moulds and appliances therefor. April 6.
 5989. P. Schroedter and A. Schroedter. Method of purifying quicksilver. April 8.
 6023. C. T. J. Vautin. An improved process for the amalgamation of gold or other metals capable of amalgamation. April 8.
 6026. F. W. Rose. --From T. K. Rose and D. Dennes, United States. An improved method of and apparatus for treating ores. April 8.
 6035. W. Kloen. Nickel-silver coating tins for canning provisions. April 9.
 6070. S. McCloud. Improvements in the manufacture of bars and rounds of steel and iron and in apparatus therefor. April 9.
 6116. J. B. A. Simmonet and S. W. Cragg. Improvements in and connected with the extraction of gold or silver, or both, from their ores, or other matters containing gold or silver, or both, and in apparatus to be employed therein. April 9.
 6278. J. E. Sherman. Improvements in or relating to open-hearth furnaces. April 12.
 6387. L. Q. Brin and A. Brin. An improved process for the production of metallic aluminium and certain by-products. April 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

7257. F. Fenton and R. J. Partridge.—From J. Woolford. Apparatus for preventing loss in the smelting of ores, metals, or compounds of zinc or other oxidisable metallic substances and ores or wastes of them. April 10.

8668. M. Settle. See Class XXII.

8925. R. P. Wilson, F. J. Wall, F. A. Thurston, T. L. Bibbins, and W. L. Flanagan. Pneumatic process of manufacturing iron, steel, and other metals. April 17.

9783. A. Feldman. Production of metals of the earths and alkaline earths. April 10.

11347. J. Williams and G. L. Morris. Finishing metal plates coated with tin, terne, or other alloy. March 27.

12459. O. Hurry.—From V. Riatti. Production of sulphide of aluminium and aluminium. April 17.

16451. J. Ewart. Protecting surfaces of iron and steel from oxidation. March 27.

1889.

2965. W. H. Melaney. Manufacture of safe and armour plates. April 10.

3098. R. H. Braudon. Process and apparatus for hardening steel. April 10.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

4871. H. A. Seegull. Improvements in the electrolytic process of obtaining copper, zinc, and tin. March 20.

5093. W. J. S. Barber-Starkey. Improvements in electric batteries. March 25.

5107. E. M. H. Audreoli. Improvements in electro-chlorinating auriferous ores. March 25.

5116. T. Pense. Improved electrical storage battery or accumulator. March 25.

5176. E. A. Sperry. Improvements in or connected with electrical installations. Complete Specification. March 26.

5251. R. Kennedy. Improvements in generating and storing electric energy. March 27.

5816. W. E. Laugdon. Improvements in electrical accumulator or secondary batteries. April 5.

5839. T. H. Allum, G. C. Fricker, and J. R. Bainton. Improvements in dynamo-electric machines. April 5.

6112. P. A. Newton.—From W. Main, United States. Improvements in secondary batteries. Complete Specification. April 9.

6119. J. J. Shedlock and R. Western. Improvements in thermoelectric batteries. Complete Specification. April 9.

6286. D. Urquhart and W. Bates. Improvements in secondary batteries. April 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

926. C. Hoepfner. Electrolytic production of metals. March 27.

5162. W. M. Mordey. Electric generators. April 10.

6386. W. E. Ayerton, J. Perry, and D. Cook. An electro-dynamic relay for constant or varying currents. March 27.

6961. G. A. Nussbaum. Automatic electric batteries. April 17.

7876. B. Willeox.—From B. A. Abakanowicz and A. d'Arsonval. Electric batteries. April 3.

8039. A. Leclercq and A. Vansteenkiste. Transformation or conversion of electric currents. April 3.

9381. A. Inschenetzky. Electric batteries. April 3.

1889.

485. H. E. Newton.—From D. Pidrálita. Electric generators. April 3.

2949. E. D. Cross. Galvanic batteries. March 27.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

5028. J. Annall. An improved lubricating compound. Complete Specification. March 22.

5353. W. G. Smith. Improvements in or appertaining to the manufacture of soap. March 28.

5622. J. Pearson. Improvements in treating cotton-seed oil mucilage to obtain soap. April 2.

5680. G. R. B. Kempton. Blue soap for laundry washing. April 2.

5908. M. Matthews. Improvements in the manufacture of soap. April 6.

6225. A. H. G. Eichelroth.—From A. Findenigg, Austria. Manufacture of stearic and oxystearic acids from fish oils, more especially the residue of train oil. April 11.

6291. O. C. Hagemann. Improvements in the manufacture of soap. April 12.

6551. O. C. Hagemann. Improvements in the manufacture of soap. April 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

8262. C. A. Morris. New preparations from vaseline. April 3.

8604. C. A. Stitt. Manufacture of soap. April 17.

9187. E. A. Ashley. Metal and marble cleaning soap. April 10.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

4724. F. Maxwell Lyte and C. H. Maxwell Lyte. Improvements in the production of basic salts of lead. March 18.

5344. F. Greening. The manufacture or production of an improved material or compound adapted for use as a substitute for ivory, horn, whalebone, india-rubber, gutta-percha, and other materials, also as a coating or varnish for waterproofing and other purposes. March 28.

5349. J. Freemont. An improvement in the manufacture of coloured sealing-wax. March 28.

5368. H. E. Kent. The British disinfecting adhesive paint. March 28.

5380. G. R. B. Kempton. Sapphire crystal-blue for laundry purposes. March 29.

5547. P. A. Abrahamson. Sealing-wax compounds for bottles, parcels, letters, and the like. April 1.

5550. E. Edwards.—From P. Charrier and E. Dubueq, France. An improved copying ink. April 1.

5763. M. Gaugi and J. Mossner. An improved solution for rendering cloth, felt, paper, and the like waterproof. Complete Specification. April 4.

5792. L. E. Andes. An enamel or paint having disinfecting properties. Complete Specification. April 4.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

5371. G. J. Geary.—From A. Keiller. See Class VII.

7398. R. Avenarius. Treatment of tar oils for use as wood-preserving paints or coatings. March 27.

7708. L. H. Goggs and T. T. Irvine. Bronze or other metallic paints. April 3.

8738. E. A. de Lisle. Manufacture of a vegetable black for decolourising purposes, and apparatus therefor. April 17.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

4959. F. Weintraud.—From C. Weintraud, jun., Germany. Novel method of preparing leather to produce a velvety exterior surface. March 20.

5671. C. W. Cooper. Process of and apparatus for treating hides, skins, or scraps in liquids. Complete Specification. April 2.

5672. C. W. Cooper. Method of treating hides, skins, or scraps in liquids. Complete Specification. April 2.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

8221. N. F. E. Rapenud. Artificial leather. April 17.

2038. F. W. P. Swinborne. Treating hides or skins to obtain gelatinous matters. April 17.

1889.

3904. G. Johnson and H. Clarke. Sole leather. April 19.

XV.—AGRICULTURE, MANURES, Etc.

APPLICATIONS.

4862. F. Hocking. Improvements in and in the manufacture of manure, and apparatus connected therewith. March 20.

5703. H. J. Kirkman. Improvements relating to the treatment and utilisation, for agricultural and other purposes, of bisulphate of soda or nitre cake. April 2.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

4741. H. Barker. A novel method or process for the manufacture of gluten and starch. Complete Specification. March 19.

4941. P. Litvinenko. Improvements in the manufacture of sugar. March 20.

4942. P. Litvinenko. Improvement in apparatus for use in the manufacture of sugar. March 21.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

7456. J. S. Rigby. Utilisation of the lime mud refuse of sugar and other industries for cement, &c. April 10.

8052. G. F. Redfern.—From W. P. Abell. Centrifugal machines for use in the manufacture of sugar. March 27.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

5564. W. P. Thompson.—From La Société Générale de Maltose, Belgium. Improvements in or relating to the manufacture of maltose or to the fermentation of mylaccous matter. April 1. Antedated (under Pat. Act, 1883, sec. 103) 28 November 1888, being date of application in Belgium.

5647. C. Schmitt. Improvements in and connected with the purification of raw spirit in order to produce highly rectified spirits of wine, and apparatus therefor. April 2.

5689. J. E. Reynolds. Improvements in the utilisation of the carbonic acid gas derived from fermentation. April 8.

5981. G. Reinighaus. Improvements in the preparation of malt. April 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

8522. A. G. Ferica and A. Ezeimann. Clarifying beer, wine, and other fermented or fermenting liquids. April 17.

11,189. J. Mitchell. Preserving the sediment from distilleries for use as a sheep and cattle food. April 10.

1889.

2110. K. Moller. Apparatus and methods adapted for breweries and distilleries for charging chambers with air free from micro-organisms and their germs, and preventing air containing the same from penetrating therein and into wort, &c. April 10.

2953. A. Seelebach. Manufacture of champagne and like wines. March 27.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

4715. J. P. Pensgood. Improvements in the preparation of tomato vinegar. March 18.

4951. E. Roberts, L. E. Roberts, and H. G. Roberts. A substitute for cream. March 20.

4961. J. Gray and T. Clement, jun. A new and improved mode and means of estimating the acidity in milk, cream, whey, and curd in the process of making butter or cheese. March 21.

5052. F. McIntyre. Improvements in the making of butter for the purpose of preserving the same. March 23.

5356. H. W. Hart. A new or improved process for manufacturing food in a concentrated cooked form. March 28.

6041. G. Dixon. Improvements in the process, apparatus, and appliances for preserving animal or vegetable products or other substances, liquids, matters, or things whatsoever. April 9.

6087. T. West. An improved process for preserving cream and the like. April 9.

6280. J. F. H. Gronwald and E. H. C. Ochluam. Improvements in the method of and apparatus for preparing milk so as to enable the same to be preserved indefinitely. Complete Specification. April 12.

B.—SANITARY CHEMISTRY.

4944. C. Johnson. An improved process for the treatment of sewage, and apparatus therefor. March 21.

5354. T. L. Seaton. Improvements connected with apparatus employed for the purification and filtration of water and other liquids. March 28.

5355. T. L. Seaton. Improved means and arrangements of articulated appliances connected with the purification and filtration of water or other liquids. March 28.

5628. B. D. Healey. Improvements in apparatus for collecting and burning noxious gases. April 2.

5753. B. Jagger, H. B. Jagger, and A. Turley. Improvements in the means employed for purifying sewage and other waters, and for deodorising and utilising the solids and excreta. April 4.

6219. W. Astrop. An improved process for deodorising, disinfecting, drying, and pulverising the solid portions of sewage. April 11.

C.—DISINFECTANTS.

5368. H. E. Kent. See Class XIII.

5984. R. Hannan. Improvements in sanitary and antiseptic preparations or compounds. April 8.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1888.

4405. T. Adair. Manufacture of butter and cheese; flavouring, colouring and preserving same; and flavouring, colouring, and preserving rancid butter and artificial butters; and apparatus therefor. March 27.

11,180. J. Mitchell. See Class XVII.

1889.

2820. R. M. Houldsworth. A tea compound. April 3.

4391. S. Marmont. Process and means for curing or preserving all kinds of fish, flesh, and fowl, and apparatus therefor. April 17.

B.—SANITARY CHEMISTRY.

1888.

6070. G. A. J. Schott.—From C. Lortzing. Process and apparatus for purifying sewage and other liquids. April 3.

1889.

4058. H. Guthrie. Treating sewage, and construction and arrangement of means therefor. April 17.

C.—DISINFECTANTS.

1888.

17,843. W. H. Daniels. Antiseptic compound for preserving perishable articles. March 27.

1889.

3159. R. Hannan. Sanitary preparations for preventing the decomposition of sizes and similar finishes for fabrics, and for preventing the access of infectious disease. March 27.

3470. A. M. Clark.—From E. Bean. Insect-destroying compound, and method of preparing same. April 3.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

5057. E. Partington. An improvement in lining boilers or vessels used in the treatment of wood and other fibre in the manufacture of paper and other pulp. March 23.

5247. F. Weyland. Improvements in apparatus for drying card-board or paper. Complete Specification. March 27.

5418. W. L. Wise.—From J. M. Badon, Belgium. Transparent printed paper having the appearance of stained glass, and means or apparatus for its manufacture. March 29.

5643. A. J. Boulton.—From Messrs. Jung and Lindig, Germany. Improvements in or relating to the prevention of the corrosion of vessels, tubes, valves, and the like, used in the manufacture of sulphite cellulose. April 2.

COMPLETE SPECIFICATIONS ACCEPTED.

1889.

295. H. J. Medbury. Apparatus for manufacturing tubes, pipes, &c., from pulp. April 3.

333. W. H. Cook. A novel application of pulped paper stock. March 27.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATION.

5409. J. Hancock. Improvements in the production of photographic pictures. March 29.

COMPLETE SPECIFICATION ACCEPTED.

1888.

5140. J. Hines, E. Howell, and A. Howell. Modes, means and apparatus for taking and producing photographs, and apparatus therefor. April 10.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

4812. R. H. Earle. Improvements in marine distress signal bombs. Complete Specification. March 19.

5031. P. de Montravel.—Partly communicated by O. Mauvant, Belgium. Improvements in explosives, and in the method of manufacturing the same. March 22.

5129. Sir F. A. Abel and J. Dewar. An improvement in explosives. March 25.

5208. C. R. E. Bell. Improvements in and connected with the manufacture of matches, and in machinery or apparatus therefor. March 26.

5289. H. Ritter von Dahmen and A. Strauss-Collin. A new manufacture of explosive compounds. March 27.

5503. E. Liebert. Improvements in the manufacture of explosive compounds. March 30.

5504. E. Liebert. Improvements in the manufacture of nitro-glycerin. March 30.

5644. Sir F. A. Abel and J. Dewar. An improvement in the manufacture of explosives for ammunition. Complete Specification. April 2.

5720. W. Kennish. Improved means for igniting the charge contained in explosive projectiles. Complete Specification. April 2.

6170. H. Ritter von Dahmen. Improved manufacture of explosives containing nitro-glycerin. April 10.

6185. H. T. Arbuthnot and G. Hookham. Improvements in the percussion fuses of explosive shells. April 11.

6332. W. H. Scott, L. Paris, and Scott (Limited). Improvements in connexion with electric fuses. April 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

5426. L. Plom. Blasting cartridges. April 10.

5668. M. Settle. Cartridges for blasting in mines or where inflammable gas is present. April 17.

18362. J. W. Skoglund. Manufacture of explosive compounds. April 10.

XXIII.—ANALYTICAL CHEMISTRY.

APPLICATION.

6083. L. Mathieu and J. Morfaux. An improved process and apparatus for testing the presence of colouring matter in wines. April 9.

THE JOURNAL

OF THE

Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 5. —VOL. VIII.]

MAY 31, 1889.

[Non-Members 30/- per annum; Members 21/- per Set of extra or back numbers; Single Copies (Members only) 2/6.

The Society of Chemical Industry.

Past Presidents:

Sir H. E. Roscoe, M.P., LL.D., V.P.R.S.	1881—1882.
Sir Frederick Abel, C.B., D.C.L., F.R.S.	1882—1883.
Walter Weldon, F.R.S.	1883—1884.
W. H. Perkin, Ph.D., F.R.S.	1884—1885.
E. K. Muspratt	1885—1886.
David Howard	1886—1887.
Prof. James Dewar, F.R.S.	1887—1888.

COUNCIL FOR YEAR ENDING JULY, 1889.

President: Ludwig Mond.

Vice-Presidents:

<i>Sir I. Lowthian Bell, F.R.S.</i>	<i>David Howard.</i>
R. Forbes Carpenter.	<i>Ivan Levinstein.</i>
Prof. F. Clowes, D.Sc.	<i>E. K. Muspratt.</i>
Sir J. Neilson Cuthbertson.	<i>Dr. W. H. Perkin, F.R.S.</i>
Prof. James Dewar, F.R.S.	<i>Sir H. E. Roscoe, M.P., F.R.S.</i>
Dr. John Evans, F.R.S.	<i>Prof. W. A. Tilden, F.R.S.</i>

Ordinary Members of Council:

Alexander M. Chance.	<i>F. J. Rowan.</i>
James Duncan.	<i>Dr. Edward Schunck, F.R.S.</i>
A. E. Fletcher.	<i>E. C. C. Stanford.</i>
S. H. Johnson.	<i>J. C. Stevenson, M.P.</i>
B. E. R. Newlands.	<i>T. W. Stuart.</i>
B. S. Proctor.	<i>Thos. Tyrer.</i>

With the Chairmen and Secretaries of Sections.

Honorary Treasurer:

E. Rider Cook, East London Soapworks, Bow, E.

Honorary Foreign Secretary:

Dr. Ferdinand Harter.

General Secretary: Charles G. Cresswell.

Offices:

Palace Chambers, 9, Bridge Street, Westminster, S.W.

THE JOURNAL.

Publication Committee:

The President.

Sir F. A. Abel, F.R.S.	Prof. A. K. Huntington.
A. H. Allen.	F. Hurter, Ph.D.
G. H. Bailey, D.Sc., Ph.D.	F. Jones, F.R.S.E.
Joseph Bernays, M.I.C.E.	Ivan Levinstein.
H. Brunner.	Prof. R. Meldola, F.R.S.
W. Lunt Carpenter.	E. K. Muspratt.
Prof. Frank Clowes, D.Sc.	C. O'Sullivan, F.R.S.
W. Y. Dent.	John Pattinson.
Prof. Jas. Dewar, F.R.S.	W. H. Perkin, Ph.D., F.R.S.
John Heron.	Sir H. E. Roscoe, M.P., F.R.S.
D. B. Hewitt, M.D.	John Spiller.
David Howard.	A. Norman Tate.
Prof. J. J. Hummel.	Thomas Tyrer.

Editor:

Watson Smith, The Owens College, Manchester.

ASSISTED BY THE FOLLOWING STAFF OF

Abstractors:

T. L. Bailey, Ph.D.	F. S. Kipping, D.Sc.
G. H. Beckett.	Chas. A. Kohn, Ph.D.
D. Bendix.	F. W. T. Krohn.
E. Bentz.	T. A. Lawson, Ph.D.
E. E. Berry.	J. Walter Leather, Ph.D.
E. J. Bevan.	A. Liehmann, Ph.D.
Bertram Blount.	D. A. Louis.
Arthur G. Bloxam.	W. Macnab.
C. H. Bothamley.	G. Harris Morris, Ph.D.
E. G. Clayton.	J. M. H. Munro, D.Sc.
Julius B. Cohen, Ph.D.	H. S. Pattinson, Ph.D.
C. F. Cross.	H. T. Penternmann.
A. R. Davis.	S. G. Rawson, B.Sc.
W. W. Haldane Gee, B.Sc.	A. Roe, Ph.D.
C. Napier Hake.	F. W. Renaut.
S. Hamburger, Ph.D.	Edward Simpson.
Oswald Hamilton.	A. J. Smith, B.Sc.
John Heron.	A. Studer, Ph.D.
Bertram Hunt.	Bertram Thomas.
C. C. Hutchinson.	Eustace Thomas.
D. E. Jones, B.Sc.	V. H. Veley, M.A.
W. E. Kay.	R. Lloyd Whiteley.
A. J. King, B.Sc.	A. Wingham.

NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list, will retire from their respective offices at the forthcoming Annual General Meeting.

Sir Isaac Lowthian Bell, Bart., F.R.S., has been nominated to the office of President; and Mr. Ludwig Mond has been nominated Vice-President under Rule 11.

Dr. W. H. Perkin, F.R.S., has been nominated a Vice-President under Rule 24; Mr. James Duncan, Mr. S. H. Johnson, Dr. Hugo Müller, F.R.S., and Dr. Edward Schunck, F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. L. Archbutt, Mr. John Brock, and Mr. John Spiller have been nominated Ordinary Members of Council under Rule 17, in the place of Mr. James Duncan, Mr. S. H. Johnson, and Dr. Edward Schunck, F.R.S., nominated Vice-Presidents.

The Treasurer and Foreign Secretary have been nominated for re-election.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18:—"No such nomination shall be valid, unless it be signed by at least ten members of the Society, who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's office, at least one month before the date of the commencement of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

ANNUAL GENERAL MEETING.

Notice is hereby given that the next Annual General Meeting will be held in London on Wednesday, Thursday, and Friday the 10th, 11th, and 12th of July next.

The following is a synopsis of the arrangements:—

Wednesday, July 10th.	
Annual Meeting, Royal Institution	- 11.0 a.m.
Doulton's Art Pottery, Lambeth	- 2.0 p.m.
Lambeth Palace	- 3.0 p.m.
Reception	- 9.0 p.m.
Thursday, July 11th.	
River Excursion, Old Swan Wharf	- 10.0 a.m.
Saccharine Works, Hammersmith	- 11.30 a.m.
Kew Gardens	- 3.0 p.m.
Dinner at "Star and Garter," Richmond	6.30 p.m.
Friday, July 12th.	
Truman, Hanbury's Brewery	- 11.0 a.m.
Cowan's Sugar Refinery, Barnes	- 11.30 a.m.
A.B.C. Sewage Works, Kingston	- 11.30 a.m.
Brush Electric Light Co., Lambeth	- 2.15 p.m.
Brin's Oxygen Co., Westminster	- 3.0 p.m.
Groth's Electric Tannery, Bermondsey	- 3.0 p.m.

Further details will be sent to each member with the Ballot List by post.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Post Office Orders in payment of subscriptions should in all instances be made payable at the General Post Office, London.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January 1883, and January, February, and April 1886. Members possessing odd copies of these numbers

are particularly requested to communicate at once, stating price required, with Mr. Cresswell. The stock of all other numbers is at present sufficient for the Council's requirements."

LIST OF MEMBERS ELECTED. 23rd MAY, 1889.

- Alpiar, Azop, Smyrna, Asia Minor, morphia manufacturer.
 Boyd, R. Nelson, 23, Queen Anne's Gate, Westminster, S.W., civil engineer.
 Chiddey, Alf., Mt. Costizan Smelting Works, New South Wales, mine manager.
 Davis, P. H., 171, Queen Victoria Street, E.C., technical journalist.
 Groth, Lorenz A., 3, Tokenhouse Buildings, London, E.C., civil engineer.
 Latham Jno. J., 157, Albert Road, Appleton, Widnes, chemical manager.
 MacIvor, R. W. Emerson, 279A, Wick Road, South Hackney, N.E., chemist.
 Milestone, Wm. C., Garrett Lane, Wandsworth, S.W., chemical manager.
 Nicholls, Chas. P., 70, Kilby Street, Boston, Mass., U.S.A., manufacturing chemist.
 Oswood, Edw. R., Cossipore Sugar Factory, Calcutta, India, sugar refiner.
 Robinson, Graham, East Taunton, Mass., U.S.A., chemical student.
 Scott, Ernest G., c/o Lever Bros., Port Sunlight, Bebington, Cheshire, chemist.
 Turner, Hy. Blois H., 6, Lyons Range, Calcutta, India, sugar refiner.
 Wilson, Wm., Delhi, India; and c/o E. Rodger, 1, Claremont Gardens, Glasgow, merchant.

CHANGES OF ADDRESS.

- Abel, Sir F. A., 10 Woolwich; 1, Adam Street, Adelphi, W.C.
 Anderson, J., 10 Workington; c/o The Alkaline Reduction Syndicate, Limited, Hebburn-on-Tyne.
 Angus, John, 10 London; The Moorhouse, Grant's House, R.S.O.
 Ashworth, L., 10 Ridcliffe; Sunny Lea, St. Anne's-on-Sea, Lancashire.
 Ball, Jos. P.; Journals to 453, Frankford Avenue, Philadelphia, Pa., U.S.A.
 Burrell, B. A., 10 Cork; 5, Mount Preston, Leeds.
 Chauncy, H., 10 Festiniog; 1, Manafeluet, Dolgelly, North Wales.
 Curtis, H. E., 10 The Croft; 15, Old Humphrey Avenue, Hastings.
 Dagger, J. H. J., 10 Neath; Cowles Syndicate Co., Milton, Stoke-on-Trent.
 Gadsden, Capt. H. A., 10 Crosby Square; 30, Keppel Street, Russell Square, W.C.
 Gilchrist, P. C., 10 Willoughby Road; Frogmal Bank, Finchley New Road, Hampstead, N.W.
 Harrison, Ern. M.; Journals to 10, Elizabeth Terrace, Appleton, Widnes.
 Hopkin, W. K., 10 Maida Vale; 14 Mowbray Road, Broudesbury, N.W.
 Lawrence, H. A., 10 Brockweir; 28, Grosvenor Road, Gunnersbury.
 Lee, C. Tennant, 10 Kilby Street; 118, High Street, Boston, Mass., U.S.A.
 Lees, S., 10 Hampstead; 9, Barrington Crescent, Yarn Lane, Stockton-on-Tees.
 Leech, F. S.; Journals to 66, Loop Street, Cape Town, South Africa.
 Lawson, J. G. F., 10 Lasswade; Beltonford Paper Mill, Duubar, N.B.
 Lupton, S., 10 The Harehills; Grove Cottage, Roundhay, Leeds.
 Mason, Jos., Eyusham Hall, Witney, Oxon; and 1, Chesterfield Gardens, Mayfair, W.
 Napier, Jas., 10 Shawlands; 15, Prince's Square, Strathbungo, Glasgow.
 Reid, T. Anderson, 10 Mersey View; 21, Greenway Road, Runcorn.
 Ross, J. G., 10 Argyle Place; 13, Jordan Lane, Edinburgh.
 Singer, Ignatius, 10 Manchester; Lister's Arms Hotel, Ilkley, Yorks.
 Sutton, F. Napier, 10 Holloway; 6, Grosvenor Gardens, Willesden Green, N.W.
 Thomas, P. Alex.; Journals to c/o Varyan Co., Palmerston Buildings, 93, Bishopsgate Street Within, E.C.
 Turgensen, Dr. R., 10 Halle; Offenbach a/ Main, Germany.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	R. Messel.
H. E. Armstrong.	B. E. R. Newlands.
W. Lunt Carpenter.	B. Redwood.
W. Crowder.	T. Royle.
W. J. Dibdin.	John Spiller.
C. Graham.	Wm. Thorp.
S. Hall.	C. R. Alder Wright.
C. C. Hutchinson.	

Hon. Local Sec. and Treasurer:

Thos. Tyrer, Garden Wharf, Battersea, S.W.

SESSION 1888-89.

- June 3rd.—Mr. W. P. Wynne. "Naphthalene Derivatives of Technical Importance."
 " Dr. W. S. Squire. "The Purification of Alcohol by means of Hydrocarbon Oils."
 " Messrs. Newlands Bros.' paper is postponed.
 July. — Annual General Meeting.

Meeting held Monday, March 4th, 1889.

MR. DAVID HOWARD IN THE CHAIR.

DISCUSSION ON TECHNICAL EDUCATION IN CHEMISTRY.

THE CHAIRMAN said that a vast deal had already been written and spoken on the subject of technical education, and he would not have ventured to add to that which had been laid before those interested in the subject, and thereby perhaps darken counsel by words without knowledge, but that in the last session of Parliament two Bills had been presented in the House of Commons, and would in all probability be re-introduced during the present session. Those two Bills might be taken to express the wisdom of the Legislature on the subject before them, and it was a matter of great importance that those who were interested in the question of technical education in one branch or another should express their opinions as to whether such proposals as had been made fulfilled the requirements of the trade of England in that respect. The first necessity in any such discussion was to be quite sure of agreement as to the terms used. Technical education had been much discoursed upon, but he was by no means sure that those who had spoken on the subject meant by any means the same thing. No doubt, in the two Bills he had mentioned, there was a certain agreement as to what was meant by technical education by those who proposed to legislate. But he failed to see that what was proposed in those Bills in the least agreed with what had been again and again urged upon the Society of Chemical Industry as the great need of modern chemistry. He would endeavour to make clear what he meant by that statement. There was a general consensus of opinion that technical education was a matter of great importance. But what was technical education? It had been again and again urged—and not one word of what had been said in that direction would he unsay, or do otherwise than add his humble tribute to its importance—that there was an absolute necessity for

training the heads of all chemical works to the highest extent which it was possible to attain. He used the word *head* in no narrow sense as meaning principals, but as meaning rather the *thinkers*. The thinkers in technical work could not be trained too highly: no technical education could be too high or too wide for them. Whether the English educational system fulfilled all that was required in that direction he would leave others to discuss. Whether the English system, with its endless examinations, was to be compared with the German system, which set original research far before cram, and which endeavoured to promote and foster individual thought rather than the mere absorption of other people's thoughts, it was not for him to say. He owed all his chemistry—not only what he had actually learned at the old college of chemistry, but what he had learned *how* to learn, which was a great deal more—to a German, Dr. Hofmann, and therefore he was prejudiced in favour of the German system. But when he looked at those two Bills which represented what was considered to be good for England, he failed to see anything which reminded him of his own training. It would be in the future as it had been in the past: all the members of one body would not have the same office. There must be a head, and there must be hands in any body whose organism rose above the elementary organisms that were found in physiological study. There must be those who think, and those who carry out their thoughts; there must be both head and hands; and he could not find in the Bills before him the smallest satisfaction of that need of which he had spoken—the training of the heads. Both the Bills (one bearing the names of Sir Henry Roscoe, Sir U. Kay-Shuttleworth, Sir Bernard Samuelson, Mr. G. Dixon, and Mr. Arthur Acland; and the other those of Sir William Hart Dyke, Sir Michael Hicks-Beach, and Mr. Jackson) were so completely on the one side, and all that had hitherto been said in the Society of Chemical Industry was so completely on the other, that it was highly desirable that they should make up their minds whether technical chemistry in England would be best promoted by the education of the heads or the hands, and that they should distinctly state their belief on that point before the Legislature took the matter in hand, and decided to spend vast sums of money in one way or the other. The two Bills were substantially the same in character. Both began by treating not of the education of the heads, but of the hands; in fact, both were so much on the same lines that he could not quite understand why the public money should have been spent in printing two Bills instead of one only. No doubt the initiated would tell him that there were great differences; but substantially in each case they appeared to consider that the one thing which English manufactures required, was that the workmen should be technically educated. Objection had been taken to the wording of the resolution of the Council which referred to the various Sections the discussion of this question of technical education. He would not say whether it was good English or bad; but at any rate it was the language of the Bills, and therefore, whether good or bad, it was the language of Parliament. The question they had to discuss was whether the technical education in chemistry of these Bills was what England required. As far as he knew—and his experience was that of a third of a century—the offices of the head and hands were essentially distinct. If the head did not think, the hands could not think for it. But here they had provision made only for the education of the hands. He had worked

along with workmen for many years—and in what he was saying he thought that he was but speaking the experience of others who had worked with their workmen—and though the names attached to these Bills were those of very able men, he did not see the name of any man whom he would really trust to stoke a boiler for 12 hours with the most economical consumption of fuel. Englishmen wanted to keep pace with their German friends, but he felt sure that these Bills would not enable them to do so. He saw no evidence that German chemical education was confined to the workmen; he would have said rather that it was confined to the leaders of the workmen. The German workman, however, had one kind of training which was denied to ours—which he hardly dared venture to touch upon before an English audience. He had three years' training in the finest school of intelligent obedience which it was possible to find—the German military service. It might be that Englishmen could do as well as the Germans; but at any rate we should first make quite certain as to whether the secret of the latter's success did not lie in their military service. One did not find that the English lad of 18 was taught those lessons which the German lad of 18 was taught, and which were not commonly called technical education. The German lad was taught military service. They might ask, what had that to do with chemistry; to which he would reply, that intelligent obedience was the foundation of all successful manufacture. He said *intelligent* obedience, for no one valued intelligence in a workman more than he did. An intelligent master needed an intelligent workman; but he did most earnestly deprecate the idea that that intelligence should be narrowed down to one particular groove in which the man was to work. He had had some experience of workmen, and the best chemists he had found among them had not been those who had been trained solely in chemical factories, but those who had had experience in widely different spheres. It might be paradoxical, but it was not wholly unwise to say that if he were training a workman, he would rather train him first in something else than the particular sphere which he was to occupy eventually. The great thing needful was that power of adaptation of the mind from one sphere to another which required that a man should not be taught all his days merely the one thing which he is to do when grown up. Looking at the Bills to which he had referred, he found that the definitions given in the Government Bills were as follows:—"The expression 'technical instruction' means instruction in the principles of science and art applicable to industries, and in the application of special branches of science and art to specific industries or employments. It does not include teaching the practice of any trade or industry or employment, but, subject as aforesaid, includes instruction in the branches of science and art with respect to which grants are for the time being made by the Department of Science and Art, and any other form of instruction which may for the time being be sanctioned by that Department." Was that technical instruction? Did we require, in order to enable English factories to surpass the German factories, that our workmen should understand the principles of science and art, and that their leaders should not? He said no. What was wanted was intelligent obedience, and not workmen who should teach their leaders science. When the workman had attained a certain position in the factory, nothing could be better than that he should be taught, as far as he had ability to learn, the principles on which he was working. But practice came before

theory in successful work. He could imagine nothing more beneficial than the action of the City of London in providing technical education for those who knew what they are about, and had had the mere manual instruction; but he questioned whether the teaching of theoretical chemistry to boys in Board schools would be of the slightest use to chemical factories. He had tried it. He could manage any boy who had not been taught chemistry; but one who had, he confessed, was beyond him. Undoubtedly an improvement in the elementary instruction of English boys was much wanted. Many years' experience as chairman of a School Board, and generally in the supervision of elementary education, had taught him that. What was required was more practical knowledge, more application of instruction to the wants of daily life, and less to a faint shadow of scholastic training and literary education for the working classes. But the proposed Bills gave nothing of that. They proposed that after a boy had passed through those deep mysteries called the "standards," he should be submitted to scientific training. He had nothing to say against science; but it appeared to him to be a mere delusion to suppose that English chemistry could be raised to a German level by calling upon the workmen to attend lectures. The heads and thinkers should be highly trained; all they asked for in their workmen was intelligence. If the leaders could not teach the workmen, it was an ill day for English manufacturing chemistry. Turning again to the Bills, he found that the science subjects spoken of were "The use of ordinary tools, commercial arithmetic, commercial geography, book-keeping, shorthand, French, German, and other modern languages, free-hand and machine drawing, and any other subject which the Education Department and the Science and Art Department jointly may from time to time prescribe as being a proper subject of technical education for the purposes of commerce, agriculture, or any trade or handicraft." With regard to the use of tools, he was quite content to leave to the consideration of the skilled workmen of England the question whether their handicrafts should be taught in the public schools. They were the best judges as to whether a boy of 14 could be taught the use of ordinary tools in an elementary school. For his part, he thought the boy would be much better taught in a workshop. But with regard to the other matters, the question was whether public money ought to be used for those purposes, or whether it should not rather be employed for the better endowment of scientific teaching and research in the higher schools. (Applause.) He had worked among workmen for so many years that he was not prejudiced against them, nor did he grudge them anything they could get. But if the lessons learnt from the study of biology were regarded, they would find that the highest organisms were those in which the different functions of the body were most differentiated; that the highest types were those in which the brain thought, and the hands carried out its thoughts. It was only in the lower organisms that each member acted for itself; where if the head were cut off the body went on quite comfortably without it, as in the case of certain insects. Were we to imitate the lower organisms in our workshops, and trust to the theoretical education of every workman, or were we to follow that differentiation which nature taught us through the science of biology? He had insisted on this point because it was evident that the idea in the minds of the promoters of these Bills, and expressive of the mind of the Legislature, was that what was required was to train the workman

in theory and not in practice. He believed, however, that what was wanted was to train the workman in intelligent obedience, and the thinkers or heads in the highest manner possible. Unless we did this, we could not hope to equal our German friends. If one examined the organisation of a German factory one found at the head of it men of the highest scientific training, while the hands were men whose chief training had been that of the German military service.

Mr. T. TYRER said it was a subject for regret that the wording of the question submitted for discussion by the Sections was defective in two respects:—

First, it was by its limited terms almost an invitation to go outside its terms in any adequate discussion.

Second, the term technical was in his opinion misplaced. The question should read thus: "*In what direction is State aid needed to assist education in technical chemistry?*"

Now it so happened that he himself was the author of the original scheme for discussion, the terms of which were as follows:—

What is technical education from a chemical point of view?

How should it be given?

- a. Elementary schools.
- b. Continuation schools.
- c. Evening schools.
- d. Technical or polytechnic schools.
- e. Existing institutions.

Ways and means:—

- a. State aid.
 1. Money or building.
 2. Endowments.
- b. Voluntary aid.
 1. Pure.
 2. Rates (local).

The Council reduced this to one point for the sake of keeping discussions within limits, viz.:—"In what direction is State aid needed to assist technical education in chemistry?" and ordered copies of the two Technical Education Bills of 1888 to be sent to each Chairman.

He (Mr. Tyrer) proposed to utilise his original scheme in his remarks, and would first indicate what technical chemistry was. It would scarcely be disputed that it was *applied* chemistry. If so, then chemistry, or chemical science, purely and simply, was not technical. Neither was that combination of applied chemistry and engineering called chemical technology. He would grant the existence of the most intimate correlation between pure chemistry applied or technical chemistry and chemical engineering, and would say that only a man possessing extensive knowledge of the whole three could be said to be the ideal technologist or manufacturer.

Perhaps he might be allowed to define the position by an illustration. The scientific institutions of the country possessed many professors of chemistry; how many were teachers of any other than pure chemistry? In how many institutions were there professors of technical or applied chemistry, or, if there were, how many were really, or indeed could be, technologists in the chemical sense of the term? He made no reflection upon these gentlemen, who needed only the clear demand to very speedily discover a means of supplying it. No one would argue for the identity of pure chemistry with technical chemistry, and it should be remembered that technical chemistry consisted in the application of pure chemistry to processes of manufacture. No operations on the laboratory scale were similar in every respect

to those in the works, and the knowledge of first principles was necessary in order to overcome the difficulties and obstacles to successful results in manufactures.

Granting his assumption that technical chemistry meant applied chemistry, was not the next question how it should be given in elementary schools? Emphatically not; the object of these was to impart the elements of education, and that perfectly; though what was attempted under the existing Code was neither the best in method nor the most adequate for its purpose. Here all that could be done was to instil the rudiments of general knowledge thoroughly, with such a proportion of teaching in science, by simple demonstration and experiment where practicable, as would excite juvenile interest and prepare the way for development at a later period, namely, in the continuation schools, where more complete scientific instruction should be given. In these, supported probably, as now, by grants from the Imperial funds and local rates, capable children should be allowed to gain specific knowledge. These State-aided schools would speedily become the secondary schools of the nation. Provision should be made for the use of these schools in the evening by voluntary students and artisans of limited means and scanty leisure.

In addition, and also aided from the Imperial funds in great measure, there should be purely technical schools or colleges, and the teachers or professors in every branch of science should be specialised, that is, there should be a teacher and professor of theoretical science, and another of its application; in the case of chemistry there should be a professor of pure chemistry, and a professor of applied or technical chemistry.

Now, as regarded existing institutions, many were most admirably situated; most were very fairly adapted to the purposes for which they were established, and a few were especially suitable. They were manned by highly qualified professors of pure science, but only in few instances, so far as he knew, were there professors of applied chemistry.

Were these institutions utilised to the best advantage, that is for technical purposes? No! and in many cases they could not be. If he knew anything of the requirements of a laboratory for the study of technical chemistry, and he thought he did, there were few places suitable; and certainly the use of the same laboratory, where research and purely scientific work was pursued, for the purposes of technical research or teaching would be an absurdity. It came, therefore, to this, that (1) there must be separate technical laboratories and teaching appliances in every institution for teaching science; (2) the smaller and more special institutions suited for the neighbourhoods of manufacturing centres must be increased; (3) State and elementary school rooms and premises for the teaching of elementary science should be made available.

Now came the question of ways and means. In this country, judging from the past, there was no hope that the requisite assistance would be obtained from the Imperial Exchequer; but it would be generally agreed that the State ought to contribute very much more than it now did to the promotion of education in science. In this country a combination of State aid by means of grants in aid, &c., contributions from local taxation or rates, supplemented by voluntary contributions, chiefly in form of buildings or scholarships, prevailed. This combination was likely to continue, but most would agree that (1) buildings should be provided in the main, as now, by local authorities and interests, supple-

mented by the State in a certain definite proportion. (2) Chairs should be endowed by the State on some equitable principle as to distribution, and the professors be made, in fact, servants of the State with a right to its honours and pensions. (3) Working expenses should be controlled by a representative local board, subject to appeal to the higher authority; the teaching to have an adequate representation upon this board. They should be covered by—

1. Fees from students.
2. Rate in aid from the locality.

He could not conclude without endorsing the opinion that the defect in our English system of education lay in the absence of any true secondary education, and until this want was supplied they would fail to progress. Also that it was not the workman, as such, who needed that technical education which is to restore our equality, much less supremacy, in technology. If he was sober, obedient, and industrious, elementary education would make him as efficient as his foreign rival probably simply as a workman. It had been stated that German professors and teachers were constantly in contact with manufacturers and works, and were continually referred to and consulted on the application of pure science to technical operations. If so, it behoved our professors and teachers to cultivate in their own interests the most cordial relations with technologists.

Dr. J. H. GLADSTONE said that this was a subject upon which he had thought and spoken a good deal. He could only approach it in certain directions, and he hoped that anything he might say would be accepted as an elementary contribution to the discussion of a large and important question. In the first place it was desirable to know exactly what was meant by technical education. No doubt the phrase had caught the attention of the public very much during recent years. He and a few others were calling for it and preaching it many years ago, but they found themselves as voices in the wilderness, with no one to listen. Now everybody seemed to have awakened to the importance of the subject, and there was a general chorus of voices clamouring for it. But technical education meant different things to different people. With some it meant giving such instruction in the theoretical or practical part of a profession as would fit a person for carrying out his business in life. That was his view of the correct meaning of the term. Thus the technical education of a medical man was given in hospitals, that of a lawyer or clergyman in their proper schools or colleges, and that of a workman to a large extent in the workshop. This specialised instruction was the more correct meaning of the term technical education. There was another matter of great importance which generally went by the same name, but which required a different term to distinguish it, namely, the fitting a man, so far as his bodily senses were concerned, for the business which he might have to do in after life. He agreed with the Chairman in what he had asserted, but not in what he had denied. He agreed heart and soul with what he had said about the necessity for educating the heads of establishments. The largest possible amount of theoretical and practical knowledge was wanted in the leaders of industry, and the more their minds were cultivated the better their work would be. The example of Germany was well quoted in that respect. How far the State should be called upon to supply that education, or to subsidise it, was another matter. There were establishments in existence, and others

could be created, which gave this kind of education, but he was not quite sure that John Bull was prepared to put his hand in his pocket to help the sons of men of substance to gain such education—to teach the capitalist, in fact. Then there were what had been called the “hands,” though of course the one class merged gradually into the other. It appeared to him that there was something deficient in our present arrangements with regard to the education of workmen. That education used to be given by the masters in their small workshops, but lately, owing to the general subdivision of labour, the practice was dying out, and there arose the danger that a man should be taught simply to perform one little part of his art or industry, becoming very perfect in that particular line. So long as the trade flowed on in the same channel, that practice might work well, though of course the man had little chance of rising. But if a change took place, or the man's particular work was done by machinery, then he was utterly superseded and drifted away into the great ocean of the unemployed. What was wanted was that men should be educated to a certain extent in the general principles of the art they pursued, so that they could turn from one part to another and employ some intelligence in their work, and not do it by rule of thumb or simply by following the direction of their “heads.” He agreed with much that Mr. Tyrer had said as to how that want should be supplied. Of the two Bills quoted he preferred that proposed by Sir Henry Rosecoe, but he hoped that in the present session some proposals would be made which would be more acceptable generally than those now before them. The nation was, he thought, prepared to give some support to “continuation schools,” as suggested by Mr. Tyrer. Such schools had risen up in various places, and were subsidised by public bodies, and he believed that the Government would be willing also to subsidise some good system of polytechnic schools. If such a course were adopted, he hoped that those who would go to the schools would be those who had already made preparation to a certain extent for the business they were to follow; for technical classes would be of little value to workmen unless they had had an education better than that ordinarily given in the elementary schools. The education given in these State-aided schools was too ambitious on the literary side. The old idea of education, which was perhaps very good in the middle ages, was certainly not fitted for the 19th century or for the working classes. It was a mistake to attempt to give high literary culture to children in elementary schools. At any rate, concurrently with the teaching of words, there should be the teaching of things; but the teaching of things should come first, then the words and phrases by which things are expressed. That was the system followed to a large extent in infant schools; and it was really a better and truer education than was given in boys' schools, because the infants were taught to use their faculties and made fit for imbibing knowledge afterwards. But in boys' and girls' elementary schools things were very different, and still more so in middle-class schools. The natural activity of the children was crushed down; they were taught that it was naughty to ask questions, and that they should sit still. What he wanted to see was a system of education which should exercise the child's every faculty, draw out all his curiosity, and satisfy it by object lessons, science lessons, and lessons which should make him acquainted with the world, while his fingers should be trained in manual exercises. Such a system should be begun in the infant schools and be followed without intermission into the highest standards. He did not think that

they should be taught any particular science (except perhaps a little practical chemistry), but rather the principles of all science—those great facts and truths which underlie chemistry and physics, mechanics, geology, mineralogy, and every other science. They should also be taught something of the use of tools. In fact the education should be such that every child would gain some advantage from it, whatever might be his pursuit afterwards. It would not be fair to teach a class one particular art or science. The instruction should be such as would bring out the intelligence of every boy and enable him to turn easily to any work, light or heavy, which he might have to do in after life. There was a tendency in this direction at the present time, and such discussions as they were engaged in would certainly advance it.

Mr. C. F. Cross said that, referring to the scheme set forth by Mr. Tyrer, he was disposed to answer the questions put to the meeting in the negative. He thought that as chemists they should not ask the Government for any aid. Firstly, because State aid administered by the State was rarely satisfactory; and, secondly, because they had sufficient educational power in the institutions which already existed. Thirdly, there appeared to be very little demand on the part of manufacturers for such education of the higher kind as already existed. There were many young chemists in England who had been at great pains to make themselves masters of chemical method; yet manufacturers generally did not recognise the necessity for research, and certainly had not risen to the height of the views expressed by the Chairman as to what should be required from the chemists they employed. One had only to peruse the technical journals from time to time to see the poor character of the men who were advertised for by the chemical manufacturers of this country; and having seen that, one ceased to wonder at the paucity of the demand for men of calibre and research. He would refer to two of Mr. Tyrer's selections of existing institutions for higher education in chemistry. Polytechnic schools were already in existence, and he saw several representatives of them present who would testify that they had done good work. With regard to such institutions as King's College and Owens College, in which he had studied, he thought them founded on altogether inelastic lines. They were by their very constitution incapable of taking full advantage of the results which they themselves achieved. They produced men who went to Germany and elsewhere for higher education and returned enriched with experience. If these institutions were founded on the same lines as the German institutions there would be a means for the country to avail itself of the educated power which those students possessed. Such men would be glad to give courses of lectures in connexion with the institution, or to ask for a room in which to prosecute research. Let the colleges aim at becoming centres of intelligence, let the student have the countenance of his *almater*, and let him do his work there so long as he continued to devote himself to research. No harm could be done, and a great deal of working power would be utilised in a practical way. He would conclude by saying that he thought their answer to the first question should be in the negative; and with regard to the second, that existing institutions were quite capable of fulfilling all the demands made upon our chemists by our manufacturing industries.

Mr. JAMES MACTEAR said that the subject under discussion had excited much interest in Glasgow

some 10 years ago. One of the results of the attention it then received was the establishment, by the late Mr. James Young, of a Chair of Technical Chemistry in the Andersonian Institute. He (Mr. Mactear) was one of the trustees, and as such was acquainted with its working, and he had no hesitation in saying that while, as a chair of chemistry, it had been of immense value to the country, as a chair of *technical* chemistry it had been an absolute failure. It had had the effect of splitting up the teaching of chemistry in that institution into two, a chair of pure chemistry and a chair of applied chemistry; but he would defy anyone to say wherein the difference lay. No one could be more capable than Professor Mills, who occupied the chair, but he doubted whether he had turned out in any direction more successful students than were turned out by Penney, Thorpe, Tatlock, Dittmar, or the late Dr. Wallace—men who professed only to teach chemistry, but in its application to the wants of everyday life. A great deal had been said and written about the necessity for new centres for teaching technical chemistry, but he thought such centres had been amply provided where needed. What was required now was to awaken in the minds of workmen who wished to better their position a desire to learn. Those who had such a desire would find ample opportunities of gratifying it; and he thought the best way of doing so would be by attending evening classes. Teaching technical chemistry to a lad who was to become a working man was more or less a farce. His time at school was too short to permit him to drink in the proper laws of theoretical work; and to give him a mere smattering of chemistry, physics, and mechanics would only confuse him and afford him no knowledge of real work. The great obstacle to the improvement of English workmen was the existence of an enormous mass of trades-unionism. Trades-unionism had laid a heavy hand upon the British workman. It had done much for him in many ways; but in most trades the result was to keep the men down to a dead level—the man who desired to rise being regarded as an enemy to his class. It was not so in Germany; it was so in France, even more than in England. So that to obtain a foreman in France from the working classes was very difficult. The moment such a man became a foreman, every man's hand was against him, and he was practically boycotted by the workmen; and the same sort of feeling unfortunately existed in England. Was it possible, he asked, by any amount of State aid, to teach a man—a glass-blower, for example—his trade by technical education, when the Glass Blowers' Union would not, in all probability, allow him to enter the trade at all, the admission of apprentices being most strictly limited; or to teach a man technical engineering, if he could not enter the engineering ranks because of his union? That was a difficulty which had to be faced, and which no amount of technical education had been able to overcome in Scotland, where they had mechanics' institutes and evening classes with what might be called extra-mural professors. In England there was ample power for giving the technical education that was wanted by polytechnic institutions, and trade schools. The fault lay in the fact that there was not a demand for that education. It seemed to him, therefore, that instead of asking for more money to erect new centres of education they should din into the ears of the working man that if he wished to improve his knowledge and position it was for him to take advantage of the opportunities already provided, and not that more opportunities should be provided. He knew of only

one case of a developed system of technical training, and that was in connexion with the weaving and dyeing schools; but in that case they had no trades-union to deal with. He had carefully studied the system of technical education pursued in Boston and Philadelphia, and had found that as a means of teaching mechanical work it had great advantages. Lads who had gone through a course of three years' training went out into the world and readily secured positions as under foremen, rising afterwards to be foremen or managers. Still the demand for technical education even there was by no means what it should be. The Chairman had made a great point of military training, and he fully agreed with him in that. He had had 25 years' experience of workmen—volunteers and non-volunteers—and he had found that the volunteers acquired during their few years in the ranks an amenability to discipline which the others had not. Such a man knew that in order to be able to command himself he must be able to obey. But an ordinary lad nowadays seemed neither willing to learn nor to obey. His chief object seemed to be to get into a corner and evade doing his proper work.

Mr. F. J. LLOYD, after a few sentences vindicating King's College against Mr. Cross's remarks, said that the subject as put before the meeting assumed that State aid was needed, and the only question they had to discuss was how that aid could be best given. He regretted that that point had not been kept to more closely by previous speakers. They might talk as much as they liked, but Parliament had to act; and the only good they could hope to do was, if necessary, to show Parliament that they were not acting in the right way. In the first place, they should separate from this question the question of original research and its endowment. The feeling of the meeting seemed to be that any workman could be trained to do work intelligently if one only obtained obedience. He had been much surprised at the Chairman's remark that military training gave intelligent obedience. It gave no intelligence whatever, but it gave mechanical obedience. We had not that military training in England, and we were a race that objected to obedience. To a certain extent it was the absence of primary education in the past and the want of that primary education in the workmen of the present day that caused workmen to be so unamenable to rules and regulations laid down by their masters; but he believed that the primary education now and for some time past given in England would produce a different class of men in the future, men who would be obedient, intelligently and not mechanically. He quite agreed with Parliament that more than mere obedience was wanted, whereas all that the Chairman seemed to think necessary was obedience.

The CHAIRMAN: I said intelligent obedience.

Mr. LLOYD, continuing, admitted that the Chairman had said so; but the question was what did he mean by intelligent obedience. If he set a laboratory assistant to watch a certain operation, and then, being himself otherwise occupied and forgetting the said operation, a time arrived when something should be done, he would consider that the man would show his intelligence by stopping the operation, and the want of intelligence by his quietly and obediently watching it spoil. He had known that to happen; and it must be so wherever technical work was carried on. The question was what education could the Government give. He thought it wrong that Government should educate those who could afford to educate themselves. What was

wanted was that after a man had entered a trade and had shown that he possessed the mental capacity for benefiting by technical education, he should be put in a position to receive it at the cost of the State. Amongst a hundred workmen who might be excellent as mere tools there would be only a few capable of receiving the instruction mentioned in the Bill as indicating the views of the Government. The aim of the Bill was that men who had attained a certain proficiency in their work, and who desired to obtain in addition to their technical skill a knowledge of the principles on which their industry is based, should have an opportunity of obtaining that knowledge at the cost of the State. If in the opinion of the members present the Bills did not give such men that opportunity, it was for them to say by what means it could be given. But he hoped that they would not merely pull the Bill to pieces and put nothing in its place, as was so often done.

The CHAIRMAN said, that in fairness to himself he must read the conditions laid down in the Bill for receiving technical education. He had not a word to say against educating the intelligent foreman; but the provisions of the Bill related simply to "anyone who can read a passage from some standard author, who can write a short theme or letter on an easy subject," whose "spelling, handwriting, and composition" are considered satisfactory, "an exercise in dictation" being, "at the discretion of the inspector, substituted for composition"; and who, in arithmetic can do "fractions, vulgar and decimal, simple proportion, and simple interest."

Mr. W. LASCELLES-SCOTT, speaking as a chemical manager of over a quarter of a century's experience, considered that the tendency of modern chemical education had been in the wrong direction. He hoped that a lesson would be taken from what was now going on in Germany and America, and that a workman's chemical education would in future commence at the practical rather than the theoretical side. He would, for example, begin by teaching a man how to stir a mass in a pot without doing any damage, and then, but not *till* then, would teach him the theoretical considerations upon which his work was based. He agreed that it would be of great advantage to England to have State aid given, both directly and indirectly, for the development of technical education, provided that aid was applied in the right way. The present time was, in his opinion, peculiarly suitable for the discussion of this question, because the newly constituted County Councils were about to commence their official work, and this was a field in which they could be of immense practical use. It seemed to him that previous speakers had not paid sufficient attention to the geographical aspect of the question before them. In one district workmen would require to be educated in quite a different direction to that of another district, and in his opinion, therefore, no system of education and no Parliamentary Bill on the subject would be satisfactory unless it was administered by the body best able to judge of the needs of any particular district, namely, the County Council of that district. And further, it was desirable that State aid should be applied to practical work, and not to the theoretical or academical portion of a man's education. This latter, with the exception, of course, of the very earliest or rudimentary stages, might safely be left to be covered by private scholastic establishments. Another phase of the question which required further consideration was that relating to appren-

ticeship. There were symptoms in some directions, he was pleased to observe, of a return to the old plan of apprenticeships; and in his opinion no system of education for converting raw lads into skilled workmen would be successful, unless its secondary or final courses were supplemented by a system of apprenticeships. It was in this direction that State aid might well be applied, under the direct supervision of the County Councils. It had been said that there were difficulties in the way—that the factories and workshops were closed against these raw hands. But that was only a difficulty of to-day, and was already showing signs of passing away. He had made inquiries on the subject in various places, and large manufacturers and companies had told him that they were willing to admit workmen and youths, provided they were guarded in some degree against loss by having the benefit of their (the workmen's) services secured to them for some time. He certainly thought that these points should be included in any Bill which might be brought forward, and in any case he would be strongly opposed to the perpetuation of the present vicious, "South Kensington" mode of education, and hoped for something better and more practically useful than Sir H. Roseoe's Bill of the previous session.

Mr. R. J. FRISWELL thought that the first thing needful was to teach the English nation to respect science and art. Another necessity was that the upper classes in this country should, as did the upper classes in Germany, set an example of plain living and high thinking. Under the present conditions directly a man began to make money, whether by a chemical works or other means, he wanted to move up into a higher class of society, and so there was a constant drafting from the ranks of those who should be the intelligent leaders among manufacturers. In Germany they had rigid class distinctions, and a chemical manufacturer was proud of becoming a good chemist and not of being a second-rate county magnate. In the same way the workman did not aspire to step into the class above his, but was content to be a thoroughly good workman. Much had been said about the best way of carrying out technical education, but it seemed to him that the first thing to be done was to instil these fundamentals into the nation, and then they might consider the other matters. Mr. Lloyd had taken the Chairman to task for attributing German success partly to military training, and had denied that such training would be productive of intelligent obedience. If Mr. Lloyd had had more experience of chemical works than he apparently had he would hardly have made that assertion. For before a man became a fit subject for military obedience in the usual sense of the term, he had to undergo an elaborate course of what was truly technical education. His own experience of chemical works made him entirely agree with the Chairman's remarks. The greatest nuisance in a chemical factory was the man who presumed to think for himself and to raise questions as to the principles of the processes he was instructed to carry out. The technical education which a workman required concerned only a few simple operations, best taught by fellow workers in a factory. He preferred the man who would look out for the things he was told to look out for, and do what he was told to do. As an instance of the results of a man thinking for himself rather than obeying orders, he might mention that in the laboratory in which he was engaged they often had tarry substances to clean off the apparatus, some of them being soluble in sulphuric acid and others in

caustic soda, and the laboratory man was of course instructed to treat them accordingly. One day he showed his power of thinking for himself by combining the two substances, and announced that he had discovered a mixture which would be invaluable, because it would clean anything, as it combined the properties of vitriol and caustic soda. That was not the sort of thing he desired to extend. What he wished to see was that the men whose capital made them masters of chemical factories should respect the scientific worker, and not expect to take a boy from a board school, call him a "chemist," and pay him 30 shillings a week. Such as they were not the sort of men to make England maintain its lead in manufactures. If leaders of industry would respect science, this country had abundant means of supplying it, and if not this, then the great continental schools. Englishmen were never slack to go to other countries to obtain what they wanted, whether sugar or brains. They had had sufficient intelligence in the past to import Hans Holbein and Van Dyck, and an immense army of foreign art workers, and they could now if they chose get chemical brains either from the schools of this country or from the continent. It was not a case of insufficient technical education, but of an insufficient demand for its possessors on the part of those who, though they ignored it, were nevertheless absolutely dependent on chemical science for the creation and continuation of the industries by which they lived.

Dr. H. E. ARMSTRONG said that he presumed the object of the meeting was to criticise the Bills presented to Parliament last session, with a view to guiding any future legislation; but that object appeared to have been largely lost sight of by the previous speakers. He could not help thinking that the Chairman, in his opening remarks, had been not altogether just to those who had backed these Bills, especially to Sir Henry Roseoe. It should be borne in mind that the gentlemen in question were practical men, possessing a fair knowledge of the present state of education in the country, and having a fair appreciation, not only of what was needed, but of the way in which legislation was conducted in England. He thought, therefore, that they deserved somewhat more credit than the Chairman was disposed to give them. They deserved credit for availing themselves of the term "technical education," because they knew it to be a popular expression. If asked to define that expression, they would probably agree that it was difficult or impossible to do so, and that the great safeguard against harm coming from its use was the fact that no two people agreed as to its definition. That was the only justification for the use of the word in the way it was so frequently used at present. Though not expressed or implied in the Bill, and though he had no authority to interpret the views of the framers, he thought that what they had in their minds was very much what had been indicated by Dr. Gladstone in his remarks, and that what they desired to do was to give a wider system of State education, with greater latitude to those who carried it out, so that they might teach something more than the "three R's," and go beyond that literary training which was at present in vogue. That, he thought, must really be their object; and, however much the meeting might object to minor details, if the Bill produced that effect, they ought to do what they could to support it. The outcome of any such measure had very little to do with what was stated in the Bill. The success which would attend the passing of the measure must depend on the way in which it was interpreted by the teachers; and if teaching of the kind suggested

was to be of any value to the country, it must be because proper views of what were rational methods of teaching prevailed throughout the schools. Sooner or later, one result of passing such a Bill must be the appointment of a skilled staff of inspectors. At present the inspectors were all literary men, having neither a knowledge of science nor the faintest appreciation of its merits. If the present system of appointing inspectors should become modified by the introduction of a Bill, such as that before them, it would be a result of great value. He agreed with the Chairman that the condition of the chemical manufactures of the country would not be materially altered by giving our workmen technical education; yet by rendering them more obedient we should gain a great deal; and better teaching would no doubt beget habits of obedience. For his part, he hoped that the military system, except in the form of volunteering, would never prevail. He had had considerable personal experience of German chemical works, and had seen that the habits of obedience referred to by the Chairman were of much value. Yet, while recognising that value, he thought that there was much truth in Mr. Lloyd's remark that we were not an obedient nation—and he hoped we never should be. He could not help noticing that the German was becoming more and more blindly obedient year by year, and it struck him forcibly that original thought was being more or less crushed out of the nation in consequence. In England, original thought was largely the outcome of the inherent disobedience—or rather, reasoning obedience—of the people: of the natural tendency of the Englishman always to say "Why should I?" when told to do a thing, and yet to do it sooner or later. The position he took up was that if the Society could suggest any minor improvements to the promoters of the Bill, let it do so. But with regard to the question: "In what direction is State aid needed to assist technical education in chemistry?" the proper course had been indicated by Mr. Friswell, and by the Chairman in his first words. Chemical manufacturers should be made to appreciate the value of chemistry. If the Government could compel every chemical manufacturer to come forward and make a confession of faith, such as the Chairman had made, the problem would be solved. A certain amount of aid was needed, especially in the provincial colleges, and the Government had announced their intention of giving help; but what was most needed was aid from the manufacturers. He wanted to see students sent to the colleges. Although willing to do all he could to help in this matter, he always felt that at present he was in a more or less powerless condition, not only on account of the number, but especially of the quality of the students of chemistry. Most students of chemistry were not of a high grade. Chemical science had not a high reputation, and the consequence was that the better class of men took other subjects—the bar, medicine, and others—which offered better opportunities. At present, therefore, chemical science did not command a fair proportion of the talent of the country, and until it got that proportion little good would be done. Teachers must, too, have the students under their control for a longer time. At present it was difficult to persuade parents to allow their sons to stay three years at college, and at most colleges only half that time was devoted to chemistry. Teachers were not only expected to turn out a lad with a fair knowledge of the principles of chemistry, but also to make him an expert workman; and the result was what might be expected, either he was turned out a fairly efficient workman without any proper knowledge of

his subject, or else with a good understanding of his subject and a very slight proficiency on the analytical side. People seemed to understand that it was impossible to make a man a good engineer on the theoretical side as well as a competent workman in so short a time. An engineering pupil had to spend a number of years at college to learn the science of his profession, and then he spent three or four years at a works in acquiring mechanical proficiency. Until chemical students underwent a similar course of training very little progress would be made. It was that which had made the Germans what they are. If one went into a German works of the better class, one found lots of men who had been at the universities for five, six, seven, or even eight years. That was the type of man sought for in Germany at present, and not the man who had been to a technical school and learnt a little bit of his subject, *i.e.*, some special branch of technical chemistry. He thought that Mr. Tyrer had made a mistake with reference to that point, because, after all, there was no good in attempting to define the difference between a technical chemist and a pure chemist. What was wanted was to turn out men who knew their subject, and who were competent independent workers.

Dr. DOBBIE said it was doubtless known to the meeting that Government had already made a small experiment in the endowment of technical education. He referred to the vote of 5,000*l.* taken last year in aid of agricultural education. The college with which he was connected had ever since its foundation taken an active part in the promotion of agricultural education, and had, therefore, been entrusted with the application of a portion of the grant. The principle adopted by the Privy Council was to make awards only to such institutions as had done useful work in the way of agricultural education. Bangor College, therefore, had to prove that it had already done good work in that direction, and then it was allowed a small share of the grant, 200*l.* The college authorities now aimed at providing a system of agricultural education for the whole of North Wales. In the college itself they attempted to give a thorough education suitable for the sons of wealthy farmers who could attend college for two or three years. Their chief work, however, lay in the agricultural districts. In every such district of North Wales they had established centres of agricultural education; they gave lectures to classes of farmers, and illustrated them by experiments in the field; they had started no less than three dairy schools in different parts of the principality. They did not attempt to teach the farmer how to drive a plough; but they taught him the scientific principles on which he manured and tilled his ground and fed his cattle. As soon as the farmers understood what they aimed at it was not only possible to get large and intelligent classes together, but the demand for such classes was greater than they could meet. They had given four courses this year, and the average attendance had been from 80 to 100. Those who attended were not schoolboys, but men actually engaged in the practical operations of farming. Many of them farmed a large number of acres and had under their control a large body of workmen. They were thus, in the words of the chairman, educating the "heads": those who corresponded to the foremen and masters of our factories and chemical works. They could do nothing for the labourers; they confined themselves to teaching the farmer the scientific basis of his craft. In the dairy schools they were obliged to attempt something more than this. They had in the first place to teach the dairymaids and men something about the

composition of milk, and about the conditions under which butter and cheese of the best quality and in the largest quantity could be obtained from it. But they had found it necessary to go further in this case and give instructions in the actual manipulation of the milk. This was due to the backward state of the dairy industry in the principality. In Denmark, where the dairy industry had been brought to a higher pitch of perfection than in any other country in the world, they had in addition to numerous and excellent dairy schools a system of apprenticeship under which many dairymaids received their training; and no doubt when the industry had been generally improved in this country that method of training would be largely resorted to. For the present it was necessary to teach the practice as well as the theory in their schools. These remarks had a direct bearing on the question under discussion, that question being as to the direction in which technical education could best be assisted by the State. In the case of the University College of North Wales at Bangor, the money was given by the Privy Council without any restrictions as to its disposal. The Council had satisfied itself that the college could make good use of it, and knew best what were the needs of the particular district in which it was situated. The grant was not perpetual, its continuance being dependent on proof of good work being done. In giving the money to an existing institution possessing nearly all the appliances and staff for giving technical education the Council had, he thought, acted wisely. It had saved the great expense of erecting new laboratories and founding new chairs. He could not help thinking that the question of State aid to technical education might be treated with advantage in a similar manner throughout the whole of England. If the Government, instead of creating a vast new system of technical education were to subsidise the provincial colleges, and leave them to conduct the work of technical education in the way best suited for the district in which they were situated, he thought that would be a satisfactory solution of the question.

Professor THORPE said that Dr. Armstrong having referred to the gentlemen who had backed Sir Henry Roscoe's Bill, it ought in common fairness to be stated that so far as training and experience went Mr. Lawes Jackson, whose name was on the back of the Government Bill, should be scarcely less competent to deal with such a question. Mr. Jackson in former days played a prominent part in educational matters in the town for which he was one of the members, and he was still at the head of a large manufacturing establishment there, which had very close relationships with applied chemistry. With respect to Mr. Mactear's remarks, he must compliment him on the easy way in which time was apparently dealing with him, for it was nearly twice the 10 years stated by Mr. Mactear since the Technical College of Chemistry in Glasgow was created. In virtue of his former connexion with Anderson's College, he had had some little experience of the working of the Young chair, and it was perfectly true that, up to the present, it had hardly realised the anticipations of its founder and his friend. He was well aware of the motives of the late Dr. James Young in creating the chair; and probably no man was better qualified to form an opinion as to the kind of training which a workman needed for success in chemical manufactures. Mr. Young was practically the founder of a new industry, and in its development he had no traditions to guide him; he had to create practically everything connected with it, and much of his success was undoubtedly due to the character of the train-

ing which he had himself received under Graham. With respect to the Young chair, some of its ill-success must be set down to the want of appreciation of such places. Although the Technical College was situated in the heart of the chemical industry of the West of Scotland, the manufacturers round about had hitherto been singularly slow for some reason or other in taking advantage of the opportunities offered to them by its founder. It was to be hoped, however, that under the recent reorganisation of the place better results would speedily follow. Much had been said about the uses of military discipline as inculcating that spirit of obedience which the heads of great manufacturing establishments desire to see. No doubt military obedience could be cultivated, but whether that was the exact sort of obedience which was desirable in a chemical works was quite another matter, for such obedience was only too apt to become purely mechanical.

Mr. W. LANT CARPENTER desired to reinforce and confirm Dr. Gladstone's remarks as to the need of State aid for continuation schools; as also the absolute necessity for a larger and trained staff of inspectors, as suggested by Dr. Armstrong. Some such measure of State aid was very necessary for workmen and others who had not the means to spend the necessary time at school. Opportunities for acquiring such training were, no doubt, already offered by the organisation at South Kensington; but those opportunities would be greatly extended if, as he hoped, a Bill for establishing continuation schools should be passed this session. He would suggest that there was need for State aid in the direction of founding a large number of scholarships in connexion with existing schools, so as to give lads of small means and good brains the opportunity of devoting a sufficient time to getting a sound scientific education. He desired to press this latter point very strongly indeed. For example, in the highest grade of board school at Birmingham, where the fee was 9s., and a very good commencement of technical education was made (although legally the place was still an "elementary school" within the meaning of the Act), artisans who entered their sons there had to sign a promise that they should remain there for three years. This was found to be a very serious obstacle, for the family not only lost the lad's wages, but also had to pay this comparatively high fee for one individual among them. He was strongly of opinion that some system of scholarships and bursaries in connexion with our elementary schools was one of the most important directions in which State aid should be given to technical education.

Prof. R. MELDOLA wished to place upon record his views respecting the technical education question from the chemist's point of view. He might say at once, that the position taken by the Chairman of the Section was very similar to that which he held. It seemed to him an extraordinary anomaly in all proposed schemes of technical instruction that only the elementary side of the subject should be dealt with. In chemistry this state of affairs was particularly deplorable, because, in his opinion, it was a subject which admitted of no half measures. He failed to see how a smattering of elementary chemistry, spread broadcast among the boys in primary schools, was going to improve the chemical industries of this country. He did not wish to decry the advantages of introducing elementary science into primary school education, because nobody could be more alive than he was to the high value of science as a means of mental training; and he should strenuously uphold any scheme, by whatever name it was introduced, which was instrumental

in effecting such an introduction of science. The point he wished to bring out was, that the chemistry which it was proposed to introduce in this way was not, and could not in any sense be made, "technical," and that it was misleading to include such elementary science under the designation of "technical instruction." It might lead to a desire on the part of many schoolboys to advance further in the subject if they possessed any natural aptitude for it, and in so far it might lead to useful results; but why should the subject be smuggled in with the much-abused word "technical" attached to it? It might appear unnecessary to draw this distinction between chemistry in the early stage of its elementary introduction, and the subsequent application of the science to particular branches of industry, when it may then be said to become distinctly technical. There was, however, a reason, and a very grave one, why this distinction should be proclaimed, and it appeared to him that the chemical manufacturers were the only people who could proclaim it authoritatively. The reason for this necessity was that technical education, having so largely caught the public ear, had become almost identified of late years with purely elementary instruction, and had thus diverted support from the higher and more truly technical education, by which alone our chemical industries could be promoted. In this way the cause of true technical education was likely to be injured by having elementary, and always elementary, training pitted against it as a rival claimant for public support. The rivalry, if it existed, as he feared it did, had been created by the neglect of the true thing and the substitution of its shadow. All manufacturers would allow that we must begin with elementary instruction; but surely it must be conceded that if State aid is to be given in enabling boys at school to acquire a rudimentary knowledge of science, the more specialised application of that knowledge to industrial purposes, which could only be taught at a later period of education, had an equal claim to State support. The elementary training was useless so far as the improvement of chemical manufactures was concerned unless means were provided for efficiently converting that preliminary instruction into technical instruction afterwards. The two grades of instruction were, as it appeared to him, so inseparably bound together that to introduce the elementary grade only and to call that technical education was an abuse of terms.

He feared that the chemical industries were at a disadvantage in this matter as compared with other industries, because in many technical subjects which involve mechanical principles only there were numerous grades of training, each of which in its degree was of use to the man who had received it, and who wished to make his living by it. But an imperfectly trained chemist was on the same level, so far as chemical manufacturing was concerned, as the man who had received no chemical training at all. He could speak from experience on both sides of this question, having spent many years in chemical factories, and the last few years in imparting to students such knowledge of applied chemistry as lay within his power with the means placed at his disposal. It was most imperative that the chemical manufacturers should declare their views, because there could be no doubt that technical education was claiming more public attention than it had ever received before in this country, and there was a danger of the subject becoming identified with the mechanical industries—in other words, with manual training only—unless manufacturing chemists stated their side of the case. With respect to the practical application of the views he had ventured to express, it would be long, he was afraid, before the requirements for really

effective training in technical chemistry were adequately recognised in this country. He did not wish to alarm legislators at this stage of their efforts, but he had recently been collecting information as to the actual cost per head per annum that is considered necessary for the thorough training of technical chemists in continental schools, colleges, and polytechnics. The result showed how miserably inadequate were the existing institutions in this country to meet such competition as the continental establishments could bring to bear against them. In answer to the specific question proposed for discussion, it seemed to him, therefore, that if State aid is to be given at all for the promotion of technical education in chemistry, it should not be confined to elementary schools only, but should be extended to existing institutions, so as to enable the latter to specialise in an efficient manner the training which is given in the schools. And not only this, but if real service is to be rendered to the chemical industries of this country, the best way of doing it appeared to him to be to enable those students who have shown real ability in this direction to continue their studies for such a period as is necessary to turn them out as really efficient managers or foremen capable of superintending or conducting the manufacture of chemical products on a scientific method, as distinguished from empirical want of method. Some system of State scholarships or capitation grants might serve the purpose. In order to benefit our chemical manufacturers it would, as it seemed to him, be far more valuable to the nation in the long run to assist in the thorough training of the few who have shown themselves most competent, than to call upon the State to impart elementary instruction indiscriminately under the name of technical education. Such appeared to him to be the requirements of the time with respect to the all-important question of the promotion of those branches of manufacture in which chemistry is concerned.

The CHAIRMAN said that there appeared to him to be far more unanimity in the opinions expressed by the various speakers than was shown on the surface. In many points in which they differed it was in expression rather than in principle. Of course, if the Bills he had criticised were not intended to promote the objects actually expressed in them, that would make a great difference. And if the British public could be persuaded into thinking that it was getting technical education when it was really getting common sense, it might be desirable to let matters take that course. He could assure Dr. Gladstone that he heartily agreed with him as to the principles of education. It appeared to him that the meeting was tolerably unanimous on two points: (1) that in elementary schools there was great need of more practical teaching; and (2) that as far as chemistry was concerned, advanced education was needed rather than special training in elementary schools. He was as anxious as any one to give the workman who had brains a chance of rising; for the most learned and valuable men that England had produced had not always come from the highest classes of society. But what he dreaded was that a vast amount of public money might be wasted in a vain attempt to teach every lad in England what they were pleased to call technical education. To bring the discussion to a practical conclusion, therefore, he would move the following resolutions:—

- (1.) That in elementary schools there was great need of more practical training.
- (2.) That advanced education in chemistry is needed rather than special training in elementary schools.

Mr. LASCELLES-SCOTT seconded the resolutions, but suggested that the discussion should be adjourned until the appearance of the Bills in the improved form in which they were to be introduced this session.

The CHAIRMAN having pointed out that the discussion was for the guidance of the Council in case necessity for action should arise—

Mr. F. EVERSHEP moved as an amendment: "That in no direction is State aid needed for technical education in chemistry." He wished to point out that there had been no attempt made by the gentlemen who had advocated technical education to show that any of the industries of the country were languishing for want of it; that there was any great scarcity of chemists; or that if there was a scarcity such chemists could not be imported from Germany. The great variety of opinion expressed at that meeting was in itself a strong reason against any form of State aid. If such aid were given, it would necessarily be on some uniform plan, and that would interfere with those individual experiments in education which were now proceeding in various directions. He thought that there was much force in Sir Lyon Playfair's remark in a recent article on this subject (*see* "the Nineteenth Century" for last September) that it is very much better that different towns in different parts of the country should work out their salvation in their own way than that we should have one uniform system dictated from a central body. Uniformity would necessarily result from State aid. [Cries of No, no.] It seemed to him that manufacturers ought individually to be the best judges of the kind of chemists they required, and that their demand ought to determine the supply. If the manufacturer offered a good price for a good chemist that chemist would be forthcoming without State aid. In support of that view he referred members to Lord Armstrong's articles in the "Nineteenth Century" of July and November last. It ought also to be clearly borne in mind that in supplying chemists for manufacturers the State would be aiding one particular class of capitalists at the expense of the general body of tax-payers, and that would be a protective measure, equivalent to giving a bounty on the products of the manufacturer. If this were thoroughly realised by English manufacturers, who were an independent and self-supporting class, he thought they would be the first to repudiate the notion that they required such assistance. For these reasons he considered the meeting was not prepared to say that any State aid whatever was required for the technical education of chemists.

Mr. BERTRAM BLOUNT seconded the amendment, which was then put to the meeting and negatived by a show of hands.

The CHAIRMAN then put the first resolution, which was carried by a large majority.

The second resolution, after some further remarks, was modified, and carried in the following form:—

That as far as technical chemistry is concerned advanced education is needed rather than special training in elementary schools.

Liverpool Section.

Chairman: F. Hurter.

Vice-Chairman: A. Norman Tate.

Committee:

E. Bibby.	H. Gaskell, jun.
J. Campbell Brown.	S. Hamburger.
H. Brunner.	J. W. Kynaston.
E. Carey.	E. K. Muspratt.
H. Deacon.	G. Shack-Sommer.
T. Fletcher.	James Simpson.

Hon. Local Sec. and Treasurer:

W. P. Thompson, 6, Lord Street, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held February 6th, 1889.

DR. F. HURTER IN THE CHAIR.

DISCUSSION ON TECHNICAL EDUCATION IN CHEMISTRY.

At the ordinary meeting held at University College, Brownlow Street, Liverpool, on February 6th, 1889, Dr. Hurter in the chair, a discussion of the question, "*In what direction is State aid needed to assist Technical Education in Chemistry?*" resulted in passing the following resolution, proposed by Mr. E. K. Muspratt, seconded by Mr. E. Carey, and carried with two dissentients:—

Resolution.—That this meeting is of opinion that it is not desirable to introduce special technical instruction in elementary schools, but that it is desirable that power should be granted to school boards or other local authorities to supplement the ordinary course of elementary education by a course of secondary education extending from the 12th to the 16th year, such education to embrace the technically important sciences (as defined in the Bill introduced on the 10th February 1888 by Sir Henry Roscoe and others) and modern languages.

Secondly, by endowing chairs of technical chemistry and allied subjects, viz., such as technical physics and engineering, furnished with the requisite staff of assistants at the various universities and colleges, possessing good laboratories, and by extending laboratory accommodation so as to permit of technical practice.

An amendment was proposed by Mr. J. W. Kynaston, and seconded by Mr. B. Kershaw, but no one voting in its favour except the mover and seconder, it was lost. The amendment was:—

"That it is undesirable to request State aid on the lines of the resolution proposed."

CONDENSED REPORT OF THE DISCUSSION.

The Chairman, Dr. HURTER, introduced the subject by reading from the two Bills dealing with technical education such portions as indicated what the promoters meant by technical education. He showed that the kind of education advocated by Sir Henry Roscoe's Bill was essentially that known in Switzerland and Germany as secondary or "real" education. He then quoted from Professor Lunge's paper on technical education of chemists, those portions in

which he (Professor Lunge) expressed his opinion that the best preparatory education for the technical chemist was that obtained in the "Real Schulen" of Switzerland and Germany and preferable to the so-called humanistic or classical education. Professor Lunge was himself at one time manager of works, and was now the head of the chemical department of the Swiss polytechnic school in Zurich, and therefore well qualified to form an opinion. Dr. Hurter then explained the Swiss system by means of diagrams. He showed that there, elementary education as a complete course was neither better nor worse than that given in English board schools. He was of opinion that, considering the early age of the pupils and the limited time from the sixth to the fourteenth year, nothing but what was now taught could possibly be taught, and he did not think that the ordinary labourer wanted more.

He then dealt with secondary or "real" education, which was open to all who by previous ability and by passing examinations had shown themselves capable of receiving a higher education with advantage, and he expressed his conviction that State aid would be best applied to the promotion of technical education in chemistry by establishing good secondary schools, which would provide a higher class of education for the better class of working men and artisans, and form a good preparatory course for colleges. He also advocated State aid for the endowment of technical chairs at the various colleges, so as to obtain some of the advantages of the continental polytechnic schools.

Mr. E. K. MUSPRATT, in proposing the resolution, said: That before moving the resolution, he wished to say that he agreed entirely with Dr. Hurter that it was not possible for chemical labourers to receive a better education than was now given in good elementary schools, and it had been the experience of Switzerland and Germany, nations which had most experience in education matters, that it was impossible to teach much more than those subjects which were indicated on the diagram. The great want in England was an efficient secondary education, and as regards chemists, he thought all of them were aware that the principal complaint was that they were deficient in a good high class secondary education. He was speaking of youths who had gone into such colleges as Owens, and attended the chemical classes, and who, when they left the college, knew just a little chemistry and nothing at all of other subjects. The reason seemed to him to be that the colleges received the students too badly prepared, and he thought that both Mr. Watson Smith and Dr. Campbell Brown would admit that their students frequently came badly prepared. (Dr. Campbell Brown: "Often not prepared at all.") The only remedy for this state of things was to improve secondary education. He was very glad Dr. Hurter had referred to Professor Lunge's opinion, as that gentleman had experience both as a manufacturing chemist and as the head of the chemical department of the polytechnic school of Zurich, and had better opportunities of learning what was required than any mere manufacturing chemist. Though there were eminent chemists, such as Professor Hofmann, who thought that gymnasium education (classical education) was preferable to "real" education, he (Mr. Muspratt) was inclined to agree with Professor Lunge, who had special technical knowledge. He thought it was most important for technical chemists that they should have the "real" education, because mathematics formed such an important element in that education.

Then as regards the higher education for those who wished for it, he thought that such institutions as Victoria University ought to provide as thorough a training as the polytechnic schools on the continent.

(He then moved the resolution given on page 335.)

Of course the wording of that resolution might be altered, but it fairly expressed the ideas which their Chairman had endeavoured to impress upon them, and in which he entirely concurred. By the endowment of chairs of technical chemistry and allied subjects, they meant that a thorough education for chemists must include something more than chemistry—it must include higher mathematics, engineering and physics, as a matter of course. He maintained that it was impossible for one professor to teach the higher branches of chemistry, educate a man practically for higher research, and put him at the same time through a course of technical chemistry. In the Polytechnic School, of which Professor Lunge was the head, there were many professors of chemistry; there were two head professors, one for theoretical, and the other for applied chemistry; they had each perfectly fitted laboratories, and the same system existed in all the polytechnic schools on the continent. In many cases they would find professors for special branches of chemistry, such as agricultural chemistry, &c.; indeed it was impossible to embrace in one professorship all that was required by technical chemists. He thought that the colleges would have to be aided to a considerable extent, for they were not likely to get sufficient endowments from private means. If they had to compete with the better educated nations on the continent in technical chemistry, they must have more aid given to higher education by the State.

Mr. E. CAREY seconded the resolution, and read a note from Mr. Norman Tate to the effect that he (Mr. N. Tate) had read the resolution and fully agreed with it, but thought it should be understood that technical chemistry included certain other subjects besides chemistry, such as engineering, building construction, machine construction, &c. Mr. Carey thought that was generally understood. He expressed himself gratified with the account the Chairman had given of the educational system in Switzerland, and wished they had some such system in England. He remarked how the people here seemed to grudge the money spent upon education, which amounted to some six millions per annum, whereas the United States of America spend 18 millions. He did not think that technical instruction should be attempted in elementary schools, nor that ordinary chemical labourers or furnacemen would be any the better labourers or furnacemen if they possessed scientific knowledge.

Better means of instruction were, however, urgently required for managers and proprietors, and such means should be provided from the general taxation of the country.

Mr. WATSON SMITH entirely concurred with the account the Chairman gave of the educational system of Switzerland, and spoke of the excellent text-books of science used in the Swiss elementary schools. The views regarding the education of workmen, expressed at this meeting, seemed to be shared elsewhere by the Sections of the Society. An attempt to give a technical education to workmen would be a mistake; a sound basis of elementary theoretical education was all that could be hoped for in the time at disposal.

He then spoke of the various institutions, such as the Science and Art Department, the City

Guilds of London, with the technical education they afforded, and the defects and failures to which they were liable, and made suggestions for their improvement.

Mr. J. W. KYNASTON had given much thought and attention to this question of technical education, and had arrived at conclusions which differed greatly from those expressed by previous speakers. It struck him as curious that they should be asked to adopt a resolution requesting State aid for technical education, while at the same time the Chairman had told them, and all the speakers in the debate agreed with it, that the working man must be excluded from the benefit of such education. Was it reasonable to suppose that Parliament would consent to the application of general taxation in aid of a scheme from the benefits of which the great bulk of the ratepayers were to be excluded? In other words, it was proposed to raise taxation from the lower classes for the benefit of those in a higher sphere. He did not like to move an amendment as he considered it would be a great advantage if professors of technical chemistry were appointed in the various manufacturing centres, but he felt that the cost should be borne solely by those who were to be benefited by the instruction. He quite agreed with Mr. Carey that a workman at a suitable furnace would produce no better saltake if he knew that the formula of sulphate of soda was Na_2SO_4 , and he was satisfied that all that was necessary to regain and maintain the supremacy of our manufactures was, that the operations should be directed and controlled by men more thoroughly educated for the work. In this country a man without any special knowledge of the scientific principles involved would often become a chemical manufacturer, though quite unable himself to control such a manufacture, and was often not careful to place men in charge who had specially qualified themselves to occupy such a position, and indeed had often little or no sympathy with men of scientific attainments. He concluded by moving the following amendment:—

"That it is undesirable to request State aid on the lines of the resolution proposed."

Mr. KERSHAW seconded the amendment. He agreed with Mr. Kynaston's views. He admitted that foremen would be better able to discharge their duties if they had technical instruction. He thought it would be better to give them this instruction only after they had shown their fitness as foremen by possession of such qualities as reliability, truthfulness, and steadiness.

Dr. J. CAMPBELL BROWN opposed the amendment on the ground that State aid for technical education was not taxing one class for the benefit of another, but was taxing the whole community for the benefit of the whole. If State aid were given in the absence of sufficient aid from other sources to promote the education necessary to enable chemical industry to be carried on as well as or better than in other countries, that would not be benefiting one class at the expense of the whole, but it would be benefiting the whole at the expense of the whole community. He suggested that the resolution should include other subjects besides technical chemistry, and should also provide for assistants to the professors for whom State aid was needed quite as much as for professors. He referred to the Massachusetts Technical College, where they had 17 teachers of engineering, 15 of chemistry, and seven of physics, not at all too many; he did not think Massachusetts was a greater place than Lancashire. They wanted efficient assistants if practical teaching were to be carried out properly. He entirely supported Mr. Muspratt's resolutions.

Mr. W. P. THOMPSON said that Mr. Kynaston had spoken of it being unfair that one class should benefit more than another from State aid, but nearly all the public money now voted for education had been spent on the lower classes. The middle classes particularly were handicapped by having to pay rates towards supporting schools, while they were obliged to send their children to private schools. He did not think that the very lowest class did pay the largest amount of taxes, and in any case it was only fair that some of the crumbs of the Government should go to the other class that had to pay taxes as well as the lower class, and secondary education was helped less by Government than any other.

Dr. HURTER said the reasons which Mr. Kynaston had urged against State aid were selfish. A good State-aided secondary education should of course be open to all. The Swiss would not have such a good system of education if it were not State aided; indeed, it was entirely free education. The working men benefited quite as much by the proficiency of the upper classes in any particular industry as those classes themselves. Mr. Kynaston's argument, that it was the proprietors who should be better educated, was an argument for the establishment of secondary schools. Where otherwise were they to get this better education? As regarded Mr. Kershaw's views that education should be given to foremen after they had entered upon the duties of foremen, he thought it would then be too late. The knowledge should be available when they entered on such duties.

Mr. E. CAREY hoped his remarks had not been misunderstood. He would give every facility to working men to better their position and to increase their culture and happiness by knowledge. He merely intended to convey his opinion that technical education would not be of advantage to a labourer as a labourer, and that, therefore, such instruction need not be given in elementary schools.

Mr. E. K. MUSPRATT drew attention to the fact that the question of the Council was entirely lost sight of by Mr. Kynaston. The question Mr. Kynaston was discussing was a political one, viz.: whether it was desirable to aid higher education by State grants. Mr. Kynaston was of opinion that it was not. The experience of England had shown that elementary education had not come up to the level of elementary education on the continent until the State contributed to that education. Then when it was found necessary to spread an idea of science among the people, the State again gave its aid through the Science and Art Department. There was not now a civilised country in the world that did not contribute State funds for education. In democratic countries, such as America and Switzerland, the people were content that State money should be directed towards higher and technical education. But the question which they had to decide that evening was only in what direction the State could assist technical chemistry; they had not to indicate the source whence the State should get the money; all they had to do was to say in what manner State aid could best be given.

Mr. KYNASTON and Mr. KERSHAW shortly replied.

The CHAIRMAN then put the amendment. Only the mover and seconder voted for it, all the other members against.

On the resolution being put, all, with the exception of the mover and seconder of the amendment, voted for it.

Manchester Section.

Chairman: Edw. Schunck.

Vice-Chairman: G. H. Bailey.

Committee:

J. Angell.	I. Levinstein.
C. A. Burghardt.	Sir H. E. Roscoe, M.P.
R. F. Carpenter.	C. Truby.
H. Grimshaw.	D. Watson.
J. Grossmann.	T. Wardle.
P. Hart.	P. Winsor.

Hon. Local Secretary:

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Tuesday, 5th February, 1889.

DR. BAILEY, F.C.S., IN THE CHAIR.

DISCUSSION ON TECHNICAL EDUCATION IN CHEMISTRY.

THE CHAIRMAN: I have been called upon at a moment's notice to take the chair in the absence of Dr. Schunck, and the chief business on the agenda is a discussion in order to elicit opinion on the question "In what direction is State aid needed to assist technical education in chemistry?" The Council has brought this subject before the different Sections for discussion in order that any steps which may be taken later on will have more weight than they otherwise would. The particular view before us is in what direction is State aid desirable or even (I suppose) undesirable in advancing technical education. You are all aware that Bills have been brought before Parliament, and, as far as my own feeling is concerned, I rejoice that they have fallen through, as they were quite incomplete and inadequate to deal with the question. A grave mistake was made in the Bill in regarding technical education as a matter to be dealt with by our elementary schools. No greater mistake could have been made. If anything is to be done in this direction it must be done in the way of erecting first in one great centre, and afterwards in others, thoroughly efficient technical schools. We do not want our school boards imbued with technical education, but what is required is a place where our chemists can receive a thorough and efficient technical education in their special subjects. If such an institution can be set up in Manchester, other towns will soon follow the example. Whether Government should be asked to assist in this matter or not is a question to be considered to-night. One method of securing a satisfactory solution of the question is to enlist the assistance of those who are actually engaged in the work of technical education, and to give them a hand in framing the Bill. Institutions should be established in different centres suited to the special trades and industries of the district. For instance, Manchester would require something different from Liverpool or Birmingham, and the proper way to solve the problem would be to form a guild of chemical manufacturers in conjunction with existing educational bodies with a board of reference in London similar, in its relations to the Local Government Board, to boards dealing with other matters.

MR. WATSON SMITH: In the first place the term "technical education" has gradually been made to cover so much, because so little understood, and therefore applied to one thing by one man, and to another thing by another, that at last it is indeed hard to say what education is not technical. The work of the Science and Art Department, for example, is brought under this category, and we find, in one typical instance that occurs to me, a noble building erected as a technical college; but in that building the work of education done by the science and art master is in preparing his students to pass the South Kensington examinations, just as they might be prepared in our central board school in Deansgate. True there are technologists also there, but they are subordinate to the South Kensington master, who acts as principal of the said college, and who, rather than his best pupils should go to the technical masters proper, strives to induce these pupils to work for higher passes, or go in for national scholarships at South Kensington. The pupils working for the South Kensington examinations are not undergoing, strictly speaking, technical education. They are laying an educational basis for the reception of it rather, and it is the recognition of this fact that has led the authorities and examiners of the City Guilds of London Institute to insist that a candidate for their full certificate in any branch of technology should first obtain passes in certain science subjects of the Science and Art Department. Suppose a student of the Science and Art Department has gained a national scholarship, why should he be obliged to go to the Normal School of Science to work it out? Why should he not be allowed to go, if he so desire, to some other college of good standing, or some technical college? In the case of the college to which I referred, why should not the student, if he so choose, work out his scholarship in the technological department? Seeing that the education of this country as regards the branches fundamental to technical instruction is so much in the hands of South Kensington, I see grave difficulties in the way of giving true technical education as a finishing course in the future technical institutes and colleges. Two circumstances will prevent any but the "base residuum," so to speak, of the Science and Art Department students from entering the technical colleges. (1.) They will be persuaded by their science and art master to keep with him, if worth retaining at all, to earn more grants for him, more honours for themselves, and haply a national scholarship to be held at South Kensington. (2.) They are naturally tempted by the brilliant chances held out, and if they do not get the scholarship they will at least get high passes, and so make up their teacher's income. But let them get to South Kensington and what do they learn? To become scientists rather than technologists, more probably to become teachers. In some respects it is good that the teachers should be paid by results, and doubtless the Science and Art Department has done grand work; but there is a dark side, as I suppose there always is, in the mere strenuous effort to pass examinations. Such education is apt to be very one-sided; however, that is not my point just now. My question now is: What should the Government do in the way of aid? The reply is: Authorities appointed by Government first organised the South Kensington scheme of science and art examinations, let them now, discriminating between educational foundation and the superstructure to be erected upon it, balance the one with the other, let them take hold of the subject of true

technical education with the technological subjects involved, and co-ordinate the one scheme with the other. At all events, let them so balance matters that the national scholarships, &c. may not only be held at South Kensington but at other colleges, and especially technical colleges and institutes. Let the science and art teachers also receive bonuses and grants for enabling their pupils to pass the entrance examinations into these colleges and institutes. Supposing this done, what next? I have said that the Science and Art Department teacher, if a good man, can make a comfortable income on his grants, even without any special practical experience. But the technological teacher, to be efficient, must possess the scientific knowledge, the theory, and also have spent some years of his life in the works and office. Now, (1) must the latter not be adequately paid then? (2) If paid adequately, where is the money to come from? Where also is the money necessary to provide and equip his department to come from? The practice of bequeathing large sums in support of chairs of arts and sciences, &c., is all very good and noble, and is regarded with astonishment on the Continent, but it produces very unequal and very unfair results. Is a whole section of the country to wait for adequate instruction in the principles and practice of chemical technology, chemical engineering, &c., through a generation, because some 15,000*l.* or 20,000*l.* is not forthcoming from private munificence to establish a department and found a chair or chairs in the above subjects? Some means should be adopted to ascertain where it would be advisable to establish departments of technology with proper qualified teachers or professors. These professors or teachers ought to be selected by a Government sub-committee, so that properly qualified men be appointed, and not scientists and theorists, however good and eminent, who have not also served and gained real practical experience in works and offices. I will not trouble to argue with those who say that the professor of pure chemistry can easily read a few technological books, visit a works or two, and then teach chemical technology and its principles forthwith, but I will ask them to turn to the papers in our Journal, by such men as Dr. Hurter, Walter Weldon, Alexander M. Chance, Ivan Levinstein, Lewis T. Wright, and others, and consider the amount of toil and years of practical work necessary for such adaptation of theory to practice. Yet these men, eminent as technologists, would need a special course in the essential principles of the art of teaching, in order to instruct youths who are so far only conversant with certain principles of pure science. Now it is an easy thing to write a paper for our Journal, but it is quite another matter to write out and prepare a course of 20 lectures on some branch in chemical technology. If we are to have technologists like Lunge, Stahlschmidt, Winkler, Post, and Engler as professors in the technical colleges of this country, we must offer them an adequate inducement, just as continental Governments do. To sum up, then, the directions in which State aid is needed, are (1) In raising the City guilds or similar systems of technical examination work to a co-ordinate rank with the South Kensington Science and Art Department examinations, so that they can co-operate; (2) In founding departments, chairs, lectureships, and colleges of technology, in such places as a Government committee of inspection, hereafter to be appointed, with power to examine into the cases of existing colleges and institutions, and to report, should recommend; (3) That the said Government committee of inspection should be formed principally of practical men,

chemical or other manufacturers as the case might be.

I cannot conclude without heartily commending to the notice of our members the sixpenny Abstract of the Report of the Royal Commissioners, edited by F. C. Montague and prefaced by Sir Bernard Samuelson. That preface, and the conclusion by Mr. Montague, contain most important suggestions.

Mr. GRIMSHAW said: I am not sure that we have in the discussion on technical education in this country reached that point at which we are prepared to say exactly what practical steps ought to be taken in the cause of such education, and if that be the case, to dogmatise too severely upon the way in which State aid should be applied is not desirable. By technical education in chemistry we mean, I presume, the scientific inculcation of that knowledge which is necessary to carry on those manufactures in which chemical reactions are involved, and it appears to me that there are in this country two necessities which need supplying in regard to this technical education. One is the teaching of our chemical manufacturers something about the theory of chemistry, and the other is to teach professors of chemistry something about chemical manufacturing, and it is difficult to decide in which direction the denser ignorance prevails, and the more enlightenment is needed. During the few years in which the cry for technical education has been heard in England, the prevalent notion appears to have been to educate in "chemical theory" those who were engaged in "chemical practice," tacitly assuming that this was the chief or only want. Now, to-day (thanks to the course of agitation on these lines) it is becoming evident that those engaged in chemical practice are scarcely so much behind in knowledge of theoretical chemistry as our scientific chemists are behind in knowledge of the details of manufacturing practice. In spite of a few brilliant exceptions, known to most of us, I must candidly say that I believe the want of familiarity of the professor with the works is to me more startling perhaps than the ignorance of the manufacturer with regard to chemical theory. There certainly would appear the superiority of our German competitors; and the constant contact of the German teachers of chemistry with what is going on in the manufactories is to my mind the chief element which has given them those advantages over us which have been exhibited in recent years. We have, therefore, to educate the manufacturer and the professor. Who else is in need of technical education? The manager, or foreman, or the workman? Which of these is to form the "corpus vile" for our technical educationalist, because upon our decision on this point will largely rest the kind and degree of State aid to be asked for. For myself, I have, I think, finally discarded the idea of technically educating the workmen of our chemical manufactories. I do not see how you are going to do it, and I do not see what you want in a workman beyond sobriety, industry, and general intelligence. If you say that he must have technical education to make him "generally intelligent," then I do not agree with you, and I fancy that you and I do not mean the same thing by the expression "general intelligence." At any rate I assume, for the present argument, that the right kind of workman for chemical works will be produced by intelligent elementary education, and subsequent work in his younger days in an intelligently managed manufactory, under capable foremen, and highly educated masters and owners. With regard to foremen and managers of departments the case is altogether different, and here I assert that a great and growing necessity exists.

Speaking in a general sense, we have no institutions in England where a sound chemical education can be obtained suited to those who are to become our analysts and foremen in chemical works. It is difficult to name an institution where instruction of the exactly right kind can be had, and certainly where it is to be had at a sufficiently low cost to make it feasible to the class of men we are considering. It seems to me, therefore, that it is at this point that your State aid may come in. I do not intend, nor am I competent to pronounce as to the exact mode of application; but if the assistance of the State can be called in to create teaching institutions to come in somewhere between our mechanics' institutes and our colleges, I think we shall have partly solved the problem of where State aid may be profitably employed in forwarding the chemical industries of Great Britain. Whether these State-aided institutions shall be enlargements of our mechanics' institutes, or be developments or off-shoots of our colleges, is a matter of consideration in individual localities; but what I claim ought to be the object is the production of educational facilities for the foremen and analysts employed or to be employed in chemical works to render themselves competent, and to give the exceptionally intelligent workman a fair chance of qualifying himself to enter upon those duties which are performed by the foreman and analyst. With a subsidy from the State and the creation of a body of teachers who are in intimate touch with manufacturing processes, institutions having the functions I have alluded to would in a comparatively short time give such a stimulus to the chemical industries of Great Britain that we should then take, what by our natural advantages we are cut out for, the very first position among countries in which those industries exist.

MR. GEORGE E. DAVIS: I thoroughly agree with all Mr. Grimshaw has said.

MR. WM. THOMSON: It seems to me that in this matter it is one country against another, and that being so I think that technical education should be given not merely to managers and foremen as had been suggested, but to the whole of the workpeople. The first thing needed is to teach them to understand English and a certain amount of mathematics and algebra. At the present time the average British workman cannot follow any instructions given him in writing, much less read a drawing. When that kind of education to which I have referred has been well grounded, then the recipient of it is ready to qualify for any special branch of manufacture or industry, and I think State aid should be granted to supply apparatus by which the actual laws of nature might be demonstrated, rather than to give rewards for passing examinations.

MR. G. CAWLEY: I agree with Mr. Grimshaw that all that is required of the British workman is sobriety, intelligence, and industry, and that technical education rather concerns masters and managers; at the same time I admit it is very difficult to say what is the best thing to do with regard to technical education, as I do not think it has been very clearly defined what that means. No doubt the technical education of the chemist is a very different thing to that of the engineer. It seems to me that what is wanted is a council of the leading chemical manufacturers in certain districts, and that they should decide as to the character of the school or college necessary, and that they should arrange for the students to spend a certain time in their works, who would thus acquire a practical as well as theoretical knowledge. I agree with Mr. Thomson that mathe-

matics and drawing are subjects which are very much neglected, as I do not think that more than 50 per cent. of the chemists are able to make a scaled drawing from which chemical engineers could make plant, and I think also that in chemical colleges or schools this should form one of the subjects to be taught. Judging from our knowledge of South Kensington I think State aid for technical colleges is a thing to be avoided.

MR. THOMSON then suggested that the meeting be adjourned for a week in order to give members further opportunity for reflection.

MR. CARPENTER: The matter came up at the November meeting of the Council, it being thought desirable that a discussion should be held in each Section, so that we might be prepared, if necessary, to send delegates to lay our views before the Council when the Bill is re-introduced. It seems to me that a vote might be taken to-night as to whether Mr. Watson Smith and Mr. Grimshaw represent the feeling of the meeting. I therefore propose that these two gentlemen do represent this Section for any action which the Council may wish to take in this matter.

MR. GEORGE E. DAVIS: The question on the post-card seems to assume something which has not been mentioned before—"That State aid is needed to assist technical education in chemistry." There is no doubt that the question has been carefully formulated, and perhaps there are some members here who will be able, in their own mind, to discover what it really means. So far as I am concerned I think the views set forth by Mr. Watson Smith and Mr. Grimshaw represent what the manufacturers think of the question. I have, therefore, very great pleasure in seconding the resolution proposed by Mr. Carpenter.

MR. ESTCOURT: I second Mr. Thomson's motion for adjournment.

THE CHAIRMAN: It has been proposed that this meeting stand adjourned in order that the points which have been raised may be put into definite form. Whether we are expected to carry a resolution does not appear to me to be very clear from the notice issued. We have on one hand a proposition that the meeting be adjourned, and on the other hand that the views expressed at this meeting are the feeling of the Section. We might gain some advantage by adjournment, but at the same time I think that if Mr. Carpenter's resolution were to take the form of appointing a small sub-committee to represent the views of this Section to the Council, it would meet the case.

MR. THOMSON: I should like the question to be more clearly defined. Is it proposed that State aid be given to the higher classes and not to the lower?—that is to say, that you will educate the masses up to a certain point and not try to take them any further?

THE CHAIRMAN: We have before us two views of technical education, one in favour of the lines laid down by Sir Lyon Playfair, and the other as set forth by Lord Armstrong. I think what is meant by the question put by the Council is, "Can you, as a body of experienced men, suggest any definite directions in which State aid is desirable for promoting technical education in this country, respective or irrespective of the people who receive it?" If the delegates can go before Sir William Hart-Dyke with some well-defined suggestions I think they would have a better chance of succeeding in their object.

A show of hands being taken on the motion for adjournment to admit of further discussion, 14 voted for it and 15 against.

The following resolution proposed by Mr. Carpenter and seconded by Mr. Davis was then put to the meeting and carried by a majority of 16 to 11:—

"That in the opinion of this meeting the views expressed by Mr. Watson Smith and Mr. H. Grimshaw are the aims to be kept in view by the State in creating and aiding, in various parts of the country, institutions for education in technical chemistry; that they represent the views of this meeting, and that these gentlemen be instructed to act as representatives of the Section to the Council."

Newcastle Section.

Chairman: T. W. Stuart.

Vice-Chairman: P. P. Bodson.

Committee:

Alfred Althusen.
G. T. France.
G. Gatheral.
John Glover.
T. W. Lovibond.
John Pattinson.

H. R. Procter.
B. S. Procter.
W. W. Procter.
W. L. Rennoldson.
C. H. Ridsdale.
J. E. Stead.

Hon. Local Secretary and Treasurer:

J. T. Dunn, The School, Gateshead.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

*Meeting held in the College of Science,
Thursday, March 7th, 1889.*

MR. T. W. STUART IN THE CHAIR.

DISCUSSION ON TECHNICAL EDUCATION IN CHEMISTRY.

THE CHAIRMAN opened the discussion by announcing that the Council had desired an expression of opinion from the various Sections on the question of the desirability of State aid to technical education so far as the chemical industries were concerned, and the direction which that aid, if thought desirable, should take. He called on—

Mr. G. T. FRANCE, who said that the general question of State aid to technical education was a very wide one, but that the limitation of the discussion to its bearings on the chemical industries narrowed the question very much, and made it much easier to come to some definite decision on the point. At present, Government aid is given to public elementary schools, higher grade schools, and to some extent in grants to science colleges. Boys in the elementary schools must pass certain standard subjects first, and can then take specific subjects.

Considering the age at which boys leave the elementary schools, it is clear that nothing can be done in the way of teaching chemistry there, so that for present purposes they may be dismissed. Higher grade schools, whether under school boards or under denominational government, are comparatively few in number; the cost per scholar may be about 6*l.* a year, of which, perhaps, 2*l.* is covered by fees, 2*5s.* by grants from the Education Department, and the rest comes in the way of grants from the Science and Art Department. These are made on the results of individual passes in the May examinations held by the department, and any boy is at liberty to take up and pass in any of the 24 (?) subjects of the department's syllabus. How far is this profitable as regards the teaching of chemistry? Boys in these schools do "standard" work until they pass the seventh standard, and then take up some of the "subjects" of the Science and Art Department. Experience of the working of these higher grade schools shows that there is always a tendency on the part of the teachers and managers to teach as many subjects as possible, for in that way is it possible to earn the largest grant. A boy at the Manchester High Grade School, under 16 years old, had in one session taken first class certificates in 12 subjects, earning 24*l.* The tendency is towards a simple system of cram. The money granted under this system (415,000*l.* in the past year) might be devoted to much better purpose. He would abolish the present system of examination altogether, and instead of individual passes as a basis for payment, he would have the teachers properly qualified and certificated, and examine into or inspect the average character of the work, and the quality and methods of the teaching. The teachers would then feel themselves free to do their best work, and would have no such strong incentive to cram as at present exists. Good science teaching could thus be established in these schools, but he questioned whether much time could be profitably devoted to chemistry, considering the age at which boys leave. Passing by grammar schools, high schools, and the larger public schools, as being unconnected with the Government, Mr. France next considered the various science colleges. To these, he thought, with their highly qualified staff of teachers and their equipment for the work, Government aid might be profitably extended. He did not think it desirable to enter at present into details, but he thought some plan might be devised for carrying on promising pupils of the secondary schools, by exhibitions or otherwise, into these colleges, and that money devoted to such a purpose would, so far as teaching chemistry was concerned, be much more profitably employed than under the present system.

Mr. JOHN PATTINSON thought that abundant facilities for learning the elements of the science exist, and that what is wanted is to enable people to carry their knowledge further and deeper. Complaint is made that in England insufficient attention is paid to the teaching of pure science, and to the training of chemists in research; that to encourage manufactures, trained chemists are necessary, and that this kind of training is carried much further in Germany than here. He thought that the elementary and higher grade schools and the science classes connected with South Kensington, went in the right direction, but not far enough. Institutions to carry on higher work were never self-supporting, and could never be expected to be so, and in his view the best thing that could be done would be to subsidise such institutions. He concluded by moving the following resolution:—"That in the opinion of

this Section further State aid for promoting technical education in connexion with chemical industries can be best bestowed on colleges of science where the principles of chemistry and methods of chemical research are fully taught."

Mr. MATHER agreed with the principle of subsidising colleges of science. He thought that Mr. France hardly gave South Kensington sufficient credit for the work it was doing.

Mr. B. S. PROCTOR thought it was difficult to speak very decidedly. His experience in many respects led him to agree with Mr. France, and to see the many evils in the present examinational system, which undoubtedly tended to cause teachers to devote attention to those pupils who were likely to bring fame and emolument by prize taking, and to neglect those who were not. It also tended to teaching with the evident and even with the avowed object of enabling the student to pass the prospective examination. At the same time he recognised that these classes were doing a large amount of good work in the country, and he feared that to do away with the examinational system would be likely to do away with the classes altogether. He thought, however, no difference of opinion could exist as to the desirability of giving support to science colleges, and he seconded the resolution. A scheme might probably be devised whereby, besides direct support to them, promising students from the South Kensington classes might go with exhibitions to the colleges, and that the teacher who recommended these students should have no pecuniary interest in their success. Still retaining the present system of elementary science teaching, he would in addition subsidise science colleges and endeavour to improve the teaching.

Mr. LOVIBOND supported the resolution. He thought the best place for chemical training was a college of the nature of that in which they met, and nearly all such colleges throughout the country were starved for want of money. He should have been pleased if Mr. Pattinson had added to his resolution some disapproval of South Kensington *methods*, though he quite recognised the good which was done through its agency. He gave an amusing instance of the weakness of its regulations as to the qualifications of teachers, by quoting the case of two children, aged 12 and 14, who having passed the examination at the end of a course of University Extension Lectures on Chemistry in a Midland town, became qualified to teach elementary chemistry under the department, and earn grants.

Dr. BEDSON, who was not able to be present, sent his views, in the shape of a letter to the Secretary, of which the following is an abstract:—The question turns upon the meaning to be attached to the words "technical education," so far as the chemical industries are concerned. The history of their development during recent years shows us that not only for the initiation of new processes, but also for their carrying on and improvement, men are wanted who have been trained in the same school as the initiators and discoverers of new processes; that is, who have received a sound training in the principles of chemistry, and have been made practically familiar with the methods of research—have, in fact, shown their capability as investigators. In seeking for an explanation of the fact that industries such as the coal-tar industry had made their home in Germany, though both raw materials were found, and finished products were used, in this country, he adduced, as

one important factor, that there already existed in Germany a large number of trained scientific workers, the German universities having recognised the importance of scientific training, and not having, like our universities, kept it subordinate to the older studies of classics and mathematics. This teaching of the German universities, and the supply of men competent to undertake the prosecution and development of such scientific industries, gave Germany a start in such enterprises, and we have in this country tried to overtake her. The most important step in this direction has been the formation, by private munificence, of university colleges, attempting to give an education in all departments of knowledge. These exist in (probably) sufficient number to supply the present educational needs of the country; but they all are cramped by want of funds, and prevented from giving such an education—similar to that given in the universities of Germany—on terms which would bring it within the reach of all those able to profit by it. It can never be hoped that private munificence will be equal to the task of finding means to place all these colleges on a sound financial footing; and the only direction in which a solution of the difficulty is to be found lies in Government support being given to them.

The CHAIRMAN supported the resolution, thinking the best way would be to appoint a committee to investigate the position, circumstances, and needs of the various colleges, and equitably adjust the money granted. He adverted to the good work done in the classes connected with South Kensington in fostering a taste for physical science among those who otherwise would have had no opportunity of commencing its study.

Mr. STEAD also supported the resolution, but did not concur with Mr. France in condemning the system of the Science and Art Department.

Mr. SOWERBY also spoke of the good work done by the South Kensington classes, stating that many boys in his works attended such classes, and derived some considerable advantage from them. He claimed that, as part of the examination in chemistry was practical, they were to that extent free from the imputation of cram. He thought that we were already well provided with the means for teaching pure chemistry, and that what was at present sought was information as to the teaching of applied chemistry. He saw no reason why such institutions as the College of Science should not be self-supporting, provided a sufficient number of students availed themselves of their advantages; and he instanced the very large number of students attending corresponding institutions on the Continent.

Dr. DUNN supported Mr. Pattinson's resolution. He concurred also very strongly with the remarks of Mr. France. A long and varied teaching experience had convinced him that along with the undoubted good which accrued from the present system of the Science and Art Department there was a large amount of positive evil. He had formerly for some years taught classes under the Science and Art Department, and had been able to observe very closely the working of other classes besides his own, and could not help noticing the very strong incentives which existed towards cram and rigid adherence to the published syllabus on the part of the teacher, and towards mental dissipation and certificate-hunting on the part of the student. He was very strongly of opinion that as the more elementary chemical

teaching of the country was, and probably would be very largely done in classes of this kind, some reform was urgently needed. It was, perhaps, premature to go into details, but undoubtedly the direction in which progress would be made, would lie in abolishing the present examination system, insisting on a much higher qualification in the teachers, and having secured well-qualified men, to trust them and leave them free to as great an extent as possible, having examination or inspection of the general efficiency of the classes, and the methods of teaching. Mr. Lovibond had given an example of the absurdity which the present system might result in, and his (Dr. Dunn's) experience throughout his connexion with Science and Art Department classes had been that teachers wishing to qualify themselves to earn payments on the results of teaching science were the worst class of students he had, showing no enthusiasm in their work, but doing as little, either in the way of attendance or work, as they possibly could without disqualifying themselves. The reason for demanding no higher qualification in the teachers which existed when the system was yet an experiment, that at first such teachers had to be taken as could be found, no longer holds now when facilities for sound scientific training are so multiplied; and the only way in which to secure better teaching is to demand and to pay more highly qualified teachers. Were these classes reorganised so as to minimise the objections to them, they would lay a sound foundation of elementary science, on which the science colleges could build without having to raise and reconstruct. The endowment of these colleges, and the remission of fees or foundation of exhibitions there for distinguished students of the elementary science classes, would provide the highest chemical training for all those who had shown the likelihood to profit by it. He objected to Mr. Sowerby's contention that instruction in applied chemistry was wanted, urging that special training was impossible except on a basis of general principles, and that a highly trained chemist was able to apply his knowledge and ability to any branch of applied science.

Mr. FRANCE urged that Mr. Pattinson's resolution did not go far enough. He would not propose to do away with the South Kensington classes, but he thought that the money spent on them at present might be made to do a much greater amount of good, and it would be much more likely to gain the ear of a Government if a proposal went up to them showing how to redistribute more effectually the money they already spend; it would be more likely to have effect than merely asking for more.

Mr. PATTINSON agreed to modify his resolution so that it should read:—"That in the opinion of this Section, State aid for promoting technical education in connexion with chemical industries can be best bestowed on colleges of science where the principles of chemistry and the methods of chemical research are fully taught, and that a portion of the money now devoted by the Science and Art Department to payments on the results of the May examinations might be more profitably used in the above direction."

The motion was unanimously agreed to.

Glasgow and Scottish Section.

Chairman: R. R. Tatlock.

Hon. Vice-Chairmen: E. C. C. Stanford,
Sir J. Neilson Cuthbertson.

Committee:

J. Addie.	T. P. Miller.
G. Beilby.	F. J. Mills.
A. Crum Brown.	J. M. Milne.
J. Christie.	T. L. Patterson.
W. S. Curphey.	J. Pattison.
W. Dittmar.	P. J. Rowan.
D. B. Dott.	D. R. Stenart.
C. Irvine.	A. Whitelaw.

Hon. Treasurer: W. J. Chrystal.

Hon. Local Secretary:

G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Held in the Society's Rooms, Glasgow, on Tuesday,
5th March, 1889.

MR. E. C. C. STANFORD IN THE CHAIR.

DISCUSSION ON TECHNICAL EDUCATION IN CHEMISTRY.

THE CHAIRMAN explained that the discussion was held at the request of the Council of the Society, who were desirous of initiating discussions in all the Sections, so that the hands of the Government might be strengthened by giving some idea of what manufacturers wanted in the shape of technical education in chemistry. He then called upon Sir John N. Cuthbertson, Chairman of the Glasgow School Board, to open the discussion.

SIR JOHN N. CUTHBERTSON said that in his opinion technical education was not instruction in any particular chemical manufacture, but was instruction in those scientific principles which a young man would find necessary in the prosecution of some art or manufacture. While he did not feel qualified to say in what direction State aid ought to be given to assist technical education in chemistry, he was able to say what was being done at present, and what opportunities there were for the study of chemistry in Glasgow. There was the University, the West of Scotland Technical College, and in the primary schools of the city and suburbs under the school board eight well-equipped laboratories, besides six or eight lecture rooms fitted up for the teaching of science. At these laboratories and lecture rooms in connexion with the school board there were at present 174 pupils working in the laboratories and 596 attending the day and evening classes. Besides these there was also several private laboratories. The State aid at present being received by the Technical College and the school board was chiefly derived from the Science and Art Department. That department granted upwards of 7,000*l.* a year for the encouragement of science and art in Glasgow, about one-third for art and two-thirds for science. The West of Scotland Technical College received about 4,000*l.* a year, much of which was devoted to chemistry. The school board received about 2,000*l.* a year, the School of Art about 600*l.*, and 1,000*l.* went to other institutions. Faults were sometimes

found with the administration of the Science and Art Department, but so far as his observation went it was fairly well managed, and was always willing to receive suggestions. If he were to make any suggestions, they would be two—first, that the procedure of the department should be simplified, and, second, that far more aid should be given to the advanced classes. The elementary classes received abundant recognition, but not so the advanced. His opinion was that at present there was as much technical education as there was demand for. He believed that if these different organisations he had described were allowed to have full swing, and a moderate amount of Government support, they would cover the whole ground.

Professor DITMAR, taking "technical education in chemistry" to mean such instruction in the technicalities of chemical industries as might with propriety be superadded to a full course of chemical instruction, said his answer to the question was very simple. The State certainly had the duty of affording to every young man in the country the opportunity of receiving sound instruction in chemistry as in other sciences, and this, in the case of chemistry, included laboratory teaching, at a moderate expense; but he did not see that it was bound to provide the means for special instruction in certain trades. If the dyers and calico printers in the West of Scotland felt the want of a special school for their trade, why did they not set up one at their own expense? 2,000*l.* a year would be plenty, and dividing this by the number of firms concerned, they arrived at a quotient which some of them would find it *indefinitely* to pay. The Tennants of Wellpark alone could well afford to keep a brewer's school going; the expense would be a mere trifle to them, and it would be less than a trifle to Bass or Allsopp. There was no need of multiplying examples. It would be immoral to tax the people for the foundation and maintenance of such technical schools. But then some might say, why not found a grand chemical school, where all the several branches of chemical industry would be taught technically? His answer was that such a chemico-technical university, as one might call it, would be an impossibility. It would demand a very large staff of teachers, and that of teachers of a kind which it would at all times be very difficult to get, and quite a series of chemical laboratories. Supposing the corresponding immense outlay of money to be risked, he felt quite sure that this university would inevitably drift into the position of a school for this or that speciality, or one or two specialities, or if it maintained its original pretensions would soon come to be looked upon as a miserable fraud. Regarding the grants of the Science and Art Department, if they had done good, they had also done much harm, for they had given rise to a system of mere cramming. He pointed out also that the teaching of science to boys about 14 or 15 years of age was a great mistake. How could they learn science if they had at the same time to learn history, French, German, and mathematics?

Mr. ALEX. WHITELOW said he quite agreed with Sir J. N. Cuthbertson in regard to the necessity for the Science and Art Department encouraging the higher subjects in chemistry. Regarding the general subject of technical education, he had always believed that a thorough grounding in the science of chemistry was the only basis of technical education. A man who had thoroughly studied the subject theoretically would be suited to go into a works and give his attention to special departments. He thought that if the Government would aid such colleges as the West of Scotland Technical College to give students the opportunity of experimenting on a large practical

scale, it would be a great help to the development of technical education.

Professor MILLS said that it was alleged in some quarters that education in technical chemistry was not required, and that a strictly scientific training—followed by immediate transition to the workshop or factory—was the best programme for a young technologist. His view was, on the contrary, that, after the rudiments of chemistry had been acquired, the intended manufacturer should be handed over to some who would teach him, in a thoroughly scientific spirit, the nature of large-scale processes, and who would, by continued suggestion, awaken in his mind the growth of technical ideas and the tendency to create new things. He was gratified to find, in the form of the summons to the meeting, that the Council of the Society took it for granted that education in technical chemistry was required, it being proposed to consider in what direction was State aid needed to assist it. The first consideration that arose was: Over what area was the proposed aid to be extended? This, in his opinion, was much more limited than at first sight might be supposed. Most of the work in chemical manufactories was executed by unskilled persons, whose business it was to carry out simple orders in a fairly intelligent manner. Technical education could be of no use in such hands—indeed, very few employers of labour would consider it desirable that their workmen should be trained to form opinions on the methods employed in the works. Thus, then, there remained only the skilled labour—the higher class foremen and assistant managers of departments, constituting much under 4 per cent. of the wages expenditure of the works. These could not leave their business during the day, but many of them would be willing to attend evening classes in their special subject, namely, for the purpose of getting ideas, and not for the purpose of eventual examination. Such classes might be held in all their large provincial colleges, and the State might well aid them by a grant of part of the expense of models and other illustrations, part of the lecturer's salary, and of the travelling expenses of selected students living at a distance from the place of lecture. It must be remembered, however, that such classes—as was always the case with specialities—would never be permanently large. In Glasgow, such subjects as "Oils, Paints, and Varnishes," "Bleaching, Dyeing, and Printing," "Fuel," "Iron and Steel," did not command an average attendance of more than about 20. The City and Guilds of London Institute, which had of late years started evening classes all over the country in a great variety of technical subjects (many of them not chemical), reported an average attendance of 22 per class. He mentioned these facts for the benefit of those who supposed that there was a great demand for technical chemical education, or that a great constituency existed ready made for lectures on technical chemistry. He wished to add his opinion that evening work in technical chemistry was not likely to lead to very advanced results. The Institute of Chemistry (of which he was one of the founders) did not recognise certificates obtained by work in evening classes. He was glad indeed to be able to concur with chemical technologists of long experience whom he had consulted that the only training of permanent value was that which was undertaken during the day; that it should be offered especially to those who were destined eventually to become managers, of whatever grade, in chemical works, and that it should be offered while the mind was sufficiently plastic, and yet sufficiently mature, to receive and appreciate it.

The minimum age of the student should be 16 to 18, according to his qualifications, and his time of going through a thorough laboratory course not less than three years, the last year to be devoted exclusively to research. He had always thought it a cruel thing to place in a work a mere boy with a six months' knowledge of analysis. The time came when processes "went wrong," and practical difficulties had to be faced without delay, and the young chemist received an unsought lesson in his deficiencies. The State might well step in there, and by granting a number of scholarships fairly proportioned to the locality, enable the less wealthy students to acquire a more complete education. It would be extremely desirable that some of these scholarships should be the "travelling" kind. The recipients could then witness foreign methods and examine foreign plant *in situ*. At his suggestion the governors of the Glasgow Technical College had accorded that privilege to the holder of the Stenhouse scholarship. Lastly, it must not be forgotten that lectures on technical chemistry required a costly outfit, especially for models. Where these related to a special industry in the district, the district might fairly be called upon to supply them, but models relating to the "great" industries, such as alkali works, dye works, and print works might legitimately be provided at the partial cost of the State.

To sum up,—the constituency for a reception of State aid in technical chemistry was highly important, but not numerically large. While the locality should undoubtedly contribute its best as to buildings and maintenance, the State might reasonably be asked for assistance in the expenses of models, the founding of scholarships, and the provision of a professor.

Mr. G. G. HENDERSON said that Professor Dittmar had expressed his own opinion when he said that the foundation of all technical education in chemistry must be a thorough education in general chemistry. But he would go a little further, for he would include a good knowledge of physics, and he believed that in many cases a knowledge of chemical engineering would be of much use. Until the student has become familiar with the general principles of chemistry and physics he was not fit to begin to specialise on any technical subject. He thought that the State might do much by assisting science colleges at present in existence, and if necessary, founding new colleges, where these subjects might be taught; but the State aid must be given in less miserly fashion than in the past, because unless the lectures were made to some extent independent of fees, these must be too high for many who would otherwise become students. He believed that many technical manufactures could only be learned in a chemical work, but such was not the case for all manufactures, and he therefore agreed with Professor Mill's suggestions so far as concerned these. It would not be difficult to arrange courses of technical lectures suitable to the wants of each district, but it would be rather troublesome to apportion State aid equally.

Mr. T. L. PATTERSON quite sympathised with what Professor Dittmar and Mr. Henderson had said. He would rather that a young man should first study general chemistry thoroughly before going into a chemical works, than that he should devote his whole time to the study of the manufacture of any special article. If a young man had a thorough training in the laboratory in general chemistry and physics, he would soon be able to apply what he had learned in the scientific laboratory, when he went into a work's laboratory, and would consequently be of some use to his employers.

Mr. R. D. PULLAR said he quite agreed with the views that had been put forward by the other speakers. It seemed to him to be scarcely fair to call upon the State to provide any assistance for special subjects, because it was only to a limited number of people any such special training could be of service. It was important, however, that there should be some means provided by the State for as many as possible getting a sound instruction in general chemistry. Of course it would be quite impossible to have classes assisted by the State, if the pupils did not go forward for examination. If there was to be State aid there must be State examination. He was of opinion that for those who could afford the time and money to get special instruction after a course of general chemistry, it was a decided advantage. He considered himself very much benefited by the time he spent at the School of Dyeing in Leeds. It saved him a considerable amount of time when he entered their own works. A great deal was at once more apparent to him, owing to the special instruction he got in the general principles of dyeing, the actions of mordants and colouring matters, and the general properties of fibres.

Dr. J. CLARK said they were all tolerably well agreed that the best way to acquire a technical education was, in the first place, to get a sound ordinary education; secondly, to devote three or four years to the study of science, and thirdly, to devote the rest of the time to the particular manufacture desired. It was not possible to pick up sufficient knowledge of any manufacture so as to be able to practice it profitably, unless in a work where such a manufacture was carried on. And that seemed to him to be the principal objection to the establishment of technical schools, if by the term technical school was understood, a school where a student was expected to learn a particular business sufficiently well to be able to go out and start to work that business. At the same time he would not go so far as Professor Dittmar and say that aid should not be given to some sort of technical education. He saw no reason why there should not be established a lectureship, where a general survey of all the principal manufactures might be had. But the subject under discussion was not as to the method of technical education, but what the Government should really do to assist technical education. The sons of the "masses" were not able to spare the time and money to get a general education and also a specific scientific education; hence, if the Government were to do anything it should be to facilitate the education of these, who were not able to spare either the time or money themselves. The first way in which the Government might be of use in the spread of technical education was in the providing of secondary schools. There were plenty of primary schools at present, but very few secondary ones. In addition to that he saw no reason why the Government should not assist in transferring the most advanced pupils in evening schools to technical colleges, where they could learn more science than it was possible for them to get in the evening schools.

Mr. D. WILSON, jun., quite agreed with Professor Dittmar in all that he said, except in regard to his own trade. He thought the trade of agriculture was quite a technical one, and that a three years' course of study in chemistry was not required for ordinary students, but that the Government might do something in the way of aiding travelling lectureships.

Dr. J. M. MILNE said that in reference to the Government grants for students who passed the examination, he thought the evil of that system was only beginning to come out now. Payment by results was faulty. Such a system could not lead to anything else than cramming. On the part of teachers it simply meant a matter of pounds, shillings, and pence. The money spent in that way was just wasted, and it might be put to much better purpose, say, for the better endowment of schools and colleges, and in the way of affording facilities for the fitting up and furnishing of laboratories.

Mr. WM. FOULIS said he quite agreed with most of the speakers as to the necessity of a chemist being thoroughly trained, but another view could be taken. It seemed to him there was no branch of chemical industry but what would be the better of technical lectures—lectures not intended for trained chemists only, but for all the men in the work, so that they might have some knowledge of the chemistry with which they were coming into contact every day. This would enable them to become more intelligent workmen.

Mr. C. M. AIKMAN said all must be agreed that before any one could benefit by a course of lectures on technical education, he must first have a thorough grounding in chemistry. He thought that the State might be asked to endow special chairs for the various great industries of the country, such as agriculture, because in so doing, it was benefiting not one class of people only, but was promoting the general prosperity of the country. As an example, he instanced the cultivation of sugar-beet in Germany. Scarcely any subject looked more difficult, at first, than the introduction of that article, but thanks to the thoroughly scientific and liberal way in which the German Government acted, the cultivation of it was now an accomplished fact. Regarding technical education being extended to agriculture, to show that there was a distinct call for that, he pointed out that in the short time the Technical College had devoted to that subject there were over 100 students attending the lectures.

Mr. E. C. C. STANFORD spoke of the difficulty there was in learning applied chemistry. If one looked into any work on that subject, he would see that it was years behind the age. The reason of that was that professors of chemistry could not write these works, and men engaged in the manufactures would not. So he thought State aid was required to build laboratories and larger colleges for the chemical profession and for the people generally, museums, and libraries. Another thing which he might refer to was the great importance of the study of organic chemistry in the present day. He need not point out that it was a study which was not very easily carried out in this country, and he thought the State might do something to make that study more accessible. If there was anything else he would like to have State aid in, it was in the direction of getting rid of examinations.

The following resolution was finally agreed to:—

Resolution.—“That, in the opinion of this meeting, State aid is urgently required to better endow existing colleges, and, where necessary, to establish new colleges for the teaching of chemistry and the allied sciences in the most thorough manner, and at moderate fees, rather than to establish schools for the teaching of special manufactures; and that scholarships should be founded in connexion with the colleges in order to assist deserving students to complete their education.”

Nottingham Section.

Chairman: Lewis T. Wright.

Vice-Chairman: Prof. F. Clowes.

Committee:

L. Archbutt.
Jas. H. Ashwell.
J. B. Coleman.
W. A. Curry.
H. Doidge.
E. Francis.

J. M. C. Paton.
S. J. Pentecost.
C. Spackman.
H. J. Staples.
R. L. Whiteley.

Treasurer: S. V. Holgate.

Hon. Local Secretary:

Jno. R. Ashwell, 111, Waterloo Crescent, Nottingham.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held February 27th, 1889.

PROFESSOR CLOWES IN THE CHAIR.

DISCUSSION ON TECHNICAL EDUCATION IN CHEMISTRY.

MR. C. L. ROTHERA (Vice-Chairman, Nottingham School Board), in introducing the subject for discussion, said it would be well to briefly consider the various forms in which the Government at present rendered aid in technical education, and whether those methods were capable of extension or should be abolished and others substituted. Beginning with the elementary schools there was very little provision in the upper standards for the introduction of technical education under the regulations of the Science and Art Department. A certain amount of Kindergarten instruction was given (which had been exceedingly valuable) in the elementary classes. Beyond that they had the provisions of the Science and Art Department and the science classes of local colleges. Now how far it would be possible for any of those provisions to be extended was the subject for consideration, and his feeling was that the Government might aid in this way: First of all, by having the period of school life and the time of exemption extended for a little longer. At present half-time attendance commenced at 10 years of age, and full time at 13, or on passing the sixth standard. These should be extended further so as to give opportunity for the extensive introduction in upper standards of instruction in technical subjects. The proportion of time devoted now in the upper standards to instruction in science was exceedingly low in proportion to that devoted to mere literary subjects, and greater opportunities might be afforded in this direction by establishing continuation evening schools, where young people of from 14 to 16 years age should be required to attend for one or two of evenings a week. There were various other ways in which technical education could be advanced, but not ways in which the Government could interfere.

Employers, now the system of apprenticing had been abandoned, might give the young people more time for instruction. Grants should not depend upon results. Teachers' remuneration should be secured to them and not depend upon the number of students or the number of passes. It was a well-known fact that educational institutions in principle were never self-supporting, and had it not been for benefactions in the past there would never have been the educational provision there was. It was for the State to supplement and complete the work thus begun. Individuals could not be expected now to maintain the work of technical instruction. What was required was more municipal and more Government grants to institutions of the University College kind, and all such aid would be well bestowed. The Bill introduced by Sir Henry Roscoe was on the whole satisfactory, and seemed to conform very closely to the provisions of the Scotch Bill. It seemed to him that the development that could be hoped for was only upon existing lines by the extension of those lines. By greater liberty and payment of allowances the State could thus aid in the development of opportunities for teaching.

Dr. BOWMAN (Halifax) had given a great deal of attention to the question of technical education, and how it could be best advanced in this country. At the very outset it was necessary to define what was meant by technical education; in his opinion the line should be drawn the moment science was begun to be applied to actual practical industry. At the present time there was sadly too little instruction given in schools of practical science. How could aid be given to men of chemical training to enable them to turn the knowledge they possessed to some of the great industries, which they could not do when encumbered with their every-day employment? Men who had received a good chemical education were often completely at sea when they wanted to apply their knowledge in a practical direction. There should be tacked on to all universities and colleges classes like those of the University of Edinburgh, where there was a special chair of applied chemistry, and where, when sufficiently grounded in pure chemistry, students were taught how to apply it to manufactures. They were also taken to see processes of manufacture, and were pointed out the principles underlying them. There were many young men who would like to pursue their studies a little further, but their means were not sufficient for the purpose: some of these men might make their mark if they had the opportunity. If the Government could see their way it would be a good thing to subsidise such as had shown aptitude by endowing "working scholarships." If young men practically engaged in the scientific part of their special industry could enter a technical class by the aid of such scholarships, that would materially aid technical education. In connexion with the Bradford Technical School some valuable researches had been made on the chemistry of wool dyes by Dr. Knecht, who would have very much liked to carry that work a little further, but he had not time. Several students had assisted him, and would have been the very men to have carried out this work, but they could not afford to do it, and thus technical education suffered. Two of these young men subsidised by Government scholarships for two or three years could have done the work.

Alderman LINDLEY (Chairman, Nottingham University College Committee) was afraid that the

exigencies of every-day life would prevent children being kept at school so long as Mr. Rothera asked. He also thought Mr. Rothera would find great difficulty in making young people of 14 to 16 attend evening schools. To his mind the sooner board schools were made truly national schools in every respect the better, and to the school board should be entrusted the technical education of the country generally. And it was not only in the elementary schools that they must foster this education, it was in secondary schools as well. They would be glad to know that it was the intention of the Government to make grants to local colleges throughout the country, and he hoped that Nottingham University College would receive a proper grant.

He was rather fearful that if they altered the mode of payment in the science and art classes very largely the results would not be so satisfactory. He was in favour of increasing the grant of payment to teachers. When they remembered that payment by results necessitated the co-operation of the students it would not be well to relax that method. It had the effect of making the students feel that out of gratitude to the teacher they must be regular and give attention. He thought the school board should certainly have power to pay the fees for all deserving students who were willing to attend technical classes in the evening, not only classes in their own schools but also at local colleges. By increasing the number of evening students in that way they would greatly advance technical education. He looked with favour upon Sir Henry Roscoe's Bill. What was wanted was to strengthen the hands of the school board and to encourage the scholars by the payment of fees.

MR. JOHN R. ASHWELL (Hon. Secretary, Nottingham Section) had not had the opportunity of studying the provisions of the late Bills in detail, and would therefore confine his remarks rather to the consideration of the question "In what direction is State aid needed to assist technical education in chemistry?"

Sir Henry Roscoe's late Bill dealt with elementary instruction in chemistry and other subjects as the basis for any more advanced instruction hereafter. The late Bill seemed rather scientific than technical so far as chemistry was concerned. He fully agreed with Dr. Bowman that technical instruction was the application of science to industry. If general instruction in chemistry was to be accepted as the starting principle, then the directions in which applied chemistry was required would baffle enumeration. He understood the scope of the Bill was limited to the subjects specified in the Science and Art Directory and to certain subjects of commercial education, but that other subjects agreed upon by the Science and Art Department and the Education Department might be included. To these "other subjects" he attached the utmost importance because they might embrace the strictly technical subjects, such as those examined in by the London and City Guilds Institute for the Advancement of Technical Education, *e.g.*, brewing, dyeing, printing, steam and steam engine, &c. Thereby the Bill would provide technical education proper.

Respecting the need for State aid to provide scientific and technical education in chemistry, they had to consider the persons taught, the teachers, and the subjects taught.

First. As to the persons taught, he contended that, in the case of children of school age, their chemical education should begin very early in their school

life by object lessons upon subjects with which children in public elementary schools had some slight every-day knowledge. Also that the instruction should be progressive (*i.e.*, from standard to standard) by much slower and easier stages than at present. He would wish to see these elementary science demonstrations made compulsory at all public elementary schools. State aid would be required in the shape of a liberal scheme of scholarships or as free education to provide means for the continuance at higher grade board schools and elsewhere of the teaching imparted at public elementary schools. No one who had seen the intense interest which children at Nottingham and at a few other board schools took in elementary science demonstrations could ever doubt the existence of elementary scientific sympathies in them, and the ease with which the taste would grow. At higher grade board schools such children ought to be able to obtain more advanced but still somewhat elementary instruction in chemistry and physics. Here the taste for science would become more pronounced. After such higher grade schools State aid would be needed to find means for continuing and still further improving the chemical education, say at university colleges and technical schools, where the students ought to have the best possible teaching and facilities, and the widest choice as to the particular phase of a science which they would wish to study, and here, too, they ought to be encouraged to specialise technically as well as chemically, and encouraged by means of State aid. Thus highly trained chemists of the purely academic type and of the technical type would be produced. The university scholarships to which Dr. Bowman had referred would form an important phase when the chemical education of students at university colleges and technical schools needed continuing to the highest point. But without scholarships our universities might do very much by allowing students or others to be examined in one or more of the science subjects of their examinations. The value of this would be very great in the interests of technology, where a man's knowledge of a special science, or of one or two sciences, was all important. Such a scheme of national education, not only in chemistry but in science, would naturally lead to a development of the special gifts of the children of school age. With regard to children at secondary schools, such as those of the high school type, he would wish to see some similar system carried out, but adapting the State aid to be afforded to the special requirements of those schools. He thought that the chemical teaching in these schools needed vastly improving in quality. Quite distinct from children of school age, there existed large numbers of ordinary workmen, foremen, and future masters; and in any provision for advancing technical education, these persons needed providing for upon an entirely distinct footing. He thought the main difficulties in technical classes—*viz.*, small attendance and poor results—arose from trying to mix boys and men in the same class, and especially when of different social status. Not a few workmen attended evening technical and science classes, knowing that if their foremen or masters heard of it, so much the worse would the daily work become for such workman. Indifference and lack of education, as well as lack of suitable teachers and facilities, were among the important reasons why so few ordinary workmen attended evening classes. State aid was needed to provide classes, teachers, and facilities for ordinary workmen—facilities of time, place, and expense. With foremen and future masters the need was far

greater. These very largely, and in the immediate future, would have control and guidance of workmen; and they exerted a very powerful influence on the commercial position of England in chemical technology. He would advocate a similar system to that suggested for children of school age, *viz.*, a system providing the greatest facilities, a progressive system, and at the entire expense of the State. Such a system would need to be carried out by day and evening classes.

Next, as to teachers, the teaching qualification should be raised much higher. Where payments by results, as in Science and Art Department and other examinations were in force, the maximum grant to a teacher should be for any single student, the grant earned for the highest grade at which the teacher had passed in that subject. And that where the teacher's qualification was not obtained by examination, there *very* much more stringent inquiries and regulations should be in force. With respect to teachers of technical subjects, he urged the necessity for compulsory examinations in practical work, and not merely written examinations. It was most important that teachers in any technical school should have been educated among external surroundings very similar to those existing in that particular locality, *e.g.*, a chemist educated in Birmingham, with its entourage of metallurgy, pottery, and other chemical manufactures, and then transplanted to a town with very large textile trades (such as Nottingham or Leicester), was placed in a most unfortunate position for himself and for his scholars. His sympathies, illustrations, and whole bent were out of harmony with the needs of the locality. The scholar, too, needed to specialise early, with a view to his business, otherwise he would find that a large amount of valuable time had, for his purposes, been misapplied.

Third. As to subjects taught. Technically there was the greatest need that the subjects taught should be adapted to requirements of special localities and by men practically acquainted with these special needs, *e.g.*, take the wool-dyeing syllabus or the cotton-dyeing syllabus of the London and City Guilds examination for advancement of technical education. Both syllabuses might be or might not be admirably adapted for dyeing purposes in Yorkshire or in Lancashire, but both quite unsuited for Nottingham dyeing trades. It was a frequent occurrence for the lecturer on dyeing at the City Guilds class at Nottingham University College to have to inform his students that he had to lecture on a subject of no interest whatever to Nottingham dyers, and that while he regretted it, he was most unfortunately obliged to conform to regulations laid down by a central authority. Again, he would ask how many of the teachers of dyeing at the technical schools throughout the country were really practical dyers and not mere scientists? He thought that if they were practical men surely it was strange they did not double their salaries promptly by going into commerce. High class teaching must proceed from personal experience, and in technical subjects State aid was sadly needed in order to pay such salaries as would command men practically as well as scientifically acquainted with their special subjects.

Mr. W. J. ABEL (Inspector to the Nottingham School Board) thought that they should consider the general question rather than the details of technical education. What they required to know was by what general means they could best foster technical

education. He thought Dr. Bowman's definition exceptionally good. Technical education should be commenced very low down, and at the very earliest stages they should instruct the students to apply their knowledge. If students were more frequently taught how to apply the education they received, they would be more impressed with their instruction. Government could best aid their various local industries, not by giving encouragement to any particular science, but by making their legislation very general, and giving facilities for the encouragement of technical education in general. They could then leave it to properly constituted local authorities to encourage what subjects they would. The next question was, who were these educational authorities to be? There were educational authorities who were incompetent to touch upon these subjects. He thought school boards should be made universal. Small boards who possessed no school buildings should be combined into school boards for large districts in sparsely populated parts of the country, so as to induce more competent men to go on the boards. He thought they should direct their efforts to the following ends:—To make large school boards universal, in order to encourage good men; to impress the central authority with the necessity of avoiding detail, and generalising legislation as much as possible; to arrange continuation courses, and to establish especially "working scholarships," the comparative absence of which throughout the country had tended very largely to make English manufacturers fall behind those on the Continent. They wanted more means for carrying on that practical work, that research without which they could not make advances such as were being made on the Continent. Mr. Ashwell had spoken about the specialisation of teaching. He doubted whether they should specialise from the beginning, for there was truth in the old saying that "man should know a little of everything, and all about one thing." Alderman Lindsey was quite right when he said payment by results could not be done away with. They did not want to abolish it, but wanted payment by genuine and not sham results, as was at present the case.

Mr. J. B. COLEMAN (Assistant Lecturer on Chemistry, &c., Nottingham University College) had noticed no provision in the Bill for advanced education, and thought there was to be no grant to colleges from the department unless it was understood by the word "school or college." He noticed in section 3 that there was a grant to be given by local authority or school board for payment of fees and also scholarships. What they desired was that there should be some central authority to concrete the teaching so that less people should teach the same thing twice over. He also recommended a graduated course, starting from the elementary schools. The purposes of the grant, he took it, would be to increase the teachers or to improve the teaching power—to give assistance by grants of apparatus and models, particularly in connexion with technical classes, to pay the fees of deserving students, and also to found additional scholarships.

Mr. F. S. GRANGER (Hon. Local Secretary of Society for Advancement of Technical Education) was under the impression that Sir Henry Roscoe's Bill dealt with higher education. The Bill before them dealt simply with elementary instruction. He himself had certainly contemplated an Elementary Education Bill separate and apart from that for higher technical education.

Mr. LLOYD WHITELEY (Lecturer on Dyeing, &c., Nottingham University College): He did not want to work elementary education under cast iron rules. The Science and Art Department should give grants just as the London City Guilds did. They were too much circumscribed in their teaching. He agreed with Mr. Ashwell, who knew as well as he, what the Nottingham University College did, and that although they could earn grants from City Guilds, they could very imperfectly adapt themselves to the requirements of the trade of the town. They were fixed with an examiner who had, he believed, a thorough acquaintance with some processes of dyeing, but had no acquaintance with dyeing as practised in Nottingham. He, himself, had to teach dyeing as required by the City Guilds, but this was of very little use to Nottingham men. If they were to launch out and teach those phases of dyeing required by the district, their students who went in for the City Guilds examination would suffer. Dr. Bowman's scheme helped every man who wanted to specialise to study equally the teachings of pure science, or of science applied either generally or to specific industries. In cases of this sort, local committees of competent men might be appointed to supervise the teaching and examinations in special or local subjects, and those who knew the needs of the district would be the best men to perform this office.

Mr. KITSON (Science Demonstrator to the Nottingham School Board) thought that a large amount of scientific knowledge should be given to children in ordinary elementary schools, and that a certain amount of it should be compulsory. If they wished to add to this, his two suggestions were, continuation schools or colleges, and classes similar to those held in the City and Guilds of London Institute. He would give a certain amount of scientific instruction in the upper schools (Standards IV. or V.). School boards should be given power either to provide scholarships for deserving children in their schools or to have some of the best children picked out and sent to higher schools where it would not be compulsory to give elementary education. They could not, however, establish higher schools unless they provided for the third standard. This condition should be abandoned and continuation schools for Standard VII. and upwards fostered for giving higher education in board schools. Elementary and advanced education should be kept quite apart; one Bill should not include the two, as there would be some danger of one swamping the other. All who had the interests of technical education at heart would rather see the elementary provided first and then the advanced than have the two together in one Bill and so endanger both. The scheme of the higher schools should be elastic, and subjects taught should have some bearing on the trade of the district. By working or travelling scholarships students might visit other schools and see the methods employed there, and thus supplement the science instruction received at home.

A VISITOR thought that there should also be scholarships for students who were connected with some place of business. The continual adoption of new methods made it very desirable that there should be more touch between the works and the teaching of the college.

Mr. E. FRANCIS (Head Master, People's College, Nottingham): With regard to the provision of funds and granting of power, there could not be two

opinions that the local authority should be the school board. They could not very well separate the teaching in the elementary schools from higher teaching; they were too intimately connected. In order to get higher teaching he agreed with Mr. Kitson that they should begin pretty low down. Continuation might then be made in the colleges which were already provided. They had schools and a great number of colleges, and they wanted power to raise more funds, so as to provide apparatus, teaching power, and all that was necessary to carry on the work. He strongly supported Sir H. Roscoe's Bill, which he thought a very fair Bill. He did not think Mr. Coleman need be afraid of colleges being left out in the cold; provision was made in the Bill for colleges of that kind.

He would like to say a word as to the Science and Art Department and their list of subjects. As a rule they tried to make the subjects as general as possible so as to cover all trades and manufactures, but something more was wanted. The local authority must be entrusted with powers to arrange the curriculum to suit the district. The Science and Art Department could not arrange their syllabus to suit all districts. For instance, in dyeing, a syllabus suitable for Yorkshire would not do for Nottingham.

He thought boys ought to be permitted to extend their education in colleges free of all cost; scholarships would not be necessary if they were allowed to come to colleges free and their books found free. They ought to adopt something of the German system and compel partial attendance at certain schools after commencing work. Boys who went to work very early in the morning were too tired to undertake study in the evening. To a very large extent they were lacking in students in the Nottingham College simply because boys had not time to come. The Bill should have a clause inserted by which boys ought to leave work at a certain time; part of the afternoon instead of being spent at continuation schools or colleges, two or three days a week, also free of cost.

Mr. S. J. PENTECOST thought that in any rearrangement of payment more money should be paid in respect of practical work. The examinations conducted by the Science and Art Department enabled a man possessing the power of composition generally to manage a first class. That was not what was wanted; they should require proof that the work done was practical work. They ought to do away with the present literary examination. If this Bill passed, would the school board have courage to supply the colleges with the necessary funds? Technical education would, no doubt, be exceedingly costly, and, if the school board applied to the ratepayers for so many thousand pounds for this particular work, the ratepayers would kick. He thought the difficulty might be got over to some extent by arranging for school boards to have a large subsidy from the national Exchequer. The British ratepayer did not mind money being paid out of the general Exchequer, and paid taxes more readily than rates, so, if a board, say in proportion to the population in the district, had power to take a lump sum from the Exchequer, increased to some extent by contribution from rates, there would be less difficulty and less friction.

Liverpool Section.

Chairman : F. Hurter.

Vice-Chairman : A. Norman Tate.

Committee :

E. Bibby.	H. Gaskell, jun.
J. Campbell Brown.	S. Hamburger.
H. Brunner.	J. W. Kynaston.
E. Carey.	E. K. Muspratt.
H. Deacon.	G. Shack-Sommer.
T. Fletcher.	James Simpson.

Hon. Local Sec. and Treasurer :

W. P. Thompson, 6, Lord Street, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

REPORT ON THE WORK DONE BY THE LIVERPOOL ASSOCIATION FOR THE PROMOTION OF TECHNICAL EDUCATION.

BY J. CAMPBELL BROWN, D.S.C.

It will be remembered that in the winter of 1887 an Association was formed in Liverpool for the promotion of technical education, to which this and other Societies were invited to send delegates. These delegates formed a provisional committee, which met and drew up a draft of the constitution of the Association, which has been adopted, with the Earl of Derby as President, and the Mayor of Liverpool and Mr. E. K. Muspratt amongst the Vice-Presidents. The Chairman is Sir James Poole. The Secretaries are Mr. Reginald Bushell and my very energetic colleague, Professor Hele Shaw. The Treasurer is Mr. T. F. Harrison. The various delegates are members of the first Council. The office is at 15, Sweeting, Liverpool.

The activity of this Association is directed to the promotion of efficient teaching of drawing and elementary science, and of manual instruction in the use of tools, in all elementary schools; to the promotion of technical education in continuation and evening schools, and of special classes for teachers; to the enlistment of the sympathy and support of merchants, manufacturers, and all engaged in commercial and industrial pursuits; and to watch legislation.

The Association has requested each of the delegates to report to the Society sending him what has been done. To save time a report has been sent by the Secretary to each member of the Liverpool Section of our Society.

Reports have been made on the proposed Government Bill, amongst other subjects, and although the Bill was withdrawn, the Association resolved to do something practical this winter.

A scheme of instruction in fret-work and wood-working was prepared for scholars in the sixth and seventh standards of elementary schools. And it has been arranged for the present winter to have ten centres in the city, and on each day, for five days of

the week, to hold two classes, each at a different centre, making 100 classes in all, teaching about 40 boys in each class, or 400 boys. These classes are now commencing. Two classes, of 25 elementary school teachers each, are already held once a week, to train teachers for more extended work in future years.

For girls it is proposed to aid the introduction of laundry work into schools, and to extend the teaching of cookery. A limited number of scholarships, of thirty shillings each, are offered for cookery in elementary schools, and these scholars are to receive further instruction at the Liverpool School of Cookery.

The building of the working sheds in connexion with the Walker engineering laboratories of University College was hurried to completion in advance of the rest of the building, and these have been open since October last for wood-working classes for elementary teachers. It is possible that before long classes for apprentices may also be held in the same workshops, in accordance with the wish expressed by Sir Andrew Walker in presenting his Jubilee gift, that it should be made useful to artisans as well as to college students.

Arrangements are being made by the Association for offering prizes or scholarships in some form to apprentices, and to evening class students for work done, to enable them to pass to a higher grade of instruction.

This is a very good beginning to the work of the Association, even in the absence of legislation, and I shall only further point out that to carry on this work and extend it the Association requires members and some money.

The members are:—

- (a.) Governors, all who give a donation of 50l.
- (b.) Life members, who give a donation of 10l.
- (c.) Ordinary members, subscribing 10s. 6d. per annum.
- (d.) Associates, who subscribe 2s. 6d. per annum.

I trust that most of the members of this Society will become members of the Association in one or other of these ways, and enable the Association to show an example to the rest of England of practical work accomplished, just as the Liverpool School Board and the Liverpool School of Cookery have done in their respective departments.

*Meeting held Wednesday, 1st May 1889, at
University College, Brownlow Street.*

DR. HURTER IN THE CHAIR.

A METHOD FOR PURIFYING LEBLANC BLACK-ASH AND THE PRODUCTION OF AMMONIA FROM ITS IMPURITIES.

BY J. L. HAWLICZEK.

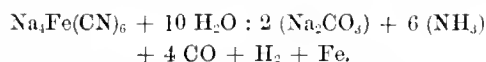
It is a well-known fact that certain impurities existing in ordinary black-ash are most objectionable and troublesome in the further treatment of the

"vat-liquor" obtained therefrom, both for the manufacture of caustic soda and especially for the production of soda-ash of good quality and colour. These impurities, to which I shall direct attention to-night, are the cyanogen-compounds, found in black-ash as cyanide, eventually in the liquors as ferrocyanide, sulphocyanide, and cyanate of sodium, together with sulphide of sodium. The first-mentioned compounds, which may be termed in general—the cyanides—and which will be the main object of my paper, are formed during the "balling" process in the revolver or hand furnace from the nitrogenous matter existing originally in the mixing fuel. We shall see presently that these compounds may advantageously be increased in the black-ash by using mixing fuel which contains a higher percentage of nitrogenous matter. The other compounds—the sulphides—will only be dealt with incidentally.

About 10 years ago several eminent chemists, in order to compete with the excellent products of the ammonia-soda process, endeavoured to improve the Leblanc soda-ash in quality and colour. As it was generally admitted that the small amount of iron combined as ferrocyanide in the vat-liquor was, to a great extent, the actual colouring agent in Leblanc soda-ash, attention was chiefly directed to destroy either in the black-ash the cyanide, or in the vat-liquor the ferrocyanide. Without going into the description of the numerous processes and their advantages which had been proposed at that time for this purpose, I just remind you of the able researches made by Peehiney, Walter Weldon, Mactear, Dr. Hurter, and others dealing with the question of the entire destruction of the ferrocyanide in the Leblanc black-ash and vat-liquor.

A first attempt not only to expel but to utilise the cyanogen-compounds in black-ash as a marketable product, *i.e.*, as ammonia or sulphate of ammonia, forms the subject of the English Patent No. 5456 of 1886, granted to T. T. Mathieson and J. Hawliczek, and I have the honour to lay before the members of this Section of the Society of Chemical Industry some of the results so far obtained.

Our method of treating the black-ash is based on the following facts. If a ferrocyanide, cyanate, or sulphocyanide of an alkali is treated with steam at a temperature not exceeding the temperature of dissociation of ammonia, the cyanogen-compounds are split up into ammonia, which passes off in a gaseous state, and leaves behind the corresponding quantity of the alkali as carbonate. The following equation shows the chemical changes which take place by this treatment:—



This reaction is quantitative if the temperature is kept within 680° to 780° F., a fact which I have proved repeatedly by treating pure ferrocyanide of potassium at that temperature with steam, when I always obtained the theoretical quantity of ammonia and carbonate of potash. The same result will be obtained by treating black-ash containing cyanide, or any cyanogen-compound, under similar condition and temperature, with steam or superheated steam. The ammonia resulting from this decomposition is carried off with the excess of steam, and may be condensed by usual means to ammoniacal liquor or used directly for the manufacture of sulphate of ammonia. The black-ash which remains after this

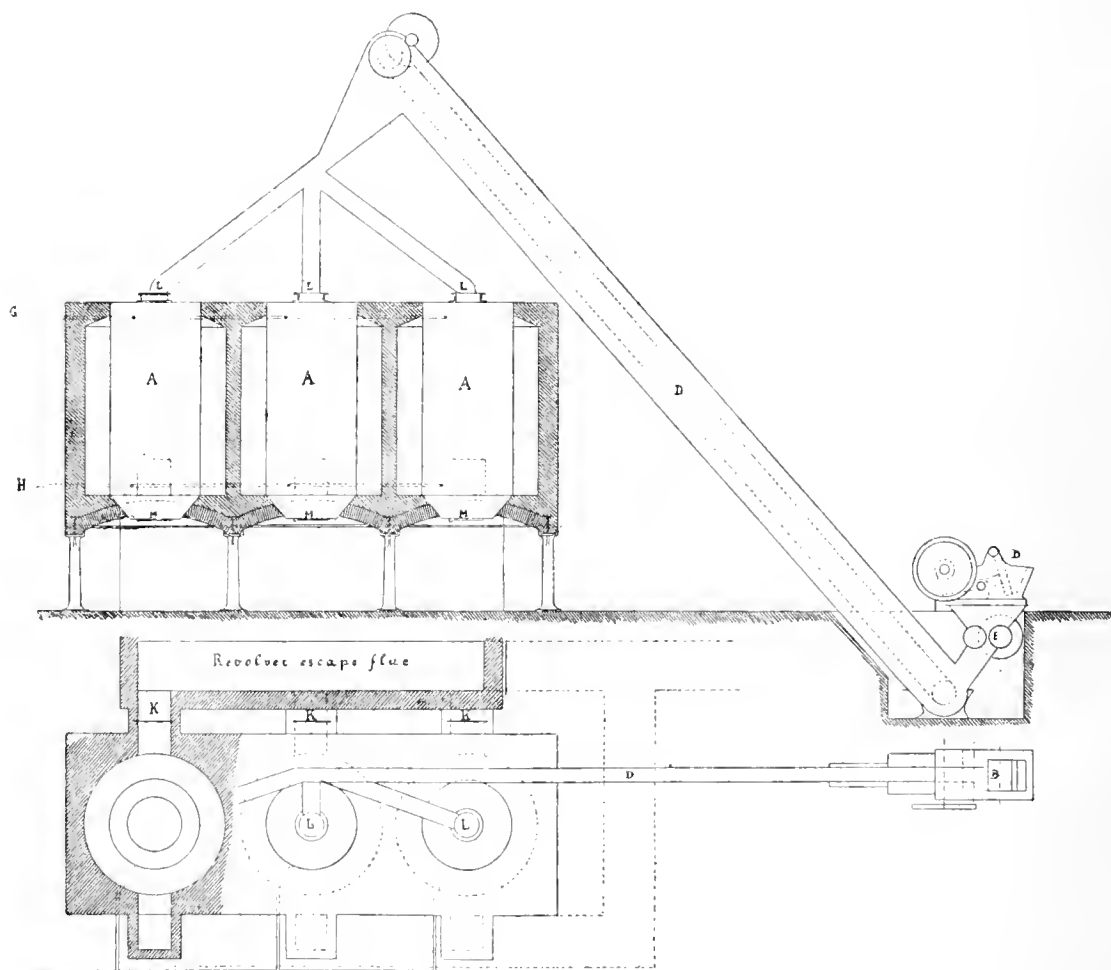
treatment is free from cyanogen-compounds, and has not been chemically changed in any way as regards the alkali. This is supported by many assays of black-ash before and after treatment with them.

After these few words on the principle employed in our method, I proceed to describe the conditions of the black-ash and the method of operating necessary for the successful working of the process on a manufacturing scale. For the purpose of treating the black-ash with steam or superheated steam, we make use principally of the sensitive heat retained in the black-ash after being drawn from the revolver. We allow the black-ash to cool in the bogies until it sets sufficiently to allow the balls to be broken into small lumps, the size of which varies, according to the density of the black-ash, from about 3 in. to 5 in. in diameter. The breaking may be commenced about one hour or one hour and a half after the charge is drawn. The central part of the balls should not be semifused. This point was overlooked in a series of experiments made on a large scale at Messrs. N. Mathieson and Co.'s works, and consequently irregular results were obtained, shown in Table No. 2, which I shall examine more closely further on. On account of our insufficient breaker arrangements, we found it necessary to reduce the

black-ash balls in thickness to about 8 in. or 10 in., but I believe that with proper plant for mechanically breaking—such plant as I shall describe—there would be no necessity for such a reduction in the thickness of the black-ash balls.

Another point to be considered is the physical condition of the black-ash itself. It will readily be understood, if solid black-ash has to be treated with a gaseous matter (in our case, steam), that the success of such treatment will depend mainly on the physical character of the solid material, which, if in large pieces, must be very open or porous, to permit a perfect diffusion of the gases through the solid, otherwise the solid material (black-ash) must be reduced to such small lumps as to expose a very large surface to the steam if the reaction is to be complete. As both these conditions of black-ash now and then occur, we provide ready means to regulate the size of the lumps of black-ash of each individual charge, according to its density, and with a little experience very regular results regarding the yield of ammonia, respectively the decomposition of the cyanides, may thus be secured.

I now come to the description of the apparatus proposed for the treatment of black-ash with steam on a practical working scale. The apparatus which



you see on the diagram here has been somewhat altered from that shown in the patent specification. It is more closely representing the appliances used in the experiments which have been made at Messrs. W. Gossage and Son's soap-works. I feel myself greatly indebted to that firm, and beg to acknowledge at this place the valuable assistance which Mr. F. H. Gossage kindly has given to me in my experiments on this process at his establishment, and which has greatly added to the success. The apparatus consists—

1st, of the mechanical arrangement for breaking the black-ash balls into convenient sized lumps.

2nd, of an elevator for charging the decomposing vessels.

3rd, of the decomposing vessels, and

4th, of the condensing apparatus for collecting the ammoniacal liquor, which can be arranged in any convenient way and which consequently is not shown on the diagram.

The mechanical appliance for breaking the black-ash consists of an ordinary type of stonebreaker B, large enough to receive one ball at a time. The pieces of black-ash leaving this breaker have to pass through an ordinary toothed roller breaker E, which is readily adjustable for the purpose of varying the sizes of lumps. These are now conveyed to the decomposing vessels by the elevator D, for which shoots L are provided for alternative charging. The decomposing vessels A are made of wrought iron. There are three of them, sufficient for an output of about 250 tons of salt cake per week. The decomposers are provided with charging holes and lids M on the top, and discharging apertures and lids at the bottom, which during the time of treatment have to be hermetically closed. Pipes G are shown on sketch for the admittance of steam from the superheater leading in at the top; and the escape pipes H on the bottom of the decomposers for the conveyance of the ammoniacal vapour and excess steam to the condensing vessels. There are also arrangements, not indicated in the diagram, to work the decomposers in sets of two or three at a time for the purpose of readily obtaining strong ammoniacal liquor, containing from 10—15 per cent. pure ammonia. The decomposers are surrounded by brickwork and placed in an elevated position, supported by cast-iron columns for simplifying the discharging of the treated black ash into bogies, which are placed underneath the bottom aperture of the decomposers. The decomposers are placed as near as convenient to the escape flue of the revolver, to make use of the waste heat of the flue-gases for warming the vessels. The temperature of the flue-gases going into the chimney is ordinarily about 600—700° F., and is amply sufficient for our purpose, and by no means injurious to the iron plates of the decomposers. However, independent in and outlet flues are provided for each decomposer, so as to be able to regulate the surrounding heat, and to prevent it becoming excessive. Thus the wear and tear on the apparatus can only be very slight.

With reference to the labour required for working this process, we found that only two extra men are necessary for attending to the treatment of the black-ash, one for the day and the other during night. The operation of dipping, breaking, and discharging the vessel (which, as you have seen before, simply means opening the discharging lid, when the decomposer will empty itself, practically speaking) is attended to by the ordinary staff of revolver-men and vat-setters. As there is no other regular labour required, the expense of working this process is but a very slight one.

The results of the experiments made are classified into two series:—

First.—Experiments made for the treatment of Leblanc black-ash with steam and the recovery of ammonia, resulting from the decomposition of the cyanogen-compounds.

Second.—Experiments made in the revolver for the purpose of increasing the cyanogen-compounds in the black-ash by utilising the nitrogen of the mixing fuel for the production of ferro-cyanide.

A few words on the method of testing black-ash for total cyanogen, respectively ammonia, which has been employed in our analysis and proved to be very regular and satisfactory in its results, may perhaps be of interest.

I have already stated that if any cyanogen-compound is treated with steam within certain limits of temperature, the resulting decomposition into ammonia and a carbonate is quantitative. It will readily be understood that a quantitative determination of these compounds in the form of ammonia may be based on this principle, and this method will be particularly suitable in connexion with our process as it gives a ready means to estimate the amount of ammonia present in the form of total cyanogen in the black-ash and consequently recoverable from it. The results obtained by this test very favourably compare with Dr. Hurter's method of testing the ferrocyanide in the vat-liquor, but, as must be expected, gives a little higher results, owing to the presence of sulphocyanides and cyanates in the black-ash.

The sample of black-ash to be tested is crushed into a coarse powder and 100 grms. of it are placed into an ordinary wrought iron gas-pipe, of, say, $\frac{1}{4}$ in. diameter and 30 in. length. The remaining space on both ends of the pipe is filled with loose asbestos and then stoppered with common corks provided with glass tubes. When charged the pipe is placed into an ordinary gas-combustion furnace and heated to a slight red heat. Steam, which is produced in a common flask, is passed through the heated black-ash, expelling ammonia, which is collected in normal acid. A simple calculation gives directly the percentage of ammonia contained in the black-ash. An assay, if everything necessary is prepared, may be finished in about 15 minutes, and requires very little care and attention.

The first experiments of treating black-ash with steam have been carried out at the works of Messrs. W. Gossage and Sons, in Widnes. The apparatus employed consisted of an upright wrought-iron vessel, large enough to hold a charge of four black-ash balls at a time. This vessel was encased in brickwork, provision being made to heat it from below at the commencement of each operation without overheating it. If, however, several successive operations have been carried out, it was found unnecessary to continue firing, as sufficient heat was retained from the former treatment. Besides, highly superheated steam, which was close at hand, could be used, so that everything desirable was provided for to secure a successful treatment.

Table No. 1 represents the results obtained.

The results of this series of experiments are very satisfactory as regards the regularity of working, the decomposition of the cyanides, and the total recovery of the ammonia. The temperature of the black-ash, as shown by this table, may vary from about 700°—800° F. The superheated steam was also high

TABLE No. 1.

THE RECOVERY OF AMMONIA FROM BLACK-ASH.

Experiments made at Messrs. W. Gossage and Sons, Widnes.

Date.	Particulars.						
	Revolver Charges.	Total Weight.	Time of Cooling in Boggles.	Time of Breaking per Charge.	° F. Pyrometer in Decomposers.	° F. of Superheated Steam.	Time of Treating with Steam.
1887.	Balls.	Cwt.	Min.	Min.	° F.	°	Hr. Min.
April 30th.....	3	21	..	..	710	560	3 50
" 30th.....	3	21	..	..	730	550	3 40
July 22nd.....	4	28	..	..	730	550	..
" 22nd.....	1	28	..	..	750	570	..
" 28th.....	3	21	..	..	750	550	..
" 28th.....	3	21	..	..	740	570	..

Date.	Analysis of Black-ash for Ammonia.					Results on 100 Ammonia.			
	Per Cent. of Ammonia Original Black ash.	Lb. of Sulphate of Ammonia in Original Black-ash.	Per Cent. of Ammonia remaining after Treatment.	Lb. of Sulphate of Ammonia remaining.	Lb. of Sulphate of Ammonia recovered.	Per Cent. Decomposed.	Per Cent. recovered.	Per Cent. Lost by Treatment or Leakage.	Per Cent. Remaining.
1887.									
April 30th.....	0.880	7.84	0.0572	..	..	93.5	93.5	..	6.5
" 30th.....	0.833	7.84	0.0458	0.43	7.41	94.5	94.5	..	5.5
July 22nd.....	0.816	10.24	0.01068	1.34	8.90	86.9	86.9	..	13.1
" 22nd.....	0.816	10.24	..	..	..	100.0	..	..	..
" 28th.....	0.690	5.65	0.01194	1.13	4.52	80.1	80.1	..	19.9
" 28th.....	0.610	5.72	0.00549	0.52	5.20	91.0	91.0	..	9.0

In all these experiments the lb. of sulphate of ammonia have actually been weighed, and the treated black-ash analysed for cyanogen.

enough in temperature, from 500°–550° F. If the temperature were to rise much beyond 800° there might, by the reaction of the steam on the cyanide, occur an entire destruction of the ammonia. It might even result in the reverse reaction, that is, a certain amount of cyanide in the black-ash might be reformed, as it is a well-known fact that under certain conditions cyanides can be produced from ammonia. On the other hand, if the temperature is much below that indicated, the cyanides are not acted upon by the steam at all, and consequently remain undecomposed. In this respect not sufficient care was taken in the experiments made at Messrs. N. Mathieson and Co.'s alkali works (recorded in Table 2), the results therefore have been much worse.

In Table No. 1 the decomposition of the cyanides amounts, on an average, from 90 to 95 per cent., in some instances even 100 per cent.; the ammonia recovered therefrom represents the total also, namely, 100 per cent. of the cyanides decomposed. I may state here, that from each individual charge the ammonia has been collected and actually been weighed as sulphate, thus giving a reliable proof of the results obtained by calculation from the cyanides respectively, ammonia in the original and in the treated black-ash. One column in the table gives the time of treating one charge, which on an average is between three and four hours.

The samples of black-ash treated in these experiments contain an unusually small percentage of cyanogen. For instance, in the fourth experiment there were only 0.483 per cent. of ammonia or 7.84 lb. of sulphate of ammonia per charge of three balls. A recovery of 94.5 per cent. of this amount, or 7.41 lb., as sulphate of ammonia, would result in a production of about 80 tons of sulphate of ammonia per annum when 250 tons of salt cake are decomposed per week, or a value (taking the present market price per ton, of 24 per cent., at 12*l.*) of about 800*l.* to 900*l.*

The numerous assays of the treated black-ash show that no chemical change in its original composition has taken place, the alkali being present in percentage and chemical condition exactly as in the original black-ash, only the sulphides being reduced by about 30–40 per cent.

The treated black-ash spent very well and somewhat quicker (due to its granular state) in the vats, leaving behind black-ash waste of the same condition as in the ordinary way of working. The vat liquor obtained contains none or only very faint traces of ferrocyanides (determined by colorimetric test), the sulphides are as low as 0.44 on 100 of alkali, which is no doubt an exceedingly favourable result compared with ordinary vat-liquor, which contains about 1.4 to 2.0 on 100 alkali.

Further experiments of treating black-ash were carried out at the works of Messrs. N. Mathieson & Co. on a large scale, the results of which are represented in Table No. 2.

TABLE NO. 2.—THE RECOVERY OF AMMONIA FROM BLACK-ASH.

Experiments made at Messrs. N. Mathieson and Co.'s.

Particulars										Analysis of Black-Ash for Ammonia.				
Date.	Re- volver Charges	Total Weight.	Time of Cooling in Bogies.	Time of Breaking per Charge.	° F. Pyro- meter in Decom- posers.	° F. of Super- heated Steam.	Time of Treating with Steam.	Per Cent. of Am- monia Original Black- Ash.	Lb. of Sulphate of Am- monia in Original Black- Ash.	Per Cent. of Am- monia remain- ing after Treat- ment.	Lb. of Sulphate of Am- monia re- maining.	Lb. of Sulphate of Am- monia recovered.		
1887.														
Nov. 7th.....	4½	Tons. 12	Min. 69	Min. ..	..	290	Hr. Min. 3 30	·0493	53·0	·0173	16·4	14·0	
" 17th.....	8	54	51	..	890	270	10 3	·1088	526·4	·0238	115·4	182·0		
" 25th.....	4	27	36	37	987	290	6 19	·1020	245·7	·0221	53·5	128·0		
Dec. 7th.....	4	24	37	36	1,109	294	6 31	·0896	192·8	·0187	40·2	86·8		
" 8th.....	4	26½	36	36	1,065	293	6 42	·0870	206·6	·0159	35·6	93·2		
" 16th.....	..	96½	39	37	1,089	296	7 10	·0867	747·6	·0238	205·2	312·0		
1888.														
Jan. 25th.....	1	6½	40	50	1,022	290	5 0	·0580	33·4	·0090	5·2	21·36		
" 28th.....	5	32½	41	47	1,025	272	5 15	·0442	128·8	·0090	26·0	96·00		
Feb. 4th.....	5	32½	39	39	..	287	5 40	·0578	168·0	·0187	54·4	97·20		
" 18th.....	7	15½	43	40	..	288	6 9	·0544	221·7	·0120	48·9	149·0		
" 23rd.....	7	15½	40	47	..	290	6 8	·0629	236·0	·0051	20·8	171·0		
March 3rd...	8	53½	40	41	..	289	7 9	·0493	236·0	·0104	49·84	124·0		
" 8th...	13	104	12	44	896	290	7 22	·0850	792·0	·0140	130·4	394·0		
" 17th...	9	67	44	42	921	289	6 42	·0646	387·8	·0136	81·6	213·0		

Date.	Result on 100 Ammonia.				Analysis of Black-Ash for Alkali.				
	Per Cent. Decomposed.	Per Cent. Recovered.	Per Cent. Lost by Treatment or Leakage.	Per Cent. Remaining.	Per Cent. of Na ₂ O Original.	Per Cent. of Na ₂ O after Treatment.	Per Cent. of Sulphide Original.	Per Cent. of Sulphide after Treatment.	Per Cent. Decom- posed on 100 Original Sulph.
1887.									
Nov. 7th....	68·96	26·41	42·55	51·04	27·07	27·5	·531	·278	47·65
" 17th ...	78·10	34·69	43·50	41·90	..	..	..	..	..
" 25th ...	78·39	51·8	26·5	21·70	24·8	24·2	·215	·176	18·20
Dec. 7th.....	79·20	45·02	34·13	20·85	25·8	25·8	·320	·242	24·40
" 8th.....	82·76	45·40	37·66	17·21	25·8	25·8	·265	·265	..
" 16th.....	72·55	41·83	30·72	27·45	..	..	..	..	35·6
1888.									
Jan. 25th.....	84·65	63·23	21·42	15·35	..	..	..	..	54·0
" 28th.....	79·82	77·53	2·29	20·18	..	..	..	..	25·5
Feb. 4th.....	67·62	57·86	9·76	32·38	..	..	..	..	15·2
" 18th.....	77·94	63·13	14·81	22·06	..	..	..	..	38·6
" 23rd.....	91·87	66·80	25·07	8·13	..	..	..	..	36·8
March 3rd...	78·99	52·40	26·59	21·10	..	..	..	..	36·7
" 8th...	83·53	50·0	33·53	16·47	..	..	..	..	..
" 17th...	78·95	55·18	23·77	21·05	..	..	..	..	31·6

I produce these results solely with the desire to be complete and to give every figure obtained in the course of experiments on the new process favourable or otherwise. These results show great irregularity in working, especially when examining the columns

Per cent ammonia recovered,
" " decomposed, and
" " lost by treatment,
or leakage. A short glance at the columns stating
the temperature prevailing in the decomposer, and

that of the superheated steam during the time of treatment, will tell at once the reason of these variable results. For in this case the most essential circumstance, necessary for the success of the treatment, has not been observed, so that there was not really a chance to secure as satisfactory and regular results as we had obtained in our former experiments, indicated in Table No. 1. There is no need to refer any further into Table No. 2, as Table No. 1 proves beyond doubt in a most satisfactory way that the process described works well, provided of course that the plant and temperatures are sufficient and adequate.

But certain results in Table 2 with regard to the chemical condition of the black-ash before and after treatment with steam, and which have been omitted in Table No. 1, are noteworthy. They demonstrate that no chemical change in respect to the alkali present before and after treatment has taken place. They illustrate at the same time to what extent a reduction of the sulphides in the black-ash has been effected.

Considering the fact that the cyanides in the black-ash, formerly so inconvenient, now become a product of value, it is desirable to increase these compounds in the black-ash, and, if possible, to utilise the entire nitrogen of the mixing fuel in form of cyanides in the black-ash, and to use mixing fuel which contains a high percentage of nitrogen. (Such fuel can be readily obtained from neighbouring collieries without further expense.) With this increase of cyanides in view, subsequent experiments were undertaken, but have not yet been brought to completeness. Nevertheless, I am able to give certain directions and figures which will prove useful to anyone desirous of making investigations on this subject.

With regard to the theory of formation of cyanides in the black-ash, I have to point out two facts which are contrary to researches made some 10 or 12 years ago.

Firstly. It now is generally accepted as fact by chemists, that the formation of cyanides in the black-ash is due to the presence of nitrogenous matter in the mixing fuel, and not to the action of the nitrogen in the combustion or flue gases on the highly heated alkali in presence of carbonaceous matter, which was the old theory. Therefore, we may reasonably suppose that mixing fuel high in nitrogen should yield a larger amount of cyanides in the black-ash, provided that the condition of working the revolver is favourable to the formation of these compounds.

Secondly. Formerly it was believed that a very high temperature in the revolver was favourable to the formation of cyanides; but, according to our experiments, we find the cyanides are greatly increased if the revolver is worked at a comparatively low temperature. In one instance we obtained black-ash containing 92 per cent. of the nitrogenous matter in the mixing fuel as cyanides. If such a result could be regularly obtained with mixing fuel of about 1.5 per cent. of nitrogen, it would mean the very considerable production of about 370 tons of sulphate of ammonia per annum, with a decomposition of 250 tons of salt-cake per week.

Many experiments have been made for the purpose of increasing the cyanides in the black-ash principally by altering the proportions of the black-ash mixings, at the same time using mixing fuel of a high percentage of nitrogen; otherwise the revolver was worked in the ordinary way. Table No. 3 gives the results:—

TABLE No. 3.

REVOLVER EXPERIMENTS.

The Increase of Cyanogen-Compounds in Black-Ash.

Charge.	Mixings.				Analysis Mixing-Slack.		Ammonia in Black-Ash.		
	Salt Cake.	Lime-Stone.	Lime-Mud.	Slack.	Per Cent. of Ammonia in Mixing-Slack.	Lb. of Sulphate of Ammonia available in Slack per Charge.	Per Cent. of Ammonia in Black-Ash.	Lb. of Sulphate of Ammonia found in Black-Ash.	Per Cent. of Ammonia recovered from Slack.
	Tons. Cwt. 4 18	Tons. Cwt. 4 16	Tons. ..	Tons. Cwt. 2 15					
No. I.					1.16	285.8	0.1128	112.6	39.34
No. II.	5 0	4 8	1	2 13	1.16	275.4	0.1700	126.5	46.03
No. III.	5 0	4 18	..	2 13	1.16	275.4	0.1666	138.1	50.13
No. IV.	5 0	4 14	..	2 13	1.16	275.4	0.1734	136.7	49.55
No. V.	5 0	4 2	1	2 13	1.16	275.4	0.1802	149.4	54.22
No. VI.	5 0	4 0	1	2 13	1.16	275.4	0.1768	139.4	50.60
No. VII.	4 15	5 5	..	2 15	1.927	474.8	0.1360	107.2	22.50
No. VIII.	4 15	4 15	1	2 15	1.927	474.8	0.1700	131.0	28.40
No. IX.	4 18	5 2	..	2 15	1.927	474.8	0.2110	177.4	37.40
No. X.	5 0	5 0	..	2 15	1.927	474.8	0.1800	149.2	31.40
No. XI.	5 0	4 10	1	2 15	1.927	474.8	0.2040	169.1	35.60
No. XII.	5 0	4 15	1	2 10	0.830	186.0	0.0990	78.6	42.26
No. XIII.	5 0	4 15	1	2 15	1.712	422.0	0.1331	105.0	24.88
No. XIV.	4 15	5 5	1	2 15	0.603	148.6	0.1734	136.7	92.00

TABLE NO. 3.—REVOLVER EXPERIMENTS—*continued*.

Charge.	Particulars.			Analysis of Black-Ash.			250 Tons of Salt-Cake decomposed per Week.
	Working-Time of Revolver Charge.	Weight of Black-Ash per Charge.	Alkali (Na ₂ O).	Sulphate.	Total Sulphate.	Sulphate.	
No. I.	Hr. Min. 3 0	Cwt. 176	25.6	60	1.51	35	128 tons of sulphate of ammonia.
No. II.	3 30	166	23.5	1.10	2.10	39	146.5 " " "
No. III.	2 55	185	26.2	49	1.71	48	154.1 " " "
No. IV.	2 55	176	27.3	40	1.76	50	152.5 " " "
No. V.	3 0	185	27.2	42	2.01	61	166.6 " " "
No. VI.	3 0	176	27.1	40	1.70	50	156.5 " " "
No. VII.	2 30	176	24.6	40	1.70	50	125 " " "
No. VIII.	2 35	176	25.3	54	1.50	40	162.1 " " "
No. IX.	2 25	185	25.6	87	2.00	46	200 " " "
No. X.	2 50	185	25.4	89	1.70	34	166.5 " " "
No. XI.	2 55	185	24.8	80	2.00	50	188.7 " " "
No. XII. ....	..	176	..	..	..	..	87 " " "
No. XIII. ....	..	176	..	..	..	..	117.2 " " "
No. XIV. ....	..	176	24.8	60	1.35	25	165.2 " " "

The figures in this table, which are of interest, refer to the different black-ash mixings with and without the addition of mud-lime to the sulphate of ammonia available in mixing slack, to the sulphate of ammonia found in the black-ash, to the per cent. of ammonia recovered from slack, and the last column represents the tons of sulphate of ammonia which would be produced per annum from the cyanides in black-ash, with reference to the results obtained in each experiment. Take, for instance, those in the charges Nos. II. to VI., where we find that the mixings have been altered in each case with regard to the quantity of limestone used. In three cases an addition of mud-lime has been made instead of limestone, yet the results in percentage of ammonia utilised show so little variation only (from 46—54 per cent.) that we may safely draw the conclusion that these alterations of the mixings are immaterial. I incline more to the belief that better results, *i.e.* an increase of the cyanides, would be obtained by altering the mode of working the revolver as regards the temperature prevailing at the time of reaction. Charge No. XIV. shows that as much as 92.00 per cent. of the nitrogen in the mixing fuel was recovered in the black-ash as cyanides, and this charge has been worked at a lower temperature than the others, having been underfired. I believe that this was the reason of its very satisfactory results. I had no other opportunity to carry on further experiments on this subject, so that I am not in a position to give absolute directions for the best mode of working the revolver in order to obtain the highest possible amount of cyanides in black-ash, but I may draw up in the following what I firmly believe to be the right way:—

First. The use of mixing fuel of a high percentage of nitrogen (the proportion of mixing being immaterial).

Second. The arrangement of so-called after-charges of mixing fuel added in the revolver just

before the time of stiffening. One-third of the total mixing fuel may be used for this purpose without otherwise injuring the black-ash or the time of working.

Third. The revolver must be worked at a comparatively low temperature, especially at the finish, which may be done by simply dropping the damper in the escape flue.

I have now given full particulars of the process in question as far as my present experience will permit, and I trust that these results will have interested at least those members of the Society who are connected with the alkali trade. The results I have given show that the new process is capable not only to destroy completely the cyanides and thus to produce soda of greater purity, but to provide a new considerable revenue from a source, the existence of which was hitherto an inconvenience, *viz.*, from the nitrogen of the mixing fuel. A yearly production of 150 to 200 tons of sulphate of ammonia represents a value of from 1,800*l.* to 2,000*l.*, and this can be readily obtained from a weekly decomposition of 200 to 250 tons of salt-cake.

DISCUSSION.

Dr. HURTER (Chairman) said that Mr. Hawliczek had given them a very clear and concise account of an interesting process for the destruction of the cyanides and the recovery of the ammonia so formed. According to the tables before them the process seemed to be not only advantageous by affording a purer carbonate of soda, but also to some extent at any rate remunerative, in so far as the amount of sulphate of ammonia obtained during the process was so large as to come to a considerable number of shillings per ton of salt-cake—at least two? (Mr. Hawliczek: "Yes.") He had no doubt that a process like that must be exceedingly interesting to the alkali manufacturers, of whom he was glad to see

a number present, and from whom he expected an interesting discussion. He had no doubt Mr. Hawliczek would be able to give them further information on several points—the pecuniary one in particular.

Dr. J. CAMPBELL BROWN asked whether there was any expenditure of fuel at all, or whether the work was entirely done by waste heat?

Mr. E. W. PARNELL said that Mr. Hawliczek had spoken of the advantage of the removal of the cyanide as effecting the quality of soda-ash manufactured from the black-ash liquors. From his own experience he could speak of the importance of this in the manufacture of high-strength caustic, as cyanides in the liquors caused an increased proportion of sulphate and carbonate in the finished caustic, the former being due to the presence of sulphocyanides.

An important point to which he believed Mr. Mr. Hawliczek had not referred was the very great purity of the ammonia thus produced, being of necessity absolutely free from tarry matters.

As regarded the proportion of cyanide produced in the black-ash, he had frequently noticed that this increased as the time of working a black-ash charge increased.

He would also like to ask how the use of the black-ash was regulated to correspond to its density, and whether there was a loss of ammonia during the discharge of the revolver, as one could frequently smell the ammonia during and after the operation.

Mr. E. CAREY understood that the Chairman and Mr. Hawliczek agreed that, on the figures set forth by the latter, the gross money credit to be gained by the process was about 2s. 5d. per ton on the salt-cake employed; but this was based upon a return of 150 tons of sulphate of ammonia per annum on 250 tons salt-cake per week, and the figures showed that in some cases he had obtained ammonia at the rate of 400 tons of sulphate per annum (Mr. Hawliczek: "Yes"); so that 150 tons appeared to be quite a moderate estimate. If the result were to reach this 400, the gross credit would be more than twice 2s. 5d., which seemed very satisfactory. Could Mr. Hawliczek give them any idea of the total cost involved in the process, including repairs? He supposed that the apparatus was not of an expensive character. He would also like to know the kind of pyrometer employed in estimating the temperature.

Mr. W. P. THOMPSON said that he took it for granted that the revolver was heated to such an extent as would dissociate the ammonia in it, and prevent its actual formation within the revolver, and that therefore it was only when the nitrogen of the slack became converted direct into cyanogen-compounds that it was saved at all. Now, under those circumstances, would not there be a very great increase in the amount of cyanogen if they could thoroughly mix the slack and the chemicals before they started by grinding them both together? Of course it would interfere with the working of the revolvers somewhat, but as an actual fact, had Mr. Hawliczek found the finer the slack, and the better the mixing at start, the larger the amount of ammonia he got eventually? He should have thought that that would be the case, because if the slack burned before it became intimately mixed with the alkali, ammoniacal-compounds would be formed, and be dissociated before they were converted into cyanogen-compounds.

Dr. S. HAMBURGER said, he saw among the analyses of slack, Nos. 7, 8, 9, 10, and 11, that the slack contained about 1.93 per cent. of nitrogen calculated as ammonia. He thought these figures rather high for ordinary mixing slack, and should be glad to hear whether the slack was of a special kind. It also struck him that if nitrogenous refuse organic matter be added to the mixing in the revolver, the yield of ammonia might be increased very largely. For instance, nitrogenous matter, such as was used for manufacturing ferrocyanides, might be found suitable. He should like to hear, whether Mr. Hawliczek had made experiments in that direction. The lecturer had also been kind enough to give them the time required for treating the black-ash with steam. He should like to know something about the amount of steam required. Mr. Hawliczek said the liquor contained 11 per cent. of ammonia. How many cubic feet of such ammoniacal liquor were obtained per ton of black-ash treated? (Mr. Hawliczek: "I did not go into that calculation.") If he could give them that information in any other form, it would be just as acceptable.

Mr. W. NORRIS JONES said that Mr. Hawliczek had suggested that in the finishing off of the black-ash, a final amount of fuel should be added to increase the cyanide. Would that not have the effect of increasing the sulphides materially; as when they over-fired black ash, they certainly increased the sulphides? In the analysis of black-ash, the tables gave .30 and upwards of sulphide on 25 of alkali, or about 1.4 per 100 of alkali. To him this seemed rather high, and when worked down would give a bad ash; or the ash would require to be highly fired in order to destroy the sulphides. Sulphides would also be a great trouble in making soap's ash. The temperature in the decomposers was as high as 1,000° F. Was that due to the chemical reaction that went on in the decomposers, and would that have any action on the sulphides present?

Dr. HURTER said he should like to ask Mr. Hawliczek in the first instance as regards Table 2, in which the best result was on January 28th, 79.8 of the ammonia calculated in the black-ash being decomposed, and 77.5 being actually obtained. (Mr. Hawliczek: "That is a mistake in print. Instead of .5 remaining, it should be .2 remaining.") That result was the best in so far that the amount recovered most closely approximated to that decomposed. Now if they compared in the other column of temperatures 1,025 and 372, they saw nothing to account for this best result. The temperature certainly did not seem to account for it, and he should like to ask Mr. Hawliczek whether he could point out any other condition that was more favourable in that particular experiment than in the others in which very often only half of the cyanide decomposed was obtained as ammonia, and in which the temperatures to all appearances were the same, at any rate not very far different.

As regards Table 3, Mr. Hawliczek said that when nitrogen was 1.16 per cent., the amount of sulphate recovered varied from about 39 per cent. to 50 per cent. With an increase of the nitrogen in the mixing fuel, the percentage became 20 to 35 per cent.; but when the nitrogen came to .6, the result jumped up to 92 per cent. This appeared to be an indication that the quantity of nitrogen in the mixing fuel, and the amount of ammonia obtained, had nothing whatever to do with each other. It looked as if there was a tolerably constant quantity

of cyanogen formed independently of the composition of the mixing fuel, and he would like to ask if Mr. Hawliczek had any explanation to give of this peculiarity of that set of figures.

As regards the temperature of decomposition when they treated the cyanide in solution—cyanide of sodium for instance, or even ferrocyanide of sodium under pressure—in his own researches he found he could not decompose them at 350° F., but at 380° he found that they split up without any assistance whatever into formates and ammonia. He did not want to say one word against the equation given by Mr. Hawliczek, which he had no doubt was correct, but he was only wondering whether it was absolutely necessary to have those high temperatures to decompose the cyanides. It appeared to him a peculiar fact that they required a higher temperature than when in solution. The amount of cyanides in the black-ash would seriously affect the prospects of the process. Now he had never been accustomed to calculate the amount of nitrogen contained in black-ash in the form of ammonia, and therefore those figures he could not readily compare with those they had at their own works; but at their own works they seldom got more in the vat-liquors at any rate than 3 of ferrocyanide on 100 Na₂O in the solution, and if he came to calculate the results of the process on that basis he should not be able to find that there would be 2s. 6d. to be gained. It would be a very much smaller amount, and he did not understand the great discrepancy, for he should come to about between 3d. and 6d. as against 2s. 6d., and there was a great discrepancy in that, and it meant that either their two tests did not agree, as Mr. Hawliczek had done him the honour of saying they did, or their own black-ash contained less cyanides than that of Messrs. Gossage and Mathieson; for from their own tests he could only arrive at the value mentioned.

Mr. HAWLICZEK said, replying to Dr. J. Campbell Brown, the process was carried out entirely by the use of waste heat in the decomposer. The steam was superheated in a similar way. The quantity of steam to complete the reaction as well as the necessary excess was so very small that it was scarcely a matter for serious consideration.

With regard to Mr. Parnell's questions, the size of the black-ash to be treated depended mainly on the physical condition of the black-ash. In order to vary the sizes of black-ash according to its density the roller breakers were made readily adjustable to suit the purpose. The sample of treated black-ash before them was entirely free from any cyanogen-compound, but it did not represent the size of the lumps of black-ash necessary for the treatment, as it had been broken up in order to get it into the bottle. In many instances he had treated lumps of black-ash of about 8 or 10 in. and more in diameter which had been found after treatment entirely free from cyanogen.

Referring to the second question about the incidental loss of ammonia during cooling of the black-ash in the bogies, he had made extensive researches in that direction which, however, had led him to the result that the black-ash in a hot state exposed to the action of the air is not at all materially changed, the only reaction which might take place was that cyanate might be formed which eventually would also be obtained as ammonia. The smell of ammonia arising from black-ash balls which Mr. Parnell occasionally noticed was no doubt due to the damp atmosphere, which acted on the cyanides on the surface of the ball, but did not

penetrate to the inner parts, thus amounting only to a very trifling loss of ammonia.

The working of the revolver at a comparatively lower temperature for the purpose of increasing the cyanides in the black-ash did not materially increase the time of working, say about 15 or 20 minutes, over the ordinary time of a charge.

In reply to Mr. E. Carey, he was not in a position to give the exact figure with regard to the cost of repairs involved in the process; but considering the simple apparatus, when sufficient care was taken not to damage the decomposers by overheating, the wear and tear on the apparatus could only be very slight. With regard to the extra labour, he stated before that only two men were required for attending to the treatment. The stripping, breaking, and discharging of the balls was done by the ordinary staff of revolver-men and vat-setters. The pyrometer used for estimating the temperature in the decomposer was quite of an ordinary type as sold by Casartelli in Manchester.

Referring to Mr. W. P. Thompson's question, he said that the revolver experiments in Table No. 3 had not been completed, as, with the exception of experiment No. XIV., they had only been carried out in one direction by varying the mixings of the charges, using mixing fuel of ordinary size, otherwise the condition of working the revolver as regard to heat had been in the usual way. He could not say if the grinding of the raw materials would increase the cyanides in the black-ash, but in all probability would not be of great advantage, and would involve an extra expense in working.

In reply to Dr. S. Hamburger, the mixing slack used in the experiments, Table No. 3, charge Nos. VII. to XI., containing 1.927 per cent. of ammonia, represented by no means a special kind of slack, the price being the ordinary one. He could also give, if desired, the analysis of various kinds of mixing fuel obtained from the Lancashire district containing from 1.17 to 1.9 per cent. of ammonia. The slack used was known as "Queen's Slack." The use of animal substances, such as horn, waste leather, &c. containing a high percentage of nitrogen, to be added to the charge in the revolver, would no doubt increase the cyanides in the black-ash if the price of such materials would allow their use. With regard to the amount of steam used for the treatment of black-ash, he stated before that the quantity of steam used was very slight. He had no notes at hand to give the number of cubic feet of ammoniacal liquor obtained per ton of black-ash treated, but he should say a simple calculation based on above facts would give the amount of liquor which may be obtained.

In reply to Mr. W. N. Jones, the "after-charges" of mixing slack had been used for the purpose of increasing the cyanides in the black-ash; the few experiments made in that direction proved to be very satisfactory, and regularly yielded from 70 to 85 per cent. of the nitrogen in the mixing fuel, as cyanide in the black-ash. The black-ash itself was of ordinary condition as regards alkali and sulphide. The high temperatures prevailing in the decomposers in the experiments of Table No. 2 were caused by charging the vessel with black-ash which had not been sufficiently cool, and consequently caused the irregular results as regards the yield of ammonia; these high temperatures were not due to any chemical reaction. Referring to the action on the sulphide, the analysis of the treated black-ash of Table No. 2 exemplified sufficiently that a temperature of 1,000° F., and even more in presence

of steam, was by no means injurious to the chemical composition of the black-ash.

In reply to Dr. Hurter, who wished to know how the best results in Table No. 2, experiment July 28th, as regard to the ammonia decomposed, 79·3 per cent. and ammonia recovered being 77·5 per cent., had been obtained, considering that the temperature of treatment stated in the other column was 1,025° F., a heat which, as he (Mr. Hawliczek) had stated, would result in the destruction of the ammonia, he might say that the experiments represented in Table No. 2 had not been carried out under his direct control, but in all probability this good result might be explained by assuming that a large excess of steam had been used in this experiment, so that the rapid current of steam had prevented the overheating of the gases, and consequently the destruction of the ammonia; in fact, the whole experiments in this table presented irregularities as regards the decomposition of the cyanides and the yield of ammonia, which beyond doubt had been caused by the irregularity in the steam used. Referring to the results in Table No. 3 respecting the increase of cyanogen-compounds in the black-ash, he had pointed out most distinctly that these experiments had not been completed and needed further investigations. The experiments numbered I. to XIII. had been made only in one direction, and this in regard to variation of the revolver-mixing. From these results he drew the conclusion that varying the mixings did not increase the cyanides in the black-ash, but that did not mean that a mixing fuel high in nitrogen was immaterial for the increase of cyanides in the black-ash, provided that the conditions of working the revolver, which had not yet finally been ascertained, were favourable for their formation. Experiment No. XIV. was the only one where the favourable conditions had more closely been obtained. This charge had been under-fired, *i.e.*, worked at a lower temperature, and he strongly believed that the success of obtaining 92 per cent. of the original nitrogen in the mixing fuel as cyanide in the black-ash had to be attributed to this fact. As regards temperature of treatment with steam, he had proved by many experiments that a ferrocyanide of an alkali or alkaline earth was decomposed by steam at a temperature not much below about 400° C. into ammonia and the corresponding carbonate. This temperature, at the very least, was necessary for the formation of ammonia from cyanides. He had no practical experience of the condition and temperature necessary for the destruction of the ferrocyanide in a liquid state or in an alkaline solution. However, it appeared that the ferrocyanides in solid condition require a much higher temperature for their decomposition than when in solution, but he could not see how this seriously affected the prospect of the process.

Finally Dr. Hurter gave a comparative calculation of the results obtained in their experiments which would represent a saving of about 2s. 5d. per ton of salt-cake decomposed as against a calculation from Dr. Hurter's own results from the amount of ferrocyanide in the vat-liquor resulting in a saving of about 3d. or 5d. per ton of salt-cake. In this calculation he (Dr. Hurter) had overlooked that the quantity of sulphocyanide and cyanate had also to be accounted for, as these compounds represented a certain extra yield of ammonia, and besides this the revolver at Messrs. Gaskell, Deacon, and Co.'s establishment no doubt was worked in a way to prevent as much as possible the formation of cyanides in the black-ash,

otherwise the percentage of ferrocyanide in the vat-liquor could not be as low as 0·3 per cent. on 100 Na₂O as stated. The lowest result in that respect which he could find in many daily assays of vat-liquor was about 0·63 per cent., which would mean, if calculated as ammonia in black-ash, not considering the other cyanogen-compounds, a turn-out of sulphate of ammonia per annum amounting to about 60 tons or 1s. per ton of salt-cake. However, no comparison in respect to the vat-liquor and the ammonia as represented in Table No. 3 of their experiments could be made, and, as stated in the table, the ammonia had actually been weighed.

Manchester Section.

Chairman: Edw. Schunck.

Vice-Chairman: G. H. Bailey.

Committee:

J. Ansell.
C. A. Burzhardt.
R. F. Carpenter.
H. Grimshaw.
J. Grossmann.
P. Hart.

I. Levinstein.
Sir H. E. Roscoe, M.P.
C. Truby.
D. Watson.
T. Wardle.
P. Winsor.

Hon. Local Secretary:

J. Carter-Bell, Bankfield, The Cliff, Huzher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held 7th March 1889.

DR. BAILEY IN THE CHAIR.

ESTIMATION AND OCCURRENCE OF SULPHUR IN COAL.

BY G. H. BAILEY, D.SC., PH.D.

IN many branches of industry it is of considerable importance to employ a coal containing as little sulphur as possible, and several instances have come under my notice in which difficulties were being encountered, and mischief done to manufactured products, arising mainly from the sulphur contained in the coal.

The evaporation of caustic or alkaline liquors in contact with flue gases, certain metallurgical operations, the manufacture of the finer qualities of pottery and terra cotta, &c., are cases in point, and others will readily suggest themselves to those engaged in the chemical industries.

Then, again, in steam raising, a large proportion of the defects in boilers arise from external corrosion, and the most rapid and dangerous cases of this arise directly or indirectly from the sulphuric acid formed during the process of combustion of a coal containing a high percentage of sulphur. It is quite common for a ton of Lancashire coal to contain half a hundred-weight of sulphur, and yet, I suppose, there are few coal users who would care to introduce, wittingly,

half a hundredweight of sulphur under their boilers for every ton of coal consumed, or who think it immaterial whether they burn this or one-third of the amount.

To gas companies it is of interest to know accurately the amount of sulphur and the forms in which it occurs in coal, for it is not only desirable that the coal, other things being equal, should be preferred which will yield a coal gas containing the smallest amount of sulphur, but will also have the sulphur combined in that form in which it can be most readily removed from the gas. And now that producer gas and gaseous fuel of all kinds are largely in demand, it is not to be overlooked that here also sulphur may occur in such quantities as to exert an influence on some of the processes to which they are applied.

Furthermore, the returns which are usually given by coal vendors as to the amount of sulphur in the coal are usually of little value, and mostly illusory, and any published analyses which are accessible afford little more than a very general guide on this point. I have had occasion, in conjunction with my brother, Dr. T. L. Bailey, of University College, Liverpool, for some time past to investigate this subject, and it seemed to me that the results were of sufficient general interest to bring before the notice of this Society. The general course of the work consisted of:—

- (a.) An examination of the various methods in use for determining sulphur in coal.
- (b.) The comparison of the results arrived at by recognised analytical methods, with a series of experiments carried out on the large scale in actual practice.

Methods of determining Sulphur in Coal.

By means of a large number of analyses carried out upon carefully sampled coals, I have made a comparative examination of all the methods of analysis of importance. All the processes commercially applied to the determination of sulphur depend upon the oxidation of the sulphur to sulphuric acid and the estimation of the sulphuric acid as sulphate of baryta, and I do not therefore propose to criticise the various methods in detail, but to state the conclusions which I have arrived at with reference to the conditions under which the oxidation may be most effectively carried out, and the amount of sulphur correctly estimated.

Oxidation by Chlorate or Nitre.

Results invariably too low, unless indeed the oxidation is allowed to proceed very slowly indeed, and even then different samples require to be differently dealt with.

A very serious objection to this method of oxidation as a commercial method is, however, that the results obtained by two analysts are never comparable. So much depends on attention to minutiae, and on niceties of manipulation. Recently Blum (*Zeits. f. Analyt. Chem.* 1888, 415), after an examination of various methods, has advised the use of the following, due, I believe, to Crossley:—1 gm. of the sample is mixed with 16 grms. of sodium chloride, 8 grms. of potassium nitrate, and 4 grms. of sodium carbonate, all perfectly dry. Apart from the risk that pertains to the use of such large amounts of bodies whose freedom from sulphates must be very carefully tested (even 0.01 per cent. of sulphur in the reagents would give an error amounting to 20 per

cent. in the determination of sulphur in an ordinary coal), there is the interference of the presence of large quantities of alkaline salts in the precipitation of barium sulphate, which, under such circumstances, is not only retarded but even incomplete.

The complete precipitation of a tenth of a gm. of barium sulphate from a solution containing 30 grms. of alkaline salts is a very slow process, and is in no case accurate.

The oxidising action of nitre or potassium chlorate is indeed rendered sufficiently gradual by a large admixture of alkaline salts, but only at the sacrifice of accuracy.

Oxidation by Wet Methods.

Crace Calvert's method may be taken as typical of these. He recognised that sulphur existed in two forms in coal, as sulphates, which he proposed to extract by digesting the finely-powdered coal with a strong solution of sodium carbonate, and as sulphur in other forms which he oxidised by means of aqua regia and then estimated separately, his idea being that only the latter portion would appear in the chimney gases. Oxidation by means of aqua regia I have found unpleasant to work, and invariably yielded low results. In other respects Crace Calvert's method will be referred to later on.

Oxidation by Magnesia.

This method, due to Eschka, gave, under all circumstances, constant and trustworthy results, and it labours under none of the disadvantages of other methods. The only reagents required are magnesia, sodium carbonate, and bromine water, and there is no difficulty in obtaining these in a state of purity. Magnesia can indeed be prepared free from sulphate by igniting magnesite, if it cannot be procured. Bromine often contains sulphuric acid, but can be readily purified by washing or re-distillation.

An intimate mixture is made, consisting of two parts, by weight, of magnesia and one part of sodium carbonate. Two grms. of this mixture are stirred in with 1 gm. of the finely-powdered coal or coke, &c. in a platinum crucible. This is then very gently heated over a Bunsen burner, placed, at first, about an inch away from the flame, and the roasting continued at a gradually increasing temperature, but never so as to bring the bottom of the crucible beyond just visible redness.

This operation usually takes about two hours, and it is finished when the whole mass has become quite white or light grey, with no appearance of black specks of undecomposed coal. It is now exhausted with water, and oxidised by means of bromine water by simply warming, it being quite unnecessary to evaporate down to dryness. The sulphur is now wholly present in the form of sulphate, and the solution may be acidulated with hydrochloric acid and precipitated by means of barium chloride, the sulphuric acid being estimated as barium sulphate in the usual way.

If Crace Calvert's method for estimating sulphur in both forms be modified by the substitution of this method of treatment for the oxidation by aqua regia, the results obtained are more reliable and the process is not rendered more complex.

A selection of the results of the analyses is appended to show the character of the error which is likely to arise by the different methods spoken of.

(1.) Samples of coke residues from destructive distillation of oil :—

	By Magnesia Method.		
	A.	B.	C.
	Per Cent. of Sulphur.	Per Cent. of Sulphur.	Per Cent. of Sulphur.
1st determination.....	0.59	0.60	0.84
2nd determination.....	0.54	0.61	0.79
Mean.....	0.565	0.605	0.815

These samples done by another analyst gave by the chlorate method results falling below 0.25 per cent.

(2.) A sample of coal on which three separate determinations were made by the magnesia method gave as results :—

	Per Cent. of Sulphur.
1st determination.....	3.06
2nd determination.....	3.09
3rd determination.....	3.03

and in no case need the divergence between different analyses by this method be greater than is indicated here.

(3.) Comparison of results by different methods :—

	1st Determination.	2nd Determination.	Mean.
Magnesia method.....	2.73	2.71	2.72
Grace Calvert's.....	2.47	1.95	2.21
Concentrated HCl and KClO_3 ...	2.14	..	2.14
Nitre method.....	2.04	..	2.04
Modification of Grace Calvert's..	2.69	2.66	2.675

(4.) Comparison of results for sulphur in both forms by Grace Calvert's method :—

	S extracted by Na_2CO_3 .			Residual Sulphur.		
	(1.)	(2.)	Mean	(1.)	(2.)	Mean.
Grace Calvert's method	0.14	0.12	0.13	2.34	1.83	2.08
Modification of this....	0.11	0.19	0.15	2.58	2.47	2.51
Total sulphur by } MnO method ... }	2.72					

(5.) In a sample in which three separate determinations were made by the modification of Grace Calvert's method :—

	S extracted by Na_2CO_3 .			Residual Sulphur.		
	(1.)	(2.)	(3.)	(1.)	(2.)	(3.)
(1.).....	0.22	0.28	0.22	3.88	3.70	3.86
(2.).....	0.22	0.28	0.22	3.88	3.70	3.86
(3.).....	0.22	0.28	0.22	3.88	3.70	3.86
Mean.....	0.22	0.28	0.22	3.88	3.70	3.86

On examining these numbers, it is seen that, notwithstanding that the experiments were done with due attention to every precaution, relatively large variations are shown between one determination and another, but that Eschka's process is quite reliable and constant and shows all the characters that are to be desired in a commercial analysis.

Comparison of the Data arrived at by Analysis on the Sample with the Results obtained by Actual Consumption of the Coal under Boilers.

The experiments which were done under this head were carried out for me by Messrs. Bryan Donkin and Co., of Bermondsey, whose works are furnished with arrangements for the examination of chimney gases. The idea with which I set out was to learn what portion of the sulphur appeared in the chimney gases and what part remained in the ash, and whether these numbers were actually such as are arrived at by the Grace Calvert method. As it was desirable that an average sample of the chimney gases should be obtained, the aspiration was continued for several hours, that is practically during the whole period of the firing. It might be objected, however, that since no special precautions were taken (beyond following the usual rule in the collection of chimney gases, a manifestly insufficient precaution) that the gases aspirated from the chimney should be representative of the whole gases passing up the chimney, the amount of sulphur could not be correctly deduced from the measurements made.

And this objection is quite valid since the composition of the gases at different points in the cross section of the chimney varies considerably. The variations referred to, however, only occur in the distribution of air and products of combustion, respectively (arising from down draughts, &c.), and the relative amount of carbon to sulphur as indicated by the carbon dioxide and sulphur dioxide in the gases, would not be affected to any appreciable extent by such irregularities of distribution.

For the purpose in question only the relative amount of carbon to sulphur in the chimney gases was required, this being then considered alongside the relative amount of carbon to sulphur in the coal.

The chimney gases were aspirated from the flues (the chimney will not do) through drying tubes, and then through two or three sets of potash bulbs.

The CO_2 and the SO_2 were in this way absorbed, and the increase in weight of the potash bulbs (and the CaCl_2 tube attached to them) gave the amount of these gases in the known volume of chimney gas aspirated.

The factors which were available for estimating and checking the estimation of the carbon and sulphur in the chimney gases were therefore :—

- The total increase in weight of the potash bulbs, representing $\text{CO}_2 + \text{SO}_2$.
- The relation of CO_2 to SO_2 obtained by weighing the BaCO_3 and BaSO_4 precipitated together, and then dissolving out the BaCO_3 and determining the residual BaSO_4 .
- The analysis of samples of the chimney gas drawn from time to time.

If the whole of the sulphur made its appearance in the chimney gases, it is manifest that the relation C:S in the chimney gas should be the same as C:S in the coal, as determined by analysis,

Separate estimations were made of the amount of carbonic oxide, but this was seldom present, as excess of air was always used during the combustion.

Appended are the results from the comparison in this way of three fuels of very diverse character:—

	By Analysis.	On Combustion in Boiler.
<i>Coke Breeze.</i>		
Sulphur washed out by sodium carbonate.....	0.27	..
Residual sulphur	3.81	..
Ash (and clinker).....	19.13	19.6
Sulphur in clinker and ash.....	..	1.1
Relation of C : S in coke breeze....	100 : 6.45	100 : 3.55
<i>Newcastle Coal.</i>		
Sulphur	1.85	..
Ash (and clinker).....	1.82	5.1
Sulphur in ash and clinker.....	..	1.0
Relation of C : S in the coal	100 : 2.2	100 : 1.156
<i>Welsh Coal.</i>		
Sulphur	1.13	..
Ash (and clinker).....	4.80	5.8
Sulphur in ash and clinker.....	..	0.61
Relation of C : S in the coal	100 : 1.35	100 : 0.719

From these numbers it is not difficult to arrive at very definite information as to the distribution of the sulphur after combustion, and a summary of this is added, the numbers indicating percentages of the whole sulphur present in the coal:—

	Coke Breeze.	Welsh Coal.	Newcastle Coal.
Sulphur in clinkers and ash.....	5.4	4.4	4.8
„ chimney gases	55.0	53.2	52.9
Unaccounted for.....	39.6	42.4	42.3

These numbers are calculated from the total sulphur in the coal, and the conclusion is irresistible that the usual assumption to the effect that that existing in the form of sulphates takes no part in the production of the sulphur dioxide in the flues.

A number of determinations made by mixing sulphates with the coals burnt on a small scale supported this.

The sulphates of course remain in the ash and clinker. There is still, therefore, about 40 per cent. of the sulphur to be accounted for, and this must have remained either in the flues or on the boiler

plates or other accessories. It is known that where the circumstances are favourable external corrosion in boiler plates is a most fruitful source of injury, and that a large proportion of the boiler explosions are due directly or indirectly to this external corrosion. But if the amount of sulphuric acid that is being constantly formed is such as is here indicated, the sulphur in coal is indeed a factor that cannot be disregarded in boiler heating.

I may mention, however, that there is a large quantity of this retained by the flue dust, and in samples of flue dust which have been examined as much as 15 to 20 per cent. of sulphur has been found. During the course of the experiments other observations were recorded by Messrs. Bryan Donkin and Co., and as these may prove interesting in themselves, I append the complete statement of the results observed by them.

Results of experiments on a Lancashire boiler with various fuels, 1888. At Messrs. Bryan Donkin and Co.'s works, London:—

		No. of Experiment.			
		1st.	2nd.	3rd.	4th.
Kind of fuel		Coke dust.	Welsh coal dust.	Newcastle coal.	Large coke from Newcastle.
Date.....	1888	Sept. 6	Sept. 20	Oct. 12	Oct. 13
Duration of experiment ...	Hours	6	6	7.1	5.75
Steam pressure.....	Lb.	45.0	52.5	51.1	49.0
Fuel:					
Fuel burned during experiment ..	"	1,211	941	1,095	955
" " per hour ..	"	202	157	154	159
" " per sq. ft. of grate. ..	"	13.4	10.5	10.3	10.6
Moisture in fuel....	Per Cent.	5.97	4.28	3.54	5.5
Ashes and clinkers ..	"	19.60	5.8	5.1	11.9
Water:					
Temperature of feed water		21° C.	20° C.	14.5° C.	15.5° C.
Water evaporated from temperature of feed ..	Lb.	6,597	6,470	8,321	6,542
Water evaporated per hour.....	"	1,083	1,078	1,172	1,060
Water evaporated per hour per sq. ft. heating surface ..	"	1.87	1.86	2.02	1.88
Water evaporated per lb. of coal from temp. of feed ..	"	5.4	6.85	7.6	6.85
Water evaporated per lb. of coal from and at 100° C.		6.3	8.07	8.77	8.08
Air and gases:					
Temperature of air entering grates, ° F.....		267.5° C.	26° C.	23° C.	22° C.
Pressure of blast under grates....	In. Water	0.5	0.4	0.1	0.2
Pull of chimney....	"	0.4	0.4	0.44	0.4
Temperature of issuing gases..		296° C.	276° C.	232° C.	248° C.
Composition of furnace gases by volume ...					
CO.....		5.7	5.4	5.65	5.4
CO.....		0.0	0.0	0.39	0.0
O.....		16.7	13.8	13.85	13.9
N.....		78.6	80.8	80.8	80.7

During the course of the work several of the samples of coal were subjected to dry distillation, and in some cases very little sulphur came over in the earlier stages of the distillation, whilst with others there was a good deal evolved during the earlier period. Moreover the percentage of sulphur remaining in the coke varied considerably with different coals. Two samples will illustrate what is meant, and these are selected because they were coals of a very similar character in regard to ash, yield of coke, and relation of sulphur as sulphates to sulphur in other forms. The numbers are percentages.

	A.	B.
Sulphur in coal	1.83	1.10
" coke	1.50	1.16
Ash	1.83	3.88
Coke	71.50	68.79

The ash of "A" contained much oxide of iron.

" "B" " very little "

In sample "A" 58 per cent. of the total sulphur in the coal remained in the coke, whereas in "B" nearly 73 per cent. remained in the coke. This, it seems to me, opens out a question of considerable importance in the manufacture of coal gas. Here are two coals, one of which gives off 42 per cent. of the sulphur it contains with the coal gas and volatile products, whilst the other only gives off 27 per cent. in this way.

This question is worthy of a complete investigation, attention being devoted not only to the relative quantities of sulphur in the volatile products of distillation and in the residual coke respectively, but to the form in which the sulphur compounds make their appearance in the gas, whether as the readily removable sulphuretted hydrogen or in other forms which are incompletely removed by the usual methods of purification.

I cannot conclude this paper without drawing attention to a further issue of importance on which some information has been derived in the course of this work. It is known that the calorific power of coal as calculated or determined on the small scale does not agree with trials made on the large scale. There is a deficiency in the latter case of from 5 to 10 per cent. according to the conditions of combustion and the kind of coal used. From observations which I have made, it has appeared that where the excess of air is not greater than a certain minimum quantity, hydrocarbons appear amongst the products of combustion, and that in any case where the firing is irregular there will be phases of the combustion during which they appear.

This is well known. But, as far as I am aware, it has usually been assumed that if a sufficiently large excess of air is present, no hydrocarbons will result. I find, however, that if the excess of air at any period during the combustion becomes large, there is also a tendency for hydrocarbons to pass off unconsumed, and this is especially the case with irregular firing. Now, a quantity of hydrocarbons which could be detected or determined only with very great difficulty under the ordinary methods of gas analysis, would

affect the results of a calorimetric comparison very seriously.

Suppose, for instance, to take an extreme case that 5 per cent. of the total carbon is transformed into, say, ethylene, and escapes combustion, passing off with the chimney gas, and that the amount of air supplied to the furnace is just treble that theoretically necessary, then we should have for every volume of the hydrocarbon over 600 volumes of oxygen and nitrogen, and 60 volumes of carbon dioxide. Even supposing the oxygen and carbon dioxide removed, we have a residue consisting of some CO, 1 volume of hydrocarbon, and about 550 volumes of nitrogen.

The greatest obstacle in the way of making a correct determination of hydrocarbons under such circumstances, is that of ensuring their combustion when mixed with such a large volume of diluent and inert gas by any endiometric method. I have suggested to Messrs. Bryan Donkin and Co. that they might pass the chimney gases through a tube containing cotton-wool, and then through absorbents for the removal of moisture—carbon monoxide, carbon dioxide, sulphur dioxide—finally passing the gas slowly through a combustion tube containing oxide of copper, and then again through calcium chloride and through potash to determine the water (and hence the hydrogen) and the carbon dioxide (and hence the carbon) in any residual hydrocarbons left in the chimney gases. Such an experiment would, of course, be continued some time.

I have not yet heard the results of any experiments which they may have been able to make in this direction, which in any case will occupy considerable time.

DISCUSSION.

Mr. P. HART thought it just possible that a portion of the sulphur compounds passed away in combination with the ammonia or hydrocarbons, as in the case of ordinary gas manufacture. One method which occurred to his mind of estimating the amount of sulphur in coal, was that suggested by Mr. Davis, where he estimates the sulphur in spent oxide by combustion in a gas furnace, absorbing the SO₂ formed in hydrogen peroxide.

Mr. WATSON SMITH said a French chemist (M. Brullé) had just devised a method of determining sulphur in which he used a combustion tube. He had tried Eschka's method, as described in the 1884 edition of Fresenius' work, and confirmed all that Dr. Bailey had said about it; on the whole it was a very accurate method. M. Brullé seemed to take exception to the ordinary methods, especially that of combustion in a crucible, owing to the fact that in this process the combustion was rather too hasty and sulphurous acid was formed. The sulphites were decomposed before they had time to be converted into sulphates. A little accumulation or inequality of mixture, as in the case of a liquid mixture, might readily account for the effect to which he referred. M. Brullé proceeded to give an improved method of his own, in which he proposed to use a long narrow boat of platinum foil, covered with a sliding lid, which had the advantage of holding the whole of the mixture in a thin layer. A little chlorate of potash and nitre was strewn on the top of the mixture and the boat was then introduced into a combustion tube closed at one end. Some of the mixed salts were

placed between the cover and the boat itself; heat was then applied to the combustion tube, and the mixture was carried over from front to back. It was then precipitated, and this gave satisfactory results.

Mr. J. E. HOLGATE said he had used the lime process, as described by Dr. Bailey, regularly for the last eight or nine years for the estimation of sulphur in coke for blast furnace use, and had found it very satisfactory, both as regards the accuracy of the results and the amount of time, care, and attention necessary to obtain results that were trustworthy. The method of working that he adopted was as follows:—He took 1 grm. of the coke, or 2 grms. if the amount of sulphur were expected to be very low, and mixed it with 1 to $1\frac{1}{2}$ times its weight of pure lime. The mixture was placed in a platinum or porcelain dish and made into a paste with water. The spatula used for this purpose was wiped with a scrap of filter paper, which was then added to the dish. It was then dried at a moderate heat and ignited in a muffle at a good red heat until all the carbon was burnt off, which usually took from half an hour to one hour. Spreading it out in a thin layer shortened the time required for ignition. After cooling, it was transferred to a beaker and dissolved in dilute hydrochloric acid, the dish being cleaned out with a little of the acid. The solution was heated to boiling and filtered. Most of the free acid was neutralised with ammonia, and the sulphuric acid precipitated with barium chloride in the usual way. If the presence of sulphites after ignition was feared, a little bromine water might be added previous to or along with the dilute acid, or if it was feared that some of the sulphur might escape absorption by the lime, a little lime might be sprinkled on the mass previous to ignition.

Dr. BAILEY, in reply, said with regard to Mr. Hart's remark as to the possibility of a portion of the sulphur compounds passing away in combination with the ammonia, he thought they must certainly be left behind in the potash. If the sulphur compensated before the point of aspiration was reached, then, of course, that would be one way of accounting for the loss of sulphur. It was worthy of remark that the lime method practically gave the same results as magnesia, namely, about one-third higher than other methods, and it was also very similar. The magnesia presented, however, manifest advantages over the lime. Being a light bulky powder, the oxidation of the coal proceeded at a much lower temperature than in the case of lime, and any magnesium sulphate that resulted was readily dissolved out without the addition of acid, and hence without any risk of loss due to the decomposition of sulphites. The insolubility of the calcium sulphate was, he considered, a serious disadvantage. Apart from these objections he had found the lime process a good one, but it showed no advantages over the magnesia method to compensate for the disadvantages. He had not, as already pointed out in the paper, detailed more than a small portion of the experiments that had been made or the methods that had been examined.

With regard to the precipitation by means of barium chloride, this, in presence of 20 to 30 grms. of alkalis was incomplete, even if allowed to stand several hours, and the volumetric method which had been referred to was, therefore, open to decided objection. He might mention that he had tried to oxidise the sulphur directly by means of barium

chlorate, which could now readily be obtained in a sufficient state of purity, hoping in this way to be able to obtain the sulphuric acid at once in the form of the insoluble barium sulphate. He found, however, that barium chlorate was too violent in its action, and he had not been able to devise any method of diluting it which should be easily managed and yield correct and reliable results.

Meeting held 2nd April 1889.

DR. BAILEY IN THE CHAIR.

NOTES ON DYEWOOD EXTRACTS AND SIMILAR PREPARATIONS.

BY LOUIS SIEBOLD, F.I.C., F.C.S.

DURING the last 10 years there has been an enormous increase in the production of these preparations, and the time will come when their application in dyeing and calico printing will become so general as to completely supersede the employment of the raw materials. The manufacture of these extracts, to be thoroughly successful, requires to be so conducted as to secure the perfect exhaustion of the dyewoods without the slightest destruction or deterioration of the colouring matters contained in them; and though nothing like perfection has been reached in the attainment of these objects, it is certain that the processes of extraction and evaporation now employed by the best makers are a very great improvement on the older methods. Indeed, there is no difficulty nowadays in procuring dyewood extracts of high excellence if the consumer is willing to pay a price for them corresponding to their quality, and knows how to avail himself of the aid of chemical skill to control his purchases. Unfortunately, however, there is so much hankering after cheap articles, and so little care is taken to ascertain their real quality, that every scope is afforded to the malpractices of the adulterator. There are many dye- and print-works in which large quantities of these extracts are used without being subjected to trustworthy tests. Moreover, much of the testing is done by fallacious methods and often by biassed hands. So fallacious, indeed, are some of these tests, that grossly adulterated extracts are often declared superior to the purer ones, the cause of this being the application of an insufficient proportion of mordant in the dyeing or printing trials, and the consequent waste of the excess of colouring matter in the case of the purer preparation. Professional analytical chemists have hitherto given but little attention to these preparations, and the employment of experienced chemists in works is as yet far from general. The testing of dyewood extracts in such a manner as to throw full light on their purity, the quality of raw material from which they are prepared, their exact commercial value, their suitability for special purposes, and the proportion and nature of any adulterants they may contain, is of course a difficult and tedious task, and must be left to the expert who is in possession of authentic specimens prepared by himself of all the different extracts made from every variety and quality of raw materials, and

who combines a thorough knowledge of experimental dyeing and printing with a large experience in the chemical investigation of these preparations. But when the object of the testing is merely careful comparison of the sample in question with an original sample or previous deliveries, the case is much simplified, and comes within the scope of the general chemist or the laboratory attached to works. A few years ago I recommended carefully conducted dyeing trials on woollen cloth mordanted with bichromate of potash as the best and simplest mode adapted to such cases, and my subsequent experience enables me to confirm that observation to the fullest extent. Most of these extracts contain the colouring matter in two states, the developed and the undeveloped, and an oxidising mordant such as bichromate of potash causes the latter as well as the former to enter completely into combination with a metallic base; whereas many of the other mordants, such as alumina or tin compounds, merely take up the developed portion of the colouring matter together with such small and variable proportions of the undeveloped as might undergo oxidation during the process of dyeing. I would therefore suggest dyeing trials with alumina, tin, iron, &c. only as subsidiary tests indicating the suitability of an extract for certain special purposes, while recommending the trial with bichromate of potash as the one giving the best information respecting the actual strength of the extract in relation to the raw material from which it was obtained, and as giving a fair idea of the money value of the sample. Cotton dyeing does not, as a general rule, afford a good means of assaying extracts, as it is generally done under conditions which do not admit of complete exhaustion of the dye-bath, but it might often with advantage be resorted to as an additional trial throwing further light on the degree of oxidation or development of the colouring matter. Printing trials are apt to give fallacious results unless the proportion of mordant is carefully adjusted to the amount of colouring matter present, and several trials with different proportions would be necessary to prevent erroneous conclusions. For the trials with bichromate of potash on wool I would recommend pieces of cloth weighing about 150 grains, and the most suitable proportion of bichromate of potash is 3 per cent. of the weight of the cloth. The requisite number of pieces (equal to the number of samples to be tested) should be thoroughly scoured and then heated in the bichromate solution at or near the boiling point for not less than 1½ hours, after which they should be well washed and then dyed separately in the solutions of equal weights of the extracts at the same temperature and for the same length of time; 15 grains of extract is a suitable quantity for a first trial under these conditions. These trials can then be repeated with different relative proportions of extract in order to ascertain what weight of a sample would give the same depth of colour as 15 grains of the standard example. Many precautions are required both in the mordanting and dyeing processes in order to obtain trustworthy results; and though the trials with bichromate of potash give the most reliable information of any single test, they should be supplemented by the subsidiary tests already alluded to, and also by a chemical examination, in order to obtain a knowledge, not merely of the wood strength, but also of the general nature of the extract. An adulteration with molasses or glucose can be best determined by fermentation in comparison with a pure sample. Mineral adulterants may, of course, be detected by an estimation and analysis of the ash, after making due allowances for variations due

to differences in different kinds of the same dyewoods. The estimation of the individual colouring matters in these extracts by means of a chemical analysis is under all circumstances a task requiring much experience, especially as the colouring principles are associated in different qualities of each class of dyewood with different proportions of other constituents which often give much trouble to the unpractised experimenter. Extracts made from logwood roots are now largely manufactured and often substituted or mixed with the extracts of real logwood, and have in some instances been palmed off as logwood extracts of high quality. The correct determination of such admixtures, like the fixing of anything like the exact commercial value of dyewood extracts, requires nothing less than a complete chemical investigation coupled with numerous dyeing trials in comparison with standard preparations, and should be left to an expert.

The presence in dyewood extracts of colouring matters in various stages of development has hitherto militated against their use in place of the raw materials by many dyers and printers who are still employing inherited and antiquated processes in which the whole of the colouring matter is not rendered available. It is often asserted by these that even the best of extracts fail to give anything like the results attained by the use of well-prepared woods, and that, indeed, their application proves a complete failure. Such, failure, however, is simply due to the want of chemical knowledge on the part of the dyers, for there is no real difficulty in making any good and pure extract serve all the purposes for which the woods were used. It is to be hoped that in this branch of industry, as well as in many others, the employment of chemists will become more general than at present, and not be restricted, as is often the case, to young men without experience and without the trained intellect so essential to success in chemical investigations. High class chemical skill is of course available to the manufacturer, but the man of science who brings matured knowledge and valuable brain work into the business required social as well as pecuniary recognition, and the sooner and more fuller this fact is appreciated the better it will be for the maintenance and progress of our industries.

With regard to the astringent extracts, such as sumac, myrabolan, divi, valonia, quebracho, oak, &c. it is the aim of the manufacturer, whenever such extracts are intended for the purposes of dyeing and printing, to obtain the tannin in a form in which it is best calculated to fix itself upon the fibre. The case is somewhat different when the same extracts are required for tanning. For this purpose it is necessary that the extract shall have considerable permeating power, and that the tannin contained in it shall readily yield leather of the desired texture, colour, and permanency. Extracts specially suited for this purpose are by no means always the most suitable for the dyer and *vice versa*.

A brief description of the processes by which the astringent extracts may be tested with particular reference to their fitness for definite purposes concluded the paper.

A further contribution on this subject was promised.

DISCUSSION.

Mr. WILSON: Mr. Siebold had referred to the action of alumina and tin, but he (Mr. Wilson) knew that most chemists engaged in print-works did not use bichromate of potash—they used alumina

and tin, and just made one single test. Mr. Siebold had pointed out the difference in the colouring matters present, but in a cotton print-works they did not use bichromate of potash. Supposing they tried it on a large scale and obtained a certain result, on a small scale they would get an entirely different result. Every time a fresh extract was tested the procedure would have to be altered in the dye-works.

Mr. WM. THOMSON: Mr. Siebold had pointed out the very complicated nature of these colouring matters and some of the chemical difficulties which had to be met; also that it was necessary to have a chemist of great practical experience in dyeing with these extracts. It seemed to him that the chemist so engaged must be able to prepare them so as to leave them in some degree of oxidation, and in this direction chemistry would have to be resorted to more especially. Mr. Siebold had mentioned that bichromate of potash was used for producing blacks in dyeing wools. He generally understood that bichromate of potash produced blue. Perhaps Mr. Siebold would kindly explain?

Dr. GERLAND thought the members were under a great obligation to Mr. Siebold for having brought this matter forward, and he was specially grateful to him for pointing out the difficulties they had to contend with in estimating the value of these materials. He hoped Mr. Siebold would fulfil his promise and come forward with fuller details on some future occasion. He quite agreed as to the great difficulties to be met with in defining the cause of oxidation. So far they were at a loss how to interrupt oxidation or how to keep it within bounds, and at the present time there was nothing left to them but to take the materials and make the best of them.

Mr. WATSON SMITH wished to know if fractional tests had been applied. If, for instance, a certain number of pieces of wool were weighed and the quantity of extract to be used, measured, would the colours come out uniform, or would they not vary according to the difference in fibre or the difference in the constituents of the solution?

Mr. SIEBOLD, in reply, said: With regard to the question as to whether experimental dyeing with bichromate of potash should be employed as a test even in works where all the dyeing was done with other mordants, he was decidedly of opinion that it should always be resorted to as one of the tests, inasmuch as it was the only simple and expeditious method giving a fair idea of the actual wool strength and money value of the extract. The test should, in such cases, be supplemented by dyeing trials with the mordants used at the works, and, if necessary, also by a chemical analysis. Printing trials were not necessarily bad tests since oxidising was usually added in these where it was necessary, and any undeveloped colouring matter would thus be oxidised during the steaming process; but, as he had stated before, it was essentially necessary in such cases to have a fair idea of the amount of actual colouring matter in the extract and to adjust the proportion of mordant accordingly. Such trials should therefore be preceded by carefully conducted dyeing trials with bichromate of potash. Mr. Thomson had raised the question whether it would not be well for the manufacturer to prepare these extracts in such a manner that they would contain all the colouring matter in one condition only, in order to ensure greater uniformity in their quality and mode of

application. This would, no doubt, be a desirable step to take if the owners of dye- and print-works were more in the habit of availing themselves of the service of competent chemists experienced in this branch, for then they would be able to make any extract do its full work irrespective of the state of development of the colouring matter. Such, however, was not the case, and it was a very common thing for the consumer of dyewood extracts to require the manufacturer to prepare them specially for him so as to suit his own dyeing recipes, or in other words to give exactly the same shades weight for weight by his own method of dyeing as the article he was in the habit of using. The manufacturer was thus often compelled to make many different qualities of the same extract to suit different customers. For the same reason adulterated articles were often preferred to the pure ones. There was, perhaps, no branch of industry in which chemical skill of a high order could be applied with greater advantage than in dyeing, and nowhere was this fact less recognised. Some of the processes of dyeing were exceedingly wasteful and stood in much need of improvement. He (Mr. Siebold) knew a large works in which a ton of logwood extract was used daily for black dyeing only, and he might safely assert that of this enormous quantity only a very small proportion would be fixed on the fibre, while by far the greater proportion was utterly wasted. Such a waste could only be prevented by a searching investigation of its causes by trained skill. Mr. Thomson had further alluded to the colour obtained with logwood or logwood extract and wool mordanted with bichromate of potash, and seemed to be under the impression that the colour thus obtained was not black but blue. This was undoubtedly the case in dyeing trials performed as tests, as these were conducted purposely with a very small proportion of colouring matter in order to admit of a better comparison of the resulting depth of shades. But with larger proportions of logwood the colour obtained was a fine bluish-black, and with the addition of a small proportion of fustic or quercitron bark to the logwood a jet black was readily produced. With regard to Mr. Watson Smith's observation as to fractional dyeing, he (Mr. Siebold) did not regard this method as a suitable trial for ascertaining the strength of an extract, but he admitted it was occasionally very valuable for detecting an admixture of extracts of other dyewoods, such as quercitron bark extract in logwood extract. It was also a good method of ascertaining the speed of dyeing and hence the relative proportion of fully developed colouring matter of an extract. Mr. Siebold concluded by saying that the subject he had dealt with was a very large one which it was impossible to treat in anything like an exhaustive manner in the course of a single paper. He was much obliged to Dr. Gerland for his kind remarks and to the meeting for the manner in which these remarks had been endorsed.

Glasgow and Scottish Section.

Chairman: R. R. Tatlock.

Hon. Vice-Chairmen: { E. C. C. Stanford.
Sir J. Neilson Cuthbertson.

Committee:

J. Addie.	T. P. Miller.
G. Beilby.	E. J. Mills.
A. Crum Brown.	J. M. Milne.
J. Christie.	T. L. Patterson.
W. S. Curphey.	J. Pattison.
W. Dittmar.	F. J. Rowan.
D. B. Dott.	D. R. Stewart.
R. Irvine.	A. Whitelaw.

Hon. Treasurer: W. J. Chrystal.

Hon. Local Secretary:

G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The Seventh Meeting of the Session was held in the Rooms, 14, St. Andrew Street, Edinburgh, on Tuesday, 7th May 1889.

MR. R. R. TATLOCK IN THE CHAIR.

THE VULCANISATION OF INDIA-RUBBER, WITH SPECIAL REFERENCE TO THE USE OF CHLORIDE OF SULPHUR.

BY CHARLES A. FAWSITT, F.R.S.E., F.C.S.

THE vulcanisation of india-rubber is not only a matter of great importance to the rubber manufacturer but also to the public in general, as by the incomplete carrying out of the process goods are produced which are of comparatively little value. For instance, a waterproof coat or tobacco pouch, which gets stiff in cold weather, is a familiar example, and is owing to the goods not being completely vulcanised, or, as is technically termed, "cured."

In an article on the india-rubber exhibits in the Glasgow Exhibition of 1888, by Mr. Anderson Smith, which appeared in the "Glasgow Herald" about the beginning of October 1888, statements were made as regards the durability of vulcanised india-rubber goods which I think were apt to convey an erroneous impression to those without a special knowledge of their manufacture. The following are extracts:—

"Nothing gave such an impetus to the rubber trade since Mackintosh, as the mingling of the crude article with sulphur, so as to make what is now so universally known as vulcanised rubber. But the article is not at all of a lasting character, more especially apparently if carefully stowed away."

Again:—

"In any case vulcanite decays but too readily, and vulcanised rubber loses its elasticity and rots in a comparatively short time."

Of course it depends entirely on what meaning is attached to the terms "lasting character" and "short time," but the impression conveyed to the minds of not a few was that 12 months would be sufficient for

the deterioration of all vulcanised goods. If the process were very imperfectly carried out, no doubt such might be the case, but rubber goods are produced which will stand for a considerable time. I was lately shown samples of vulcanised rubber goods which were exhibited by Messrs. Warne and Co. in the London Exhibition of 1882, and which have since been exhibited in the South Kensington Museum, exposed to sunlight in a glass case, and some of the articles still retain their original elasticity, whilst others which have hardened on the surface are quite soft and pliable immediately below it.

I was also kindly shown some fine "cut thread" by the same firm, and also by Messrs. Moseley and Sons, which was 19 years old in each case, and I may say that that thread will show deterioration far more quickly than thick rubber. The above rubbers were vulcanised either with sulphur or sulphide of antimony without any compounding, as in that case they would be certain to lose their elasticity in a less time.

Another instance of the longevity of vulcanised rubber is furnished by a mat which is being exhibited at present in Glasgow by the North British Rubber Company, and which for 24 years did service at the principal entrance at Messrs. Arthur and Co.'s warehouse. I was informed by one of the principals of the latter firm that at least 30,000,000 people must have passed over this mat, which on examination did not show any sign of deterioration except that it was worn a little in the middle. In fact it seems to confirm the view that india-rubber or gutta-percha will be the pavement of the future.

The above will serve to show that vulcanised rubber does not in all cases deteriorate quickly. Mr. Smith also says that vulcanised rubber deteriorates more quickly if stowed away, which is not always the case. Take a thread, for instance, which, if carefully shut up in a box, may last for 20 years and keep in good condition, but the same thread if exposed to strong sunlight would not last a month.

The substance which is almost entirely used for vulcanising rubber is sulphur, either in the combined or uncombined state, as the latter principally in the form of "flowers of sulphur" and as the former in combination with a metal as a sulphide or with chlorine as chloride of sulphur. It is in connexion with the action of this latter body that this paper treats.

For reasons which will be mentioned further on, the chloride process has not been a favourite with india-rubber manufacturers; in fact, it has mostly been used for certain work which could not be produced without it, for instance those beautiful silk waterproofs so much worn by ladies in the summer months are "cured" by this process, as the heat necessary for "curing" with sulphur or metallic sulphides would be sufficient to injure the silk. In fact, mostly all "transparent" proofing is done by this process whether on wool, cotton, or silk. Being interested in the process, and, from a little experience I had gained, confident that good results could be obtained, I resolved to try and determine the conditions necessary for attaining those ends.

In order to render what follows clearer, it will be advisable to convey to you some idea as to the process now in use for vulcanising with chloride, and at the outset this process differs from the others in that the chloride cannot be mixed with the rubber as in the case of sulphur and sulphides, as it vulcanises at ordinary temperatures, hence it is called the "Cold cure" process, and the rubber could not therefore be kept in the plastic state

necessary for its subsequent manipulation. As an example I shall take that of a waterproof coat. The rubber is first softened with solvent naphtha and then kneaded by a machine into a doughy mass. This is now spread in very thin layers upon the cloth, the solvent naphtha driven off by heat, and the coated cloth passed between two revolving rollers, one of which dips into a solution of chloride in bisulphide of carbon or other diluent, and so the surface of the rubber is wetted as it passes between the rollers. The cloth is next warmed so as to expel the bisulphide and complete the reaction between the chloride and rubber, and which consists in an interchange of sulphur for hydrogen which unites with Cl_2 to form HCl . In some cases the cloth is again passed through the vulcanising mixture.

In order to ensure the complete decomposition of the chloride and neutralise any acid which may have been formed, the cloth is usually exposed to the action of ammonia.

Articles made of cut sheet, such, for instance, as tobacco pouches, are "cured" by dipping them into the solution and afterwards pickling them in a weak solution of caustic soda or other alkali.

On account of the rapid action of chloride of sulphur great care is required in carrying the different processes to a successful issue, and a knowledge of the properties of the chloride is almost indispensable.

As regards the chemicals employed, *i.e.*, bisulphide of carbon and chloride of sulphur, great care should be exercised both in the selecting and testing of the same, as this process has often got into disrepute through the india-rubber manufacturer using in ignorance what was unfitted for his purpose.

In a paper which I read before this Society in 1886, special attention was drawn to the fact that the different chlorides of sulphur occurring in commerce have different compositions and behave very dissimilarly when brought into contact with rubber, and to attempt to produce good work with the same proportions of each kind must result disastrously.

The chloride which appears to be best fitted for general work is one having approximately the composition S_2Cl_2 , as it can be used in much stronger solution than one containing SCl_2 , and at the same time does not act so violently on the rubber. Besides this, it is more economical, as it contains a higher percentage of sulphur, and as it altogether depends on the percentage of this substance taken up it is possible to do more work with it.

As regards the bisulphide of carbon used, it should not contain any free sulphur or oily and tarry matter, nor leave an unpleasant smell behind on the goods. This is accounted for by the sulphide containing a small proportion of some undefinable substances which occur in the crude product, and are difficult to remove if once allowed to creep in.

I conducted a series of experiments in order to find out in what proportion the sulphur was taken up by rubber, using different strengths of solution and varying the treatment, and at the same time to find out how the rubber vulcanised by this process compared with that done by the other methods.

I procured for the experiments some "cut sheet" of good quality (kindly supplied by Messrs. Moseley and Sons). The thicknesses were as follows:—

No. 1.	$\frac{1}{16}$	of an inch =	.4	mm.
No. 2.	$\frac{3}{32}$	"	=	.65 "
No. 3.	$\frac{1}{22}$	"	=	1.1 "

Nos. 2 and 3 being approximately two and three times as thick as No. 1.

The following was the method of procedure for vulcanising and afterwards testing samples in order to find out if they had been properly "cured." A bath of the proper strength having been made up, the rubber, previously softened by heat, was then immersed for a certain time and afterwards transferred to a drying bath. In some cases the rubber was dipped in pure CS_2 before being immersed in vulcanising mixture, and in others was washed with the same reagent after vulcanising. The samples when dry were laid upon a table in a cold room, where they were exposed during the winter months, not only to cold which on several occasions gave a thermometer reading as low as -10°C . (14°F .), but also to a strong draught. They were examined carefully, especially in very cold weather, to see if they remained pliable or if they were suffering any deterioration either on the surface or as to their elasticity. If the samples turned hard on standing they were deemed to be only "*semi-cured*," if they remained pliable and would not tear when stretched as severely as possible with the hands, they were considered "*well-cured*," and if they were soft and pliable, but tore on being stretched, they were called "*well-cured, overdone*." I noticed that some of the samples only turned hard after standing six months. After they had all stood for nine months the sulphur was determined in each sample, and you have the numbers and final condition of the rubber in Table I. The strengths are always stated by volume: for instance, 1 to 30 means in the proportion of 1 gallon of chloride to 30 gallons of CS_2 ; but as the strengths are usually expressed in so many ounces to the gallon by india-rubber manufacturers, it will be as well to mention that—

1 to 60 =	4½ oz.	chloride per 1 gallon CS_2 .
1 " 30 =	9 oz.	" " 1 " "
1 " 15 =	18 oz.	" " 1 " "

It was found difficult to dip exact times, and therefore the results cannot be super-exact, but they will convey a good idea as to how the rubber behaves with solutions of the strengths experimented with.

In Table II. you have a few of the results so arranged that at a glance it can be seen how the percentage of sulphur differs for different times and strengths.

On examining the numbers it will be noticed that the increase in the amount of sulphur taken up by the different thicknesses of rubber for the same time and at similar strengths is as 1:1.8:2.9, *i.e.*, the thinnest rubber (No. 1) takes up 2.9 times, and No. 2, 1.8 times as much sulphur as No. 3 does. Again, for the same thickness of rubber at the same strength, but for different times of dipping, we get the following proportional increase, 1:1.4:2.1, *i.e.*, that by immersing for 30 secs. the rubber takes up 2.1 times, and for 15 secs. 1.4 times as much as at 5 secs.

Again:—

The same thickness of rubber for equal times of dipping in the different strengths of solution gave as the proportional increase 1:1.7:3.9, *i.e.*, the same rubber in a solution of 1 to 15 takes up 3.9, and in 1—30 1.7 times as much sulphur as when dipped for the same time in 1—60, and you will notice that the numbers are almost proportional to the strength, which was in each case doubled.

As regards the rubber which was, previous to vulcanisation, softened with CS_2 , the numbers are higher than with the plain treatment, excepting with

TABLE I.

No. of Experiment.	Strength.	Order and Duration of Treatment.	Sulphur.	Final Condition.	Thickness.
1	1 to 60	5 seconds mixture	Per Cent. 0.769	Semi-cure 1. hard.....	No. 1.
2	"	15 " "	1.071	Well-cured	"
3	"	30 " "	1.618	"	"
4	"	5 seconds CS ₂ , 5 seconds mixture.....	0.843	"	"
5	"	15 " 15 " "	1.312	"	"
6	"	30 " 30 " "	2.191	"	"
7	"	15 seconds mixture, dried, 15 seconds mixture	1.800	"	"
8	"	5 seconds mixture	0.493	Semi-cured, hard	No. 2.
9	"	15 " "	0.704	" "	"
10	"	30 " "	1.002	Well-cured	"
11	"	5 seconds CS ₂ , 5 seconds mixture.....	0.505	Semi-cured, hard	"
12	"	15 " 15 " "	0.786	" "	"
13	"	30 " 30 " "	1.204	Well-cured	"
14	"	5 seconds mixture	0.227	Semi-cured, hard.....	No. 3.
15	"	15 " "	0.468	" "	"
16	"	30 " "	0.530	" "	"
17	"	5 seconds CS ₂ , 5 seconds mixture	0.319	" "	"
18	"	15 " 15 " "	0.546	" "	"
19	"	30 " 30 " "	0.587	" "	"
20	"	60 " 30 " "	0.556	" "	"
21	1 to 30	5 seconds mixture	1.314	Well-cured	No. 1.
22	"	15 " "	1.950	"	"
23	"	30 " "	3.026	" overdone	"
24	"	5 seconds CS ₂ , 5 seconds mixture.....	1.279	"	"
25	"	15 " 15 " "	2.130	" overdone	"
26	"	30 " 30 " "	3.463	" "	"
27	"	5 seconds mixture.....	0.958	"	No. 2.
28	"	15 " "	1.387	"	"
29	"	30 " "	1.787	"	"
30	"	5 seconds CS ₂ , 5 seconds mixture	0.877	Semi-cured, hard.....	"
31	"	15 " " 15 " "	1.448	Well-cured.....	"
32	"	30 " " 30 " "	2.223	"	"
33	"	5 seconds mixture	0.545	Semi-cured, hard.....	No. 3.
34	"	15 " "	0.709	" "	"
35	"	30 " "	1.063	Well-cured.....	"
36	"	5 seconds CS ₂ , 5 seconds mixture	0.450	Semi-cured, hard.....	"
37	"	15 " " 15 " "	0.758	Well-cured.....	"
38	"	30 " " 30 " "	1.060	"	"
39	"	60 " " 30 " "	1.369	"	"
40	1 to 15	5 seconds mixture	3.013	" overdone	No. 1.
41	"	15 " "	4.061	" "	"
42	"	30 " "	3.020	" "	"
43	"	5 seconds CS ₂ , 5 seconds mixture	3.016	" "	"
44	"	15 " " 15 " "	5.332	" "	"
45	"	30 " " 30 " "	8.984	" "	"
46	"	5 seconds mixture	1.892	" "	No. 2.

TABLE I.—*continued*.

No of Experiment.	Strength.	Order and Duration of Treatment.	Sulphur.	Final Condition.	Thickness.
47	1 to 15	15 seconds mixture	Per Cent. 2'892	Well-cured, overdone	No. 2.
48	"	30 " "	3'963	" "	"
49	"	5 seconds CS ₂ , 5 seconds mixture	1'469	"	"
50	"	15 " " 15 " "	2'164	" overdone	"
51	"	30 " " 30 " "	4'569	" "	"
52	"	5 seconds mixture	0'989	" "	No. 3.
53	"	15 " "	1'555	" "	"
54	"	30 " "	2'129	" "	"
55	"	5 seconds CS ₂ , 5 seconds mixture	0'776	"	"
56	"	15 " " 15 " "	1'226	"	"
57	"	30 " " 30 " "	2'067	" overdone	"
58	1 to 60	5 seconds mixture, then twice CS ₂	0'379	Semi-cured	No. 2.
59	"	15 " " " "	0'509	"	"
60	"	30 " " " "	0'685	Well-cured	"
61	1 to 30	5 " " " "	0'535	Semi-cured	"
62	"	15 " " " "	1'028	Well-cured	"
63	"	30 " " " "	1'131	"	"
64	1 to 15	5 " " " "	1'196	"	"
65	"	15 " " " "	1'635	"	"
66	"	30 " " " "	2'170	" overdone	"
67	"	5 seconds mixture, once CS ₂	1'289	"	"
68	"	15 " " " "	1'868	" overdone	"
69	"	30 " " " "	3'103	" "	"
70	1 to 60	5 " " " "	0'360	Semi-cured	"
71	"	30 " " " "	0'832	Well-cured	"
72	1 to 30	5 " " " "	0'644	"	"
73	"	30 " " " "	1'564	"	"
74	1 to 60	5 seconds mixture, 60 seconds CS ₂	0'241	Semi-cured	"
75	"	30 " " 60 " "	0'339	"	"
76	1 to 30	5 " " 60 " "	0'308	"	"
77	"	30 " " 60 " "	0'796	Well-cured	"
78	"	30 " " 2 minutes	0'613	Semi-cured	"
79	"	5 " " " "	0'474	"	"
80	"	15 " " " "	1'267	Well-cured, overdone	"
81	"	30 " " " "	1'558	" "	"
82	"	15 " " " "	1'391	" "	"
83	"	15 " " then once CS ₂	0'775	"	"
84	"	30 " " " "	1'548	" overdone	"
85	"	30 " " then once CS ₂	1'125	"	"
86	1 to 60	15 " " " "	0'967	" overdone	"
87	"	15 " " then once CS ₂	0'761	"	"
88	"	5 seconds mixture, 60 seconds CS ₂	0'466	Semi-cured	"
89	"	30 " " 60 " "	0'813	Well-cured	"
90	1 to 30	5 " " 60 " "	0'813	"	"
91	"	30 " " 60 " "	1'482	" overdone	"
92	"	30 " " 2 minutes CS ₂	1'389	" "	"
93	"	30 " " 5 " "	0'627	" "	"

TABLE I.—*continued.*

No. of Experiment.	Strength.	Order and Duration of Treatment.	Sulphur.	Final Condition.	Thickness.
PETROLEUM EXPERIMENTS.					
94	1 to 60	5 seconds mixture.....	Per Cent. 0'354	Semi-cured	No. 2.
95	"	30 " "	1'193	Well-cured, tacky.....	"
96	1 to 30	5 " "	0'678	" "	"
97	"	30 " "	1'859	"	"
98	1 to 15	5 " "	1'158	"	"
99	"	30 " "	2'078	"	"
100	1 to 60	5 seconds petroleum, 5 seconds mixture.....	0'377	Semi-cured	"
101	"	30 " " 30 " "	0'652	Well-cured, overdone	"
102	1 to 30	5 " " 5 " "	0'545	"	"
103	"	30 " " 30 " "	1'304	"	"
104	1 to 15	5 " " 5 " "	0'890	"	"
105	"	30 " " 30 " "	1'666	" overdone	"

TABLE II.

Time.	No. 1 Rubber.		No. 2 Rubber.		No. 3 Rubber.	
	Plain	CS ₂ before.	Plain.	CS ₂ before.	Plain.	CS ₂ before.
5 seconds	0'769	0'843	0'493	0'505	0'227	0'319
15 "	1'071	1'312	0'704	0'786	0'468	0'545
30 "	1'618	2'191	1'002	1'201	0'530	0'587
5 "	1'314	1'279	0'958	0'877	0'546	0'450
15 "	1'950	2'130	1'387	1'448	0'769	0'758
30 "	3'025	3'163	1'787	2'223	1'063	1'060
5 "	3'013	3'016	1'863	1'609	0'989	0'776
15 "	1'061	5'332	2'898	2'164	1'555	1'226
30 "	6'202	8'981	3'964	4'560	2'120	2'037

PETROLEUM EXPERIMENTS.

	Plain.	Petroleum before.
5 seconds	0'354	0'377
30 "	1'193	0'652
5 "	0'678	0'545
30 "	1'859	1'304
5 "	1'158	0'890
30 "	2'078	1'666

TABLE III.

No. of Experiment	Strength.	Treatment.	Sulphur.	Final Condition.	Elongation in Inches.	Breaking Strain.
			Per Cent.		Inches.	Lb.
1	1 to 60	15 seconds mixture.....	0.169	Semi-cured, hard.....	13	5½
2	"	30 " "	0.559	" "	10	5½
3	"	60 " "	0.686	Well-cured	10½	5
4	"	2 minutes "	1.097	"	15	5½
5	"	30 seconds CS ₂ , 15 seconds mixture.....	0.631	Semi-cured, hard.....	12½	6½
6	"	2 minutes " 60 "	1.271	Well-cured	13½	6
7	1 to 30	15 seconds mixture.....	1.203	Semi-cured, hard.....	12½	5½
8	"	30 " "	1.359	Well-cured	10½	5½
9	"	60 " "	1.800	" overdone.....	11½	5½
10	"	2 minutes "	2.664	Inelastic, overdone ..	4	1½
11	"	30 seconds CS ₂ , 15 seconds mixture	1.148	Well-cured	13	6½
12	"	2 minutes " 60 " "	2.433	Inelastic, overdone...	5½	2
13	1 to 15	15 seconds mixture.....	2.025	" "	7	2½
14	"	30 " "	2.371	" "	1½	2
15	"	60 " "	3.632	" "	2	1½
16	"	30 seconds CS ₂ , 15 seconds mixture	2.112	" "	4	1½
17	"	2 minutes " 60 " "	5.320	" "	2½	1½
18	"	30 seconds CS ₂ , 15 seconds mixture, 3 seconds CS ₂ ..	1.295	Well-cured	13	6
19	1 to 60	30 " " 15 " " 3 " " ..	0.463	Semi-cured, hard.....	8½	4½
20	1 to 30	30 " " 15 " " 3 " " ..	0.729	" "	12½	5½
21	1 to 60	30 " " 60 " " 5 " " ..	0.683	" "	12	6
22	1 to 30	30 " " 60 " " 5 " " ..	1.083	Well-cured	13½	7
23	1 to 60	30 " " 15 " " 5 " " ..	0.105	Semi-cured, hard.....	10	1½
24	"	30 " " 60 " " 5 " " ..	0.712	" "	10½	5
25	"	Unvulcanised, hard.....	"	"	4½	2½
26	"	" softened.....	"	"	5	0½

the highest strength and thickest rubber, and I think this must be due to the strong mixture acting so quickly on the surface of the rubber as to render it more or less impermeable.

Experiments Nos. 58—66 inclusive were made in order to see what effect dipping twice in pure CS₂ after vulcanising would have, on removing the surface sulphur, *i.e.* without drying between, and, as you will notice, this was to a large extent removed, for with 1 to 60 there was a loss of, approximately, 28 per cent. of sulphur; 1—30, 36 per cent.; 1—15, 38 per cent.

Dipping only once, experiments 67—73, the loss was respectively 22 per cent., 23 per cent., 28 per cent. of sulphur.

These experiments showed that the sulphur was retained to a great extent on the surface, and could easily be removed.

Experiments 74—78 were made with a view of finding out whether rubber which had been dipped in the vulcanising mixture could be deprived of its sulphur, or, as it is termed, "de-vulcanised," by merely immersing it in pure CS₂, *i.e.* without drying between, and for an immersion of 1 minute it lost 68 per cent. of its sulphur, and the rubber which without this after-treatment would have been

well cured and elastic, was found too inelastic and hard in cold weather.

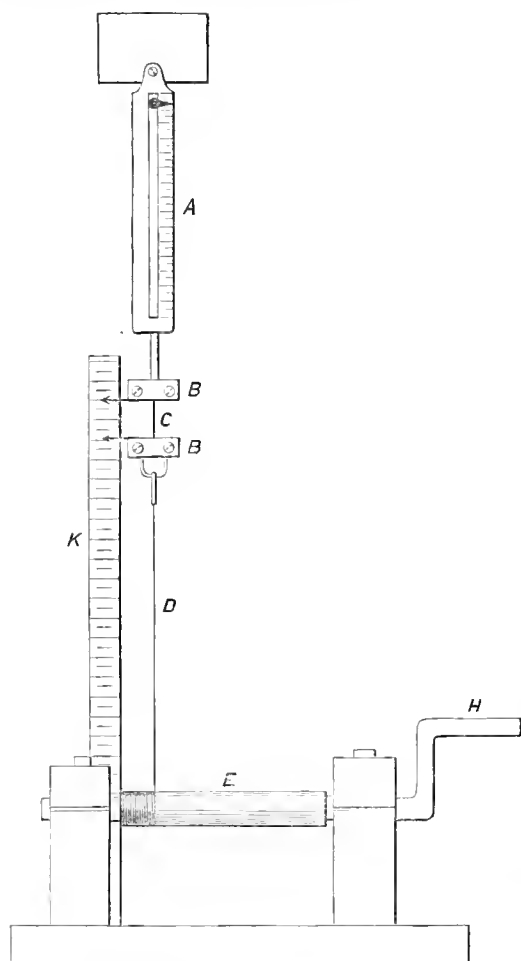
Experiments 88—93 were somewhat similar to those just mentioned, but with this exception, that the rubber after vulcanising was dried and then treated with pure CS₂ to see if it could be de-vulcanised. The results showed that the drying had a marked effect, as by immersing it for 1 minute in pure CS₂ only 19 per cent. of sulphur was removed, but when it was continued for 5 minutes, 65 per cent. passed into solution. The de-vulcanised rubber was still elastic, but at the same time weaker than without the after treatment, as it tore easily.

The percentage of sulphur for well vulcanised rubber varied 0.7—3 per cent., and the best experiments gave 1.4 per cent. I shall now show you a sample of each thickness of rubber vulcanised from the experience gained in the above experiments.

Thread Experiments.

Along with the "cut sheet" experiments I made a few with some "cut thread" size $\frac{1}{11} \times \frac{1}{11}$ of an inch (2.3 × 1.8 mm.). They were vulcanised in the same manner and allowed to stand for the same time and under similar conditions to pieces of "cut sheet." They were, after standing, subjected to a

breaking test in an apparatus, sketch of which you have in the figure below, and the numbers for which you have in columns 6 and 7 in Table III.



- A. Spring balance.
- B. Clamps for thread.
- C. India-rubber thread.
- D. String joining under clamp to roller E.
- H. Handle for turning roller.
- K. Scale giving length of elongation.

The length of thread taken was 2 inches, but as $\frac{1}{4}$ inch was held in each clamp, only $1\frac{1}{2}$ inches was available for stretching. The thread having been adjusted, the readings of the balance and scale K were taken, the handle of the roller slowly and steadily turned round, the readings being at the same time taken. Three trials were made with each thread.

These numbers bring out very forcibly the great superiority of vulcanised over unvulcanised rubber. Unvulcanised rubber which had been softened by heat, broke with only $\frac{1}{4}$ lb., with an elongation of only 5 ins., but 7 lb. were required for one of the vulcanised samples with an elongation of $13\frac{1}{2}$ ins.

In the same table you will find the percentages of sulphur, method of treatment, and condition of threads in the coldest weather to which they were exposed.

The percentage of sulphur for well vulcanised thread varied from 0.68–1.9 per cent., and averaged

about 1.25 per cent., a number agreeing fairly well with that for the "cut sheet" experiments. The previous treatment with CS_2 had the effect of increasing the percentage of sulphur, and the after treatment with the same reagent had a marked effect on removing the surface sulphur.

The strength of solution most suitable for vulcanising varies with the nature of the process employed as well as the thickness of the rubber and the time during which the rubber is exposed to the action of the chloride.

For vulcanising waterproof cloth the strength will depend principally on the speed of the rollers as well as the thickness of the rubber coating, but in an ordinary way of working the light yellow chloride can be used as strong as 1 to 30, by measure equal in weight to about 9 oz. of chloride to 1 gallon of bisulphide. It should not be used weaker than one-half this strength.

Using the dark chloride 1 to 60 is sufficiently strong, but it cannot well be used weaker than 1 to 100. It will no doubt seem strange that the dark chloride, containing the lesser percentage of sulphur, must be used in a weaker solution, but the reason is, that in strong solutions it attacks the outer surface of the rubber violently and destroys it before the inside is vulcanised. My results apply only to pure rubber, as it must be borne in mind that the mixing of it with foreign material will quite alter the action of the chloride solution. For instance, low class proofing does not contain above 10 per cent. of rubber, the remaining 90 per cent. being made up of substitute and the usual compounding materials. The substitute which seems most applicable for mixing with the rubber is that made by vulcanising rape oil with chloride as it softens, and mixes up very well with "solvent naphtha," and the chloride has little or no effect upon it when the coated cloth is passed through the vulcanising mixture. Besides this it has the property of standing high and low temperatures very well. In fact it often improves the rubber in this respect. The most rational way to vulcanise rubber with chloride appears to be first to soften it with CS_2 , then expose it to the action of the vulcanising mixture, finally dipping quickly in CS_2 ; and if the thickness of the rubber, times of dipping, and strength of solution are properly adjusted, very good results are obtained. Care must be taken in treating with CS_2 that it is not too long continued either previous to or after vulcanisation, as in the former case the rubber will lose a portion of its most valuable, that is, its viscous, constituent, and in the latter the rubber will be de-vulcanised. A short immersion only seems necessary to remove surface chloride and sulphur from undried rubber. For vulcanising articles made of "cut sheet," such as tobacco pouches, surgicals, &c., this process seems specially applicable, and if rightly understood would be more generally taken advantage of. I lately procured some unvulcanised tobacco pouches to see if a good vulcanisation could be effected, as I had often heard that a really reliable pouch could not be obtained by this process. The requirements of a good pouch are elasticity combined with strength, pliability in cold weather, and one not easily affected by heat; durability; and a taking appearance. After a few trials I produced a pouch which answered all these requirements (samples shown). On analysis this pouch gave 1.38 per cent. of sulphur, being less than in any well-vulcanised pouch which is sold.

Now the question arises, has the chloride process any advantage over the others in use? I may safely say it has.

1st. The cost of production is less, as it is possible to turn out a very much larger quantity of material in a given time, say of waterproof cloth, than when vulcanising with dry heat or steam, as the two latter processes are discontinuous, and the apparatus much more costly.

For a low class of proofing the cost does not exceed one farthing per yard, *i.e.*, for chloride, CS_2 , and labour, and for high class not above one half-penny, whilst for the other processes the cost will be double this.

2nd. There is no efflorescence of sulphur, which is a most important point, as in "curing" by dry heat that is the greatest difficulty the manufacturer has to contend with, and is the cause of more damaged goods than all other causes put together.

"Steam-cured" goods certainly do not show an efflorescence, but the process is damaging to the colours of the cloth.

Why there should be no efflorescence with the chloride process it is difficult to say, but I noticed in my experiments that rubber containing even 9 per cent. of sulphur showed no signs of it, although it could not be all combined, as it is for the most part easily removed with CS_2 .

3rd. The process being conducted at ordinary temperatures, no damage can occur to the cloth, which is very often the case with the dry and steam heat processes, as for these latter a temperature of 105°C . (220°F .) and of two hours' duration is thought to be very low, and even at this temperature wool is damaged to a certain extent, whilst at 121°C . (250°F .), a temperature which is often used, the damage is very considerable.

4th. The rubber "cured" with chloride, on account of the small percentage of sulphur it contains, combines greater strength with greater elasticity than if cured by the other processes, as I contend that rubber which is properly cured and contains the least proportion of foreign material, must give the best results. For instance, if a rubber be vulcanised with antimony sulphide, which, in order to produce good results, must contain a certain amount of uncombined sulphur, it will tend to be weaker and less elastic, because a greater percentage of foreign material is introduced which must destroy the properties to which rubber owes its special value. I had hoped to put this idea to a practical test, but failed to procure reliable samples. I may say that pure native Para rubber will keep quite sound for a period of 50 years, probably much longer, and it stands to reason that well-vulcanised rubber having the closest composition to this will last the longest.

5th. The chloride-cured rubber has a glossy appearance, and is transparent when held up to the light, which is much desired in a certain class of goods, and which cannot be obtained by any other process.

As regards the disadvantages urged against the chloride process there are some which would be very much minimised if only proper attention were paid to several details in the working of the process, and there are others which are imaginary or exist only where the process is not properly worked.

Before proceeding to discuss the objections, it may be as well to mention that the chloride process is not put forward as being applicable to rubber of above a certain thickness, about $\frac{1}{4}$ of an inch.

It would be impossible to vulcanise, for instance, mechanical goods which are so familiar to all.

The first objection I shall mention is the smell remaining in the goods after curing, especially with waterproof cloth, but my experience of the smell is that it entirely disappears if the goods are aired for

a few days provided attention has been paid to certain details which are often neglected. I shall briefly mention them. The quality of the solvent naphtha used for softening up the rubber should be carefully tested, especially as regards its being free from high boiling constituents, as these are apt to be left behind in the rubber, and when acted upon by chloride of sulphur produce resinous-like bodies, and which impart a very unpleasant and lasting odour to the goods. Another cause of a disagreeable odour which clings to the goods is produced by using an impure bisulphide of carbon.

The "stoving" of the goods after passing through the vulcanising solution should be very carefully done, as it not only removes any acid which may be formed on the surface, but also that disengaged in the inside of the rubber by the decomposition of the chloride. Of course it may be urged that the after treatment with ammonia neutralises all danger, but I deny this, as the acid from the inside of the rubber, if not removed by heat, will be very slow coming out to the surface, perhaps weeks, and will not be affected by the alkaline treatment.

Another objection against the process is as regards the lasting power of the goods. There can be no doubt that goods are produced by this process which do deteriorate quickly, but it can also be said for any of the other processes.

It is no fault of the process, as the careless manner in which it is sometimes worked makes one wonder how a presentable article is produced at all.

As it is only within the last year or two that the process has come to be more generally used and better understood, it is not to be expected that goods of any considerable age can be brought forward as a proof. I have seen waterproof cloth "cured" by this process eight years old, still in good condition, and have myself pieces of cut sheet which I cured three years ago, and they have not deteriorated in the least, either as regards elasticity or appearance. (Samples shown.) Again, I was lately told that, although the "cold cured" rubber might stand in this country, it would not in either very hot or cold climates, as in the former case it would become soft and in the latter hard. My experiments quite disprove the latter, and to test the former I took several pieces of the rubber which had been so cured, and heated them in an air-bath to 230°F . (110°C .) for three hours, and the only difference which I could observe was that they were a little less transparent; they certainly had not softened, become "tacky," or lost any of their strength and elasticity. If they had been so affected I should have concluded that they had not been well cured.

3rd. The process, owing to the use of CS_2 , is said to be hurtful to the health of the workmen. Of course this is owing to the air becoming laden with its vapour on its being expelled from the cloth, and, naturally, it must have a serious effect on the nervous system if no means be taken for its removal, as it is formed, from the workroom. In some works the health of the workman is of secondary importance to the bank book; but all the principal works have now adopted improvements whereby the fumes are, for the most part, confined and carried away before they pollute the air which has to be breathed by the workmen. An important factor in carrying out the chloride process is the choice of the diluent, the chief requisites of which are that it does not react with chloride, is a good solvent for rubber so that the same will quickly soften up and allow the chloride to penetrate its mass, besides being easily and entirely removed from the goods on warming and not be hurtful to the workpeople. CS_2 fulfils all

these with the exception of the last, and this is not urged as a serious objection by some manufacturers. The only other diluent which has found any favour is petroleum spirit, usually of a specific gravity about '700, and this principally because it has no effect on the workpeople. As far as I can make out this is its only recommendation. It is a bad solvent for rubber, and necessarily a very much longer time is required to allow of its softening the rubber so as to effect a thorough vulcanisation, and for rubber of any thickness ($\frac{1}{32}$ of an inch), I found it was not possible to effect a thorough vulcanisation in a reasonable time. Another disadvantage is that it reacts with the chloride, and the solution turns dark in colour if allowed to stand, and leaves behind a very disagreeable odour which it imparts to the goods, and the rubber is left in a "tacky" condition. In Table 1, Nos. 94—105 are the details of a few experiments done with petroleum spirit, and you will notice that the numbers for the sulphur are much below those for the corresponding strength when CS_2 was used as the diluent.

In conducting these experiments the rubber did not appear to soften up at all, as in the case with the CS_2 , and therefore it is probable that the sulphur was almost entirely on the surface, which could for the most part be removed by an after treatment with CS_2 . No doubt petroleum spirit can by repeated treatment with oil of vitriol and soda be very much much improved, *i.e.*, as regards its being acted upon by the chloride and also as regards its complete removal from the goods on "stoving" and smell, but it then costs considerably more than CS_2 , with which reagent I do not believe it will ever be able to compete for good work.

One important advantage which CS_2 possesses over petroleum is that the former has an almost constant boiling point, 46°C ., whereas the latter, although commencing to boil at a low temperature, rises considerably higher, and the residue is a dark, smeary looking substance.

The following is a boiling test of a sample of petroleum spirit, sp. gr. '701 at 15°C .

Began.....	53°C .
10 cc.....	67°C .
20 ".....	71.1°C .
30 ".....	75.7°C .
40 ".....	81.3°C .
50 ".....	85.8°C .
60 ".....	91.0°C .
70 ".....	96.5°C .
80 ".....	105.1°C .
90 ".....	123.6°C .
95 ".....	156.4°C .

No doubt some one will be prompted to ask whether or not chloride of sulphur has any action on CS_2 . I was once asked this question before, and answered it in the negative, but I find that although no apparent action takes place, a change of some kind occurs in the properties of the vulcanising solution.

I made up a solution in the usual way, 1—30, and kept it for three days, and then vulcanised a few pieces of rubber. They should have been elastic and strong, but they tore quite easily. (Experiments 79—81.) The solution was now kept for six weeks and experiments repeated, when the same effect was noticed, although the solution had the same colour as when first made up. These experiments are Nos. 82—85, Table 1. The solution, although diluted to 1—60, showed the same peculiarity. (Experiments 86 and 87.) The per cent. of sulphur was approximately the same as when vulcanising on the usual way, so I think the action must have been a surface one, as a subsequent treatment with CS_2 removed the

bad effects. Experiments Nos. 23 and 24, Table III., were also done with this solution. In order to find out if the CS_2 had undergone a marked change I shook a portion of it with water, whereby all the chloride present was decomposed; the CS_2 was now separated, washed with water, and distilled, when it was found to all come over at approximately 46°C . A small residue of sulphur was left in the flask, which resulted from the decomposition of the chloride.

I can scarcely conclude this paper without mentioning another process, which was patented by Abbott, for vulcanising with the vapour of chloride of sulphur. In this process no diluent is required, the chloride alone, or mixed with other substances, being vaporised in a chamber in which the goods are hung up or passed through. After being exposed to the vapour for a certain time, they are exposed to the fumes of ammonia. No doubt a dark chloride could be used with advantage, as much less heat is required to vaporise it. I intended to carry out a series of experiments in order to determine in what proportion the sulphur was taken up, by exposing rubber for different times in the vapour of chloride, but the first few experiments convinced me that, for rubber of any thickness, it was not very applicable. No doubt, for very thin rubber, $\frac{1}{16}$ to $\frac{1}{32}$ of an inch in thickness, it is possible to obtain a good vulcanisation, but the rubber has quite different properties from the "cold-cured" article. Anyone with experience can tell at once whether, say, a pouch has been vapour-cured or not, as the virtue seems to be out of the rubber, and in many cases the outer surface is over "cured" in attempting to get the vulcanisation through and through.

My best thanks are due to Messrs. Matthews and Burbridge for the valuable help they have given me, and also to Messrs. Shaw and Anderson for the care bestowed upon the analyses.

DISCUSSION.

The CHAIRMAN felt quite sure that he was only speaking the mind of the meeting when he said that they were all indebted to Mr. Fawsitt, not only for bringing before the Section the important subject of the vulcanisation of rubber, but for the manner in which he had done it. The literature of the subject, as far as it went, was good, but exceedingly scant, and although a few excellent papers had been read to the Society and had appeared in the Journal, notably those by Burghardt and by Thomson, the subject had neither been investigated nor ventilated to anything like the extent which its growing importance deserved. He considered these papers on technical subjects of great importance, and regarded this as a typical one. His own experience was confined chiefly to the deterioration of "proofed" goods, and its causes, questions regarding which were constantly pending between the manufacturers of the cloths and linings and the proofers. It was extremely difficult, when these differences arose, to avoid litigation of the most expensive kind, there being little information on the subject except that excess of oil in the fabric might easily cause damage, a fact which was universally admitted, although there were numerous other possible causes. The crude condition of this question might be judged of from the circumstance that a minimum proportion of oil in the cloth was commonly stipulated for—it might be 2 per cent. or 1 per cent.—regardless of any other circumstances or conditions, which might have as much to do with deterioration of proofing as the amount of animal or vegetable oil in the fibre. He would just refer to a few of these. There were, first,

the quality of the raw rubber, which was variable, from "Para" downwards; secondly, the proportion of added foreign ingredients, chiefly mineral matters such as carbonate of lime, clay, &c., which "sponged" the rubber and made it more readily oxidised by the oxygen of the air; thirdly, the quality of the naphtha employed, which, if not free from high boiling point oils, would leave the latter in the rubber where it would act like an oil; fourthly, the introduction of rubber substitutes; fifthly, the nature of the oil in the fabric; sixthly, excess of sulphur; and, lastly, the *ratio* of the oil on the surface and in the substance of the cloth to the rubber employed, as it was quite clear that proofers could not go on reducing the quantity and quality of the rubber employed without at the same time getting the proportion of oil reduced to match, otherwise they might expect damage. Very often it was recklessly alleged that because the fabric contained more than a fixed and definite amount of oil, the damage was due to that cause without reference to any other condition, which he considered unfair to the manufacturer. He believed that if the cost of a single action at law, or very much less, were expended on an honest and well-conducted investigation, which should be as exhaustive as possible on these points, by a representative manufacturer and a chemist, with appeal to an oversman, much misunderstanding and threatened litigation might be avoided; both manufacturers and "proofers" would know what to stipulate for in making contracts. When questions relating to deterioration of proofed garments or other goods arose, an examination of them would show where the blame lay, and the whole trade would be benefited. He begged to move a hearty vote of thanks to Mr. Fawsitt for his excellent paper, which was unanimously accorded.

Mr. IRVINE remarked that it was impossible for him to criticise Mr. Fawsitt's paper, for the author had gone fully into all the questions and difficulties which seemed to surround the process of vulcanising with chloride of sulphur. He remarked that all the processes employed in the manufacture of india rubber goods were faulty in so far as they were dependent upon the use of solvent materials which in themselves were extremely dangerous and often hurtful to the health of the workmen employed. Of course the ideal method of using this valuable material would be in the condition in which it is taken from the tree (that is, as milk), but hitherto the rubber as received in this country had defied all his efforts to bring it back to its native state. He, however, suggested this as a field holding out brilliant prospects to the hosts of young chemists whose chief difficulty lay in not knowing what fields into which they might push their energies. Such a process if found would be of incalculable value.

Mr. FAWSITT, in reply, said that the Chairman's remarks on the deterioration of "proofed" goods showed that he had given the subject close attention. His own experience lay principally with goods which had been "enred" with chloride, and the damage to the cloth in this process often arose from the acid not having been entirely removed before the cloth was rolled up. In order to free the cloth entirely from acid more "stoving" was required than it usually got, and the after treatment with ammonia would, if much acid be left, leave a considerable amount of chloride of ammonium in the cloth, and impart to it a whitish appearance, and in time cause more or less damage. He had found that cloth moistened with a neutral 2 per cent. solution of chloride of ammonium, on drying and exposing

to the air, turned slightly acid. As regarded the deterioration of rubber coating, this was, he thought, in the majority of cases owing to the "proofing" mixture not being properly prepared. It was well known that certain classes of "recovered" rubber were very dangerous to use, especially in the dry heat process. Again, the "substitute" made by acting upon oil with chloride, unless very carefully prepared and freed from acid, would invariably cause premature decay as the acid vapours were slowly emitted, and would rot the "proofing" as well as the cloth. If the surface of the rubber coating were freed from excess of sulphur or chloride of sulphur, as the case might be, by a solvent or other reagent, a beneficial effect, as regards the deterioration of the rubber, was produced, and if CS_2 were used the oil was at the same time partly removed from the cloth. As regarded the action of oil upon the rubber, it had, as the Chairman remarked, a damaging effect, especially an oil which oxidised readily, but he thought that oil was often blamed when the cause should be looked for elsewhere. The Chairman had thrown out a very good suggestion in stating that if the expenses incurred in litigations were expended in investigating the cause of dispute, it would lead to more just results. As regarded Mr. Irvine's remarks, the use of solvents in the manufacture of rubber was not attended with any great danger if the workpeople were instructed as to their properties; certainly to a far less degree than their manufacture. There was one point which should be carefully attended to when using CS_2 , and that was that its vapour took fire at about 15°C . (302°F .), so that a plumber with his bolt, for instance, which would not melt solder, might cause an explosion.

NOTE ON THE CONDENSATION OF CARBON PARTICLES IN SMOKE.

BY R. IRVINE, F.R.S.E., F.C.S.

IN the manufacture of lamp black hydrocarbons are burned in an atmosphere with a limited supply of oxygen; the resulting dense black smoke is conducted into large chambers, where on account of the extremely sluggish draught it is allowed to roll about until the particles, by attraction between themselves, gradually coalesce into masses, which after a lengthy period fall on the floor in the form of soot. This process is exceedingly slow, and the product obtained from even an enormous condensing space, is comparatively very small. Consequently this manufacture is one carried on on a limited scale, considering the magnitude of the plant required.

Following the lead given by Professor Lodge of Liverpool, in his experiments upon lead stythe, I, assisted by my friend Mr. J. Lillie Mitchell, undertook a series of experiments with a view to more rapid condensation of smoke carbon; and for this purpose erected a glass structure 5 ft. \times 4 ft. \times 4 ft., in which were fixed two malleable iron plates, provided with a great number of points—these facing each other; the plates being separated by a distance of from two to three feet, and all the conducting surfaces except these points being carefully insulated with shellac varnish.

This chamber was filled with smoke produced by burning pitch oil, which retained its opacity for at least two hours; so much so that on then looking through the chamber, a bright light placed on the

other side was totally obscured by the vapour. The chamber was now refilled with smoke, and the whole atmosphere therein was to a greater or less degree electrified by coupling the conductors which were connected to the plates with a small dynamo. The effect immediately produced was exceedingly striking, the minute particles of carbon at once separated from the opaque smoke, and were attracted to or driven from the points of the plates, congregating together in a most extraordinary manner; and in the space of two or three minutes the atmosphere in the glass chamber was almost entirely cleared of smoke. The prohibitory cost of electricity has, however, prevented the application of this process on the large scale, for the present at least.

[This paper was illustrated by practical demonstration of this experiment.]

ERRATA.

This Journal, April 1889.

Page 263 (2nd col., line 7). For "process" read "processes."

Page 266 (2nd col., line 3 from bottom). For "junction" read "function."

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Reasons why Iron Water-Mains corrode if not Turred.
G. Weissmann. Chem. Zeit. 13, 433.

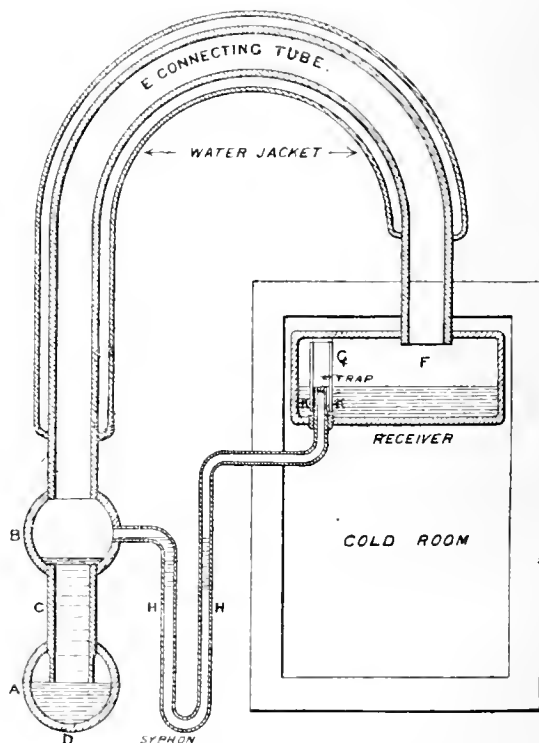
EVEN if iron water-mains contain only traces of sulphur and phosphorus, they are readily corroded if not turred. This is especially the case if the soil in which they lie be rich in organic substances such as humic acid, contain nitrates and ammonia compounds, or if it be saturated with water containing carbonic acid. Access of air is equally detrimental. It is a well-known fact that brine has no corroding action on iron tubes which are turred, so long as the latter are kept full. This applies equally to pure water.

—A. R.

The "Arktos" Cold Air and Freezing Apparatus. L. Perkins. Engineer, 1889, 209.

AMONGST other difficulties which have been connected with Carre's apparatus, and prevented its use on a large scale, was the evaporation of some of the water with the ammonia from the heating vessel, the evaporation taking place at about 270° F. This, passing over into the cooler, lessened the effect in the manner that will be seen. This has been overcome by L. Perkins in the "Arktos." The Figure shows in cross section two tubes, A, B, connected by small tubes C; these tubes form the vessel in which the evaporation is performed by the application of heat, and in which the ammonia and water again combine when the supply of

heat is stopped. It is therefore called the combiner. The saturated solution of ammonia, containing about one-third by weight of ammonia, is placed in this vessel and heat applied to the liquid by a Bunsen flame at D below the lower tube of the combiner, or, as in most cases, and always for large apparatus, by means of hot water or steam tubes passed through it. By the application of this heat to the liquid the ammonia rapidly evaporates, and when first starting the apparatus a little ammonia and water vapour is allowed to escape through a water-sealed pipe, which is afterwards capped. The escape of ammonia is very small, only sufficient to ensure the discharge of all or nearly all the air from the apparatus. If at this stage the heat supply were stopped, there would be a vacuum of about 25 in. as a result of the escape of gas and vapour and the cooling of the gaseous and liquid contents. The ammonia vapour passes through the tube E, which is surrounded by a water jacket, where it is condensed, the liquid ammonia passing into the freezing vessel F, which, when the apparatus is first put to work, contains water up to the level of the top of the small vessel G. The ammonia, being lighter than the water, remains afloat, and as it increases in quantity with evaporation from A B, it drives the water from F, through the small holes in the bottom of G, and thence down the syphon tube H into the vessel A. Here any ammonia that may have been carried over is again heated, and passes over through the condensing tube to E. This evaporation then continues until all the ammonia is in the vessel F, and all the water driven therefrom through the syphon H, with the exception of the small quantity, which being below the little holes K in the bottom of G, cannot be driven over. Now the supply of heat is stopped. The whole apparatus cools down, partly by the continued cooling action of the jacketed tube E, and partly by cold water, which is allowed to trickle over B. The vacuum of about 25 in. is immediately brought about, and the



re-evaporation from the freezing vessel F proceeds, giving temperatures that will freeze large quantities of mercury, until all the ammonia is again over in A B recombined with the water. The re-evaporation from F takes much longer than the evaporation from A B, and in some applications of the freezing or cooling apparatus need only

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Luck, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	1/4d.
Above 8d., and not exceeding 1s. 6d.	1d.
„ 1s. 6d. „ „ 2s. 4d.	1 1/2d.
„ 2s. 4d. „ „ 3s. 4d.	2d.

be done once per day. From this it will be seen that, for the proper working of the apparatus, the capacity of the vessel A B must be to that of F very near the proportion which the water bears to the liquid ammonia.

In the whole apparatus there is not a single moving part, not a single valve, the whole apparatus is a closed-up system, and in the large apparatus the control of the supply of heat is by cocks on pipes apart from the "Arkos."

—O. H.

PATENTS.

A Vertical Grinding Mill for Grinding all kinds of Minerals. G. and R. A. Norman, Sheffield. Eng. Pat. 2103, February 17, 1888. 6d.

Two or more chilled iron or steel discs are keyed one above the other upon a vertical spindle, which is made to revolve by gearing fitted either at the top or bottom. A casing of iron or steel rings encloses the spindle and discs. The mineral to be ground is fed in upon the top disc, and is ground between the periphery of the revolving disc and the inner surface of the casing, and falls through upon the next lower disc, and so on to the bottom where the ground mineral is removed by a revolving scraper.—H. S. P.

Improvements in Machinery or Apparatus for Grinding, Pulverising, and Separating Animal, Vegetable, and Mineral Substances. W. H. Thompson, Old Charlton, H. E. Hunt, London, and C. W. Kutto, Stoke Newington. Eng. Pat. 3296, March 3, 1888. 1s. 1d.

This has reference to improvements in machinery previously described in Eng. Pats. 4325 of 1876 and 12,560 of 1881, and refers principally to the parts employed for separating the pulverised substances, and to combining those parts with the mill, so as to effect more rapid and efficient working, and to rendering the various parts of the mill and sifting apparatus more accessible. For this purpose the casing of the mill is so arranged as to admit of the propelling blades being applied to the driving discs, for the purpose of retaining the substance to be pulverised under the action of the ball until it is reduced sufficiently fine for sifting, and then for propelling it to the sifting apparatus. This latter is mounted on wheels, and runs on a tramway, thus rendering it and the mill easily accessible for adjustment and other purposes. A further improvement consists in feeding the mill with the material, by means of a vibrating and adjustable shoot. In wet grinding, the mill is formed with a casing, on one or both sides, constructed to form a tank, where the substances are kept in suspension, by the agitation of the mill, until sufficiently pulverised, when the floating particles are caused to flow over or out through spouts or apertures into several settling tanks, so arranged as to discharge one into the other, the coarser particles being deposited in the first tank, while the lighter ones will be carried into the next tank or tanks. The details of the improvements are protected by six claims, and are illustrated by three sheets of drawings.

—E. S.

Improvements in or connected with Apparatus or Machines for Heating, Cooling, or Condensing Fluids. A. Rathbone, Warrington. Eng. Pat. 1689, March 27, 1888. 8d.

THE improvements described apply to apparatus for heating, cooling, and condensing which are of the tubular type; the heating or cooling or condensing body passing over the external or internal surface of a tube, whilst the body operated upon passes over the other surface. In order to increase the length of path of the material over the surface of the tube with which it is in contact, the patentee provides the interior of a tube with a sheet, bar, or second tube of any shape or structure, plain, corrugated, or otherwise shaped, so as to ensure a spiral or helical path, and so secure the longest possible path of contact with the surface of the tube separating the materials which convey or subtract the heat from each other. Fourteen variations are shown in the specification.—C. C. H.

An Improved Automatic Separator and Purifier of Solids and Fluids. P. A. Maignen, London. Eng. Pat. 4760, March 28, 1888. 8d.

THIS specification describes and illustrates 19 modifications of a form of apparatus proposed by the patentee for the separation of suspended solid matter from water or other liquid. In the interior of a vessel, preferably of a cylindrical form, a number of obtuse conical and perforated vessels are superposed base-upwards; the apex of each is directed towards the centre of the cone below, and open so as to direct the stream of water issuing against the said perforated base below. Passage of a current of water through such an apparatus results in the formation of eddies, and "a large flow of the water is retained in a dormant condition, which allows the suspended matter to deposit with the least possible hindrance.—C. C. H."

Improvements in the Method of and Apparatus for Superheating Steam. R. Shackleton, Bradford. Eng. Pat. 5812, April 19, 1888. 6d.

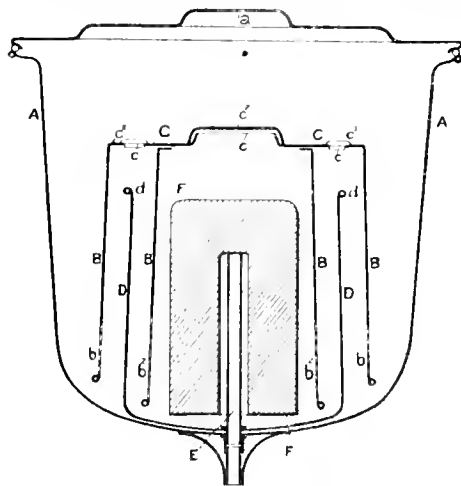
ATMOSPHERIC air heated to a high temperature by any convenient means is passed or forced through a series of pipes placed in the steam space of a boiler; or the steam pipe leading from the boiler is heated by means of an annular jacket of hot air. By either means, dry steam of a higher temperature than that corresponding to its pressure is obtained.—C. C. H.

An Improvement in Machines for Agitating or Mixing Substances, Solid and Liquid. W. Smith, Barnard Castle. Eng. Pat. 6124, April 25, 1888. 6d.

A RECEPTACLE containing the substances to be mixed has a ridge on the bottom, internally, and is mounted on two gudgeons. On a reciprocating motion being given to it, the enclosed substances are thrown from one side to the other, over the ridge, which stays the progress of the substances until the vessel has been lifted high enough to throw them over the ridge. The invention is specially applicable for washing and churning. The claim consists in the ridge at the bottom of the receptacle for the purpose described.—E. S.

Improvements in Means for Filtering Water or other Liquids. O. A. Berend, Hamburg, Germany. Eng. Pat. 6282, April 27, 1888. 8d.

IN the interior of a cylindrical vessel A, concentric spaces are formed by means of any number of cylinders B B, D D,



the latter with their open ends upwards, the former with their closed end upwards and the open end downwards. These concentric spaces, therefore, communicate with each other alternately at their upper and lower parts, and communication is likewise facilitated by perforations at *b b'*.

Filtering media of any appropriate kind is packed in the spaces so formed, through the doors c^2 , and as a result any water passing through the apparatus necessarily pursues a tortuous path through the media before arriving at the porous carbon block F and leaving the filter by the pipe E.

—C. C. H.

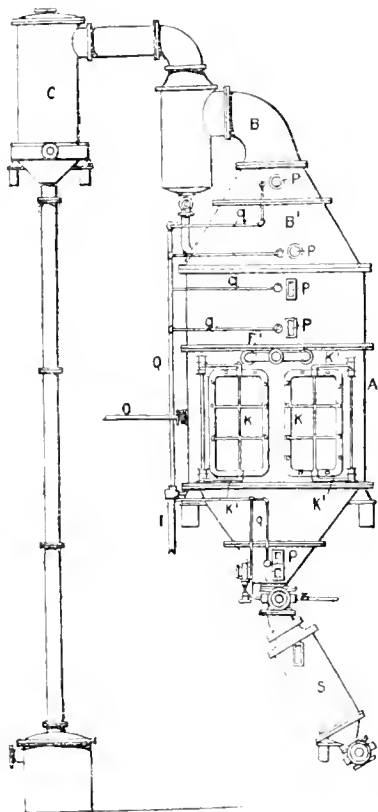
Improvements in the Method of and Apparatus for Forcing and Drawing Chemical or other Liquids. S. Spencer and J. S. Lord, Bes-er-o'-th-Barn. Eng. Pat. 7768, May 28, 1888. *8d.*

THE improvements in this patent have for their object the prevention of the chemical liquid acting injuriously on the interior of the pump. This is effected by employing a volume of air between the piston of the pump and the liquid to be raised, so that the liquid is prevented from coming in contact with the pump cylinder and piston. The receiver is made, preferably, of earthenware, and is formed with an inlet and outlet ball valve. The pump can be placed at the side of the receiver, or over it, as shown in the drawing accompanying the specification. On moving the piston outwards a vacuum is made in the receiver, the inlet valve is raised and the liquid enters. At the upper end of the pump cylinder is an air-opening; on the piston passing this, air enters and fills the cylinder. The return stroke of the piston closes the inlet valve, and the compressed air forces the liquid through the outlet valve, the compressed air being allowed to escape through a port on the piston reaching its lowest position. By employing two receivers the pump can be made double-acting.—E. S.

Improvements in Apparatus for Evaporating Brine and for similar Purposes. H. H. Lake, London. From J. M. Duncan, Silver Springs, Wyoming, U.S.A. Eng. Pat. 785, January 16, 1889. *8d.*

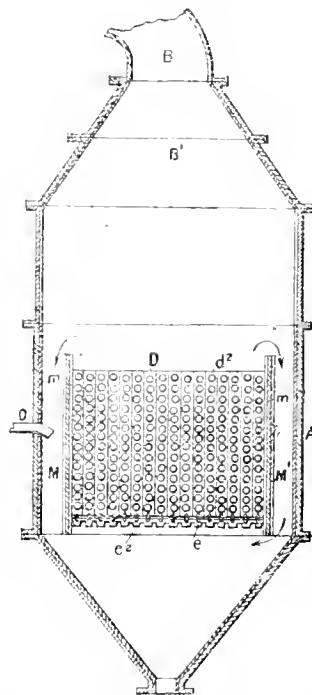
THE apparatus devised is a special form of vacuum pan in which the object aimed at is to so construct the heating

Fig. 1.



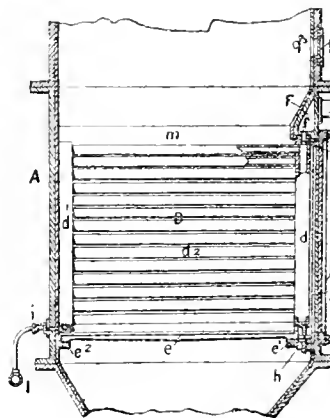
tubes or coils that they may be readily and expeditiously removed from the interior of the apparatus. A is the heating portion of the pan connected by the swan neck B in the usual way with the condenser C, and provided with sight opening P, and the various appliances common to most forms of vacuum pans. K K are hinged doors through which access is had to the heating tubes. S is a closed vessel which receives the salt as it is crystallised and precipitated, so that it can be removed in a manner readily seen without stopping the operation in the pan; O is the brine supply pipe. D in Fig. 2 shows the heating pipes

Fig. 2.



arranged between two diaphragms $m m$, which with the sides of the pan form the circulating spaces M M'. Fig. 3

Fig. 3.



shows the manner in which the pipes are supplied with steam and condensed water removed. F is a common steam supply passage into which the inlet manifold d , receiving the ends of the pipes D, enters by the nipple g ; the joint of each manifold is made steam-tight by the

pressure of the set screw *h*. The outlet may be managed in the same way, or each manifold at the outlet end may communicate by a separate drip pipe *i* with a main drain pipe *l*. The facility with which a section of pipes may be removed is apparent. The interior of the pan is lined with glass or porcelain to obviate incrustation.—C. V. H.

II.—FUEL, GAS, AND LIGHT.

On the Testing of Spent Substances from Gas Purification. E. Moldenhauer and W. Leybold. Journ. f. Gasbeleucht. 32, 155.

See under XXIII., page 421.

PATENTS.

Improvements in the Manufacture of Illuminating Gas and in Apparatus employed therein. J. H. R. Dinsmore. Liverpool. Eng. Pat. 2096, February 11, 1888. 1s. 3d.

THESE improvements refer to a process for converting into permanent illuminating gas the tar obtained during the distillation of coal in closed retorts. The main features of the process have already been mentioned in this Journal (1888, 741; and 1889, 272). The present specification contains 27 claims, and is illustrated by eight sheets of drawings.—A. R. D.

Improvements in the Manufacture of Vapour and in Mixing Nozzles therefor. J. J. R. Humes, London. Eng. Pat. 2111, February 11, 1888. 8d.

THIS is a device for impregnating a gas with liquid hydrocarbon. Both gas and liquid are admitted to the apparatus under pressure. The latter is pumped with a portion of the former into a preliminary mixing chamber, and the combined stream is joined at right angles by the remainder of the gas admitted from an annular passage close to the delivery point.—A. R. D.

Improvements in the Manufacture of Gas and in Apparatus used therefor, the said Apparatus being adapted in other Manufactures. W. Foulis and A. J. Liversedge, Glasgow. Eng. Pat. 4372, March 22, 1888. 8d.

THE inventors propose to free a gas from the solid or liquid impurities mechanically suspended therein by imparting to it a rapid rotary motion. The impurities being heavier than the gas are projected by the centrifugal action thus induced against the periphery of the vessel in which the operation is conducted. The apparatus consists essentially of an outer casing or enclosing vessel through which runs a shaft carrying such an arrangement of fans as may be found most suitable for imparting the motion desired.—A. R. D.

Improvements in or relating to Hydrocarbon Furnaces. W. P. Thompson, Liverpool. From the Porcelain Dental Art. Co., Detroit, U.S.A. Eng. Pat. 4402, March 22, 1888. 8d.

THIS specification describes an apparatus for heating a muffle furnace with a mixed blast of air and hydrocarbon. As the improvements refer mainly to the arrangement of the details of the apparatus, the specification with its drawings should be consulted.—A. R. D.

Apparatus for Supplying Furnace Fires with Moistened Air. W. Le Las and A. Robin, Paris, France. Eng. Pat. 5527, April 13, 1888. 8d.

THIS apparatus is intended for furnaces working under a forced draught. The air blast is made to pass through a moistening chamber where it comes into contact with a wetted screen or a shower of water, and whence it is admitted to a

box connected with the ash pit. Each firebar consists of a number of plates very deep in the middle and kept apart by distance washers. With this construction the moistened air has to pass over a very extended surface, and the bars are effectually prevented from overheating. The furnace is constructed with an inner and an outer fire-door, between which a regulated supply of moistened air is admitted to the fire to cool the metal and promote the combustion of smoke.—A. R. D.

Improvements in Gas-Producers. E. Brook, Huddersfield. Eng. Pat. 6454, May 1, 1888. 8d.

THESE improvements have reference to details in the construction of gas-producers of the ordinary kind. Round the lower part of the producer is placed a water jacket through which run tuyeres for supplying air to the interior of the mass of fuel. Air is admitted to the exterior portion of the fuel from an annular blast chamber below the water jacket. The producer is provided with a water base, and the ashpit is thus kept luted. Just below the level of the working doors is placed a central cross-bar which serves to support temporary bars when lighting up, clinkering, &c. This crossbar may be made hollow and perforated at the top so as to serve instead of tuyeres for the admission of air to the interior of the producer.—A. R. D.

Improvements in Gas Producers. A. Wilson, Stafford. Eng. Pat. 6514, May 2, 1888. 8d.

THESE improvements have reference to producers that may advantageously be used for the manufacture of gas for driving engines. After leaving the producer, the gas is caused to pass through a regenerator in order to heat the air and steam used in the process. This enables a larger percentage of steam to be decomposed, and tends greatly to the enrichment of the gas. When a gas-holder is used the inventor employs also a water seal or luted escape to provide for the automatic cessation of production when the holder is full. When the pressure in the holder reaches a certain point, the water seal allows the air and steam blast to escape without entering the producer. The charging-hopper, chimney and a working-hole are fitted in a revolving plate that covers an opening in the top of the producer. By this means any one of the three can be brought over the opening at will.—A. R. D.

Improvements in the Purification of Carburetted Hydrogen or Coal Gas. W. A. M. Valon, Ramsgate and Brin's Oxygen Co., Westminster. Eng. Pat. 6920, May 9, 1888. 6d.

COAL gas, from which the tarry and ammoniacal impurities have been eliminated, is mixed with oxygen and passed through purifiers containing caustic alkali—preferably lime. The sulphur compounds and the carbonic acid combine with the lime, with separation of a considerable proportion of free sulphur. To a thousand volumes of the gas one volume of oxygen should be added for every 100 grains of sulphuretted hydrogen present per 100 cub. ft. of gas.—A. R. D.

Improvements in Artificial Fuel. H. Williams, London. Eng. Pat. 7219, May 15, 1888. 4d.

SMALL coal or breeze, tar, and spent lime taken direct from the gas purifiers are mixed in a pug-mill, and the resulting mass made into blocks and dried. Even if the tar be omitted an excellent artificial fuel is obtained.—A. R. D.

Improvements in the Method of and in Means and Appliances for Measuring Air, Gas, and other Fluids. H. Lane, London. Eng. Pat. 7674, May 25, 1888. 8d.

A HOLLOW vessel, made in two parts, with flanges for bolting together, is fitted with a flexible air-proof diaphragm

in combination with a valve, so formed and fitted as to become automatically reversed by the increase of pressure caused by the check imparted to the fluid when the receiver is filled (arising from the difference of pressure between the induction and eduction fluid), and thus also rendering the flow continuous. "A valve box and valve (preferably of the piston type) are fitted, having passages to each half of the vessel, and induction and eduction ports, and connexions from and to other vessels, from which the fluid is drawn." The valve has a rod passing through a stuffing-box, and is connected in any convenient manner with any suitable recording instrument. The action of the valves and other parts is fully shown in the drawings accompanying the specification. The improvements are protected by three distinct claims.—E. S.

Improvements in the Treatment of Peat. S. Pitt, Sutton. From D. Aikman, Montreal, Canada. Eng. Pat. 13,679, September 21, 1888. 8d.

AFTER being freed from sticks the peat is mixed to a pulpy state in a trough with the aid of open steam. It is then dried between heated rollers, whereby the material is obtained in the form of films or flakes, and the more volatile constituents of the peat are driven off. These are recovered and again mixed with the solid portion, and the whole subjected to a pressure of 10 or 12 tons per square inch in moulds heated to a temperature of from 800° to 1,000° F. The analysis of the hard glazed block thus obtained is approximately as follows:—

	Per Cent.
Moisture	3.84
Volatile combustibles	41.22
Fixed carbon	18.04
Ash	6.90

—A. R. D.

Improvements in Apparatus for Testing and Detecting the Presence of Gases or Gaseous Mixtures. T. Shaw, Philadelphia, U.S.A. Eng. Pat. 18,105, December 11, 1888. 11d.

See under XXIII., page 425.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Collection of Ammonia and Tar from Coke Ovens, with special regard to the Conditions in the Ostrau District. W. Jicinsky. Osterr. Zeits. f. Berg.-u.-Hüttenw. 36, 527 and 540.

ANALYSES of a few coals are given, together with the yields of gas and coke on dry distillation. The amount of ammonia produced is not proportional to the quantity of nitrogen in the coal. About three-fourths remain in the coke, the remainder goes to form ammonia, cyanogen, and some also escapes as free nitrogen, so that only between 0.089 and 0.188 per cent. of the total nitrogen of the coal is converted into ammonia. A table of results are given which demonstrate this.

The tar usually amounts to between 2 and 3 per cent. of the coal, and is generally about one-third to a quarter of that obtained in laboratory experiments. Coke-oven tar contains from 0.9 to 1.06 per cent. of benzene, 4.26 to 5.27 per cent. of naphthalene, 0.57 to 0.64 per cent. of anthracene, 50 per cent. of pitch, and 40 per cent. of other residual matter.

The following are analyses of coke-oven and illuminating gases:—

	Coke-oven Gas.	Illuminating Gas.
	Per Cent.	Per Cent.
Benzene	0.61	1.54
Ethylene	1.63	1.19
Sulphuretted hydrogen	0.43	..
Carbon dioxide	1.41	0.87
Carbon monoxide	6.49	5.40
Hydrogen	53.32	55.00
Methane	36.11	36.00
	100.00	100.00

—A. W.

Fichtelite. C. Hell. Ber. 22, 498—502.

FICHELITE occurs together with retene in the turf beds of Redwitz in the Fichtel mountains, and is found in the fossil stems of the sporadic bog-fir *Pinus uliginosa* N.

It has been previously investigated by Trommsdorff (Ann. 21, 126), Bromeis (Ann. 37, 304), and Clark (Ann. 103, 236), and, according to the last named, who obtained a number of chloro- and bromo-derivatives in an impure condition, its constitution is $C_{15}H_{26}$.

It is best separated from retene and obtained in a pure condition by repeatedly recrystallising from a mixture of alcohol and ether, from which it separates in long prismatic crystals melting at 46°. The mother-liquors yield, on further evaporation, first retene and, finally, a brown soft mass with a strong smell of vanilla.

Vapour density determinations by V. Meyer's method at 440° seem to show that it has the formula $C_{15}H_{26}$ or $C_{15}H_{26}$; it would therefore be a tetra- or di-hydride of a sesquiterpene. On the other hand, it is possible that partial dissociation may have taken place, and the true formula is $C_{30}H_{54}$; this formula agrees better than any other with the author's and Clark's (*loc. cit.*) analyses, and the high boiling point of this hydrocarbon also points to a much more complicated constitution than that indicated by the vapour density determinations.

Fichtelite is only acted on extremely slowly when boiled with fuming sulphuric acid, potassium bichromate and sulphuric acid, or a 10 per cent. solution of potassium permanganate, but when treated with chromic acid in glacial acetic acid solution it seems to be oxidised to carbonic acid. It is not acted on by cold fuming nitric acid, but when boiled with nitric acid of sp. gr. 1.32 it yields oxalic acid. Bromine acts on it very readily, but the products could not be obtained free from unchanged hydrocarbon.—F. S. K.

The Hydrocarbon $C_{60}H_{122}$. C. Hell and C. Hägele. Ber. 22, 502—505.

THE highest saturated hydrocarbon, the molecular weight of which is known, is $C_{35}H_{72}$, and it is probable that the solid paraffins obtained from shale, wood, &c. do not contain more than 30 carbon atoms.

A hydrocarbon $C_{60}H_{122}$ can be prepared artificially from myricyl iodide, which latter is easily obtained by treating the alcohol with iodine and phosphorus according to Pieverling or Walter's method. The iodide is carefully heated at 120°—140° with about one-tenth of its weight of finely-divided potassium or sodium; the product is then extracted with boiling water, alcohol, petroleum spirit, and glacial acetic acid consecutively, to remove the unchanged iodide, and recrystallised from benzene. It separates in the form of a white powder, melts at 101°—102°, and is very sparingly soluble in alcohol and ether, more readily in petroleum spirit and glacial acetic acid, and most easily in chloroform and benzene. It is partially decomposed when

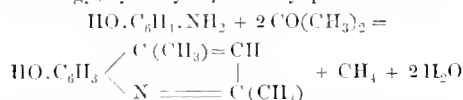
aniline which assumes a dark colour by the action of light. It therefore seems necessary that the hydrocarbon should be treated more thoroughly than is customary with sulphuric acid, to obtain an absolutely pure product.

Aniline, ortho- and paratoluidine, free from thiophen, yield only traces of magenta with arsenic acid, whereas by adding nitrothiophen to the nitro-derivatives previous to reduction, the formation of the colouring matter takes place as usual.

—A. R.

On the Action of Acetone on Ortho- and Paramidophenol.
C. Eng'ler and A. Kauer. Ber. 22, 290—215.

Acetone acting on amidophenols ought to produce, according to analogy, hydroxy- α - γ -dimethylquinoline—



Dry *o*-amidophenol hydrochloride was heated with 3 molecules of acetone for 48 hours to 170°—180° C. On opening the tubes a gas escaped consisting of 90 per cent. of methane. The brown contents of the tubes were boiled with dilute hydrochloric acid, the remaining residue was dissolved by acetone, and the whole mass then heated by steam, when acetone and its condensation products distilled over, whilst some resinous matters were precipitated. By partial neutralisation with caustic soda and evaporation more resinous matters separated. After filtration the basic compounds were precipitated by carbonate of soda solution, care being taken not to use excess, and the yellow floccular precipitate was washed with hot water until it was of the consistency of a thin paste. From the filtrate the amidophenol can be recovered. The dry residue was dissolved in absolute alcohol and to the solution concentrated sulphuric acid was added. After cooling needle-shaped crystals separated. These were filtered and washed with alcohol and ether until colourless. The crystals were then dissolved in water and after addition of potassium bichromate an abundant yellow precipitate was obtained, which was filtered and washed with cold water. After standing with carbonate of soda solution the base is obtained in flakes, which become crystalline after some days. The new compound is soluble in dilute, with difficulty soluble in concentrated caustic soda, and these solutions produce orange- and Bordeaux-red coloured precipitates when treated with diazo-chlorides. The colour produced with β -naphthylamine dyes silk in an acid alcoholic solution a yellowish-brown with a red shade. Ferric chloride produces a green coloration, disappearing gradually on heating, but at once on acidifying. The base is easily soluble in ether, benzene, acetone, alcohol, and chloroform, less easily in petroleum spirit, nearly insoluble in water. It is scarcely volatile with steam, but may be sublimed, and possesses the peculiar odour of quinoline derivatives and an intensely bitter taste. It melts at 65° C., boils at 281° C. On addition of bromine to the hot alcoholic solution a yellow crystalline precipitate separates. The compound is *o*-hydroxy- α - γ -dimethyl-quinoline, $\text{C}_{11}\text{H}_{11}\text{NO}$.

The sulphate, hydrochloride, bichromate, picrate, and platinum double salt are described. The yield was at the best 20 per cent. of the amidophenol.

Para-hydroxy- α - γ -dimethylquinoline was obtained by heating *p*-amidophenol with three times its weight of acetone for from 2—3 days to 170°—180° C., when a gas was formed containing 87 per cent. of methane. The purification was effected in a similar manner to that already described. The yield was 12 per cent. of the theoretical one. The base crystallises from alcohol in prisms or plates melting at 214° C., boiling above 360° C. with decomposition. It is nearly insoluble in cold and hot water and benzene, with difficulty soluble in ether, easily soluble in ether and acetone, in acids and caustic alkalis (with the exception of ammonia). Carbonic acid precipitates the alkaline solutions. The alkaline solutions yield with diazo-chlorides coloured precipitates; the acid alcoholic solution of the colour from β -naphthylamine dyes silk a beautiful red colour. Ferric chloride produces in its alcoholic solution

a brown coloration, disappearing on addition of acids. The hydrochloride, sulphate, bichromate, and platinum double salts are described.—A. L.

On Aldehyde Blue. L. Gattermann and G. Wichmann.
Ber. 22, 227—236.

Action of Aldehyde on Pararosaniline at Ordinary Temperatures.—5 grms. of pararosaniline were dissolved in a mixture of 55 grms. of concentrated hydrochloric acid and 55 of water, and to the solution 22 grms. of aldehyde were added. After 24 hours the reaction terminates. The blue solution was diluted to one litre, and the colouring matter precipitated by common salt. The colour thus obtained was redissolved in absolute alcohol and recovered, after evaporation of the alcohol, as a mass with a bronze-like lustre.

Action of Paraldehyde on Pararosaniline at Ordinary Temperatures.—The reaction and the result were the same as above described. The blue colouring matter has all the properties of the rosaniline derivatives. On reduction it yields a leuco-base, which, however, could not be obtained crystalline. It is re-oxidised in the air, as well as by oxidising agents, to the original blue colour.

To discover the constitution of the colour a quantity of the product was heated for five hours with concentrated hydrochloric acid to 220° C. A colourless base was thus obtained which could not be crystallised. When, however, the aldehyde blue was distilled, first hydrochloric acid and water escaped, then an intense odour of quinoline was observed, and a heavy oil condensed, eventually solidifying. The analysis gave figures for $\text{C}_{10}\text{H}_9\text{N}$, the formula of a methylquinoline. It was proved to be identical with the homologue of Claus' diquinoline, prepared by heating quinaldine hydrochloride for eight hours to 220° C. The molecule of this body was found, according to Raoult's method, to consist of three quinaldines, $(\text{C}_{10}\text{H}_9\text{N})_3$.

Aldehyde blue seems, therefore, to be a quinoline derivative and probably $\text{C}(\text{C}_{10}\text{H}_9\text{N})_3(\text{Cl})\text{HCl} + 3\text{H}_2\text{O}$.

Action of Paraldehyde on Rosaniline at Ordinary Temperatures.—The experiments were conducted in the same way as above, and a blue obtained of the formula $\text{C}(\text{C}_{10}\text{H}_7\text{NCH}_3)(\text{C}_{10}\text{H}_9\text{N})_2(\text{Cl})\text{HCl} + 3\text{H}_2\text{O}$.

The constitution of the Aldehyde blue being satisfactorily explained, the authors tried to prepare the green from this compound, but all experiments failed. It was at last observed that when salting out the blue colouring matter the mother-liquor always remained deeply coloured. This mother-liquor yielded without any difficulty Aldehyde green. When acting, therefore, with aldehyde on pararosaniline two blue bodies are formed, one of which is capable of yielding under certain treatment Aldehyde green.

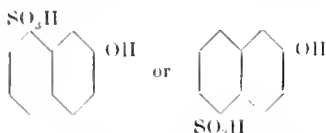
The Aldehyde blue is not applicable to dyeing purposes on account of its high price, and because it is not fast to light. But it is useful for microscopical purposes.

If the action of aldehyde and paraldehyde on pararosaniline be carried out at a higher temperature, say at 50° C., a different result is obtained, a blue colouring matter being formed of another composition.—A. L.

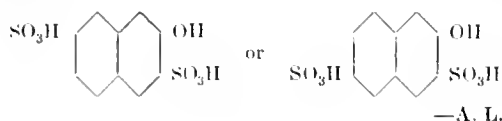
On the Constitution of the Beta-Naphthol-Alpha-Monosulphonic Acid and the Beta-Naphthol-Alpha-Disulphonic Acid (Salt R.). W. Pfützinger and C. Duisberg.
Ber. 22, 396—399.

BERGER's beta naphthol-alpha-monosulphonic acid was converted in the autoclave into a beta-naphthylamine sulphonic acid identical with the one obtained by the Badische Anilin und Soda Fabrik by heating beta-naphthylamine with fuming sulphuric acid. From this body was prepared the hydrazine compound by treating the diazo-compound with stannous chloride and hydrochloric acid. After purification the hydrazine group was eliminated from this body by boiling with copper sulphate, and the resulting naphthalene sulphonic acid was fused with caustic soda. Alpha-naphthol, of the melting point 96° C., was obtained. If Witt's experiments (this Journal, 1889, 277) and the above are considered together, they prove that the beta-

naphthol- α monosulphonic acid must be either represented by the formula—

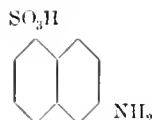


Beta-Naphthol-alpha-Disulphonic Acid (Salt R).—This acid was treated in the same way as the monosulphonic acid, and naphthalenedisulphonic acid was finally obtained which yielded, on heating with caustic soda from 250°–280° C., a dihydroxynaphthalene, melting at 183°–184° C., and a naphtholmonosulphonic acid. The latter is identical with beta-naphthol- δ monosulphonic acid (naphthol-sulphonic acid F.). (This Journal 1887, 593.) The melting point of the dihydroxynaphthalene and the properties of the naphtholmonosulphonic acid render it probable that the naphthalenedisulphonic acid is identical with the one described by Ebert and Merz (Ber. 9, 592), and the constitution of the beta-naphtholdisulphonic acid is, therefore, either—

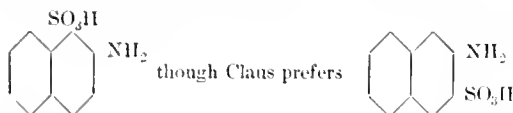


On the Constitution of Beta-Naphthylamine-Alpha-Sulphonic Acid. C. Immerheiser. Ber. 22, 412–413.

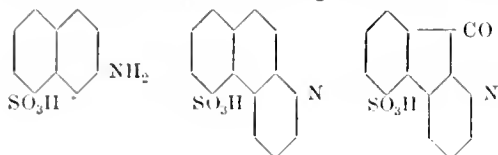
Of the seven possible beta-naphthylamine sulphonic acids four are known, two of which are considered to have their sulpho-groups in the α -position. One of those first prepared by Dahl and Co. (this Journal, 1885, 279–280) has, according to Cleve and Forsling (this Journal 1887, 721), the following constitution:—



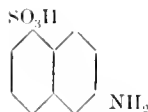
The second acid, first prepared by the Bañische Anilin und Soda Fabrik, is believed to be—



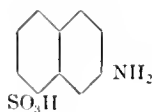
The formation of the pyridinephenyleneketone sulphonic acid, however, proves that the amido and sulphonic groups are in different rings, as the following formulae show:—



Dahl's acid is believed to be



Therefore there remains for this acid only the formula—



—A. L.

On the Symmetrical Tetramidobenzene. R. Nietzki and E. Müller. Ber. 22, 440–450.

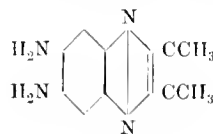
The constitution of the symmetrical tetramidobenzene is



Two amido-groups are either in ortho, para-, or meta-position to each other. Anhydrous acetic acid ought therefore to produce a soluble anhydro-base. This result, however, could not be achieved. When the hydrochloride of the base is mixed with dry sodium acetate and heated with anhydrous acetic acid a colourless body separates from this mixture after addition of water, with difficulty soluble in alcohol, easily soluble in hot glacial acetic acid, crystallising in long white needles, and melting at 285° C. The analysis gave figures for a tetracetyltetramidobenzene. On saponification with caustic potash, partial conversion into anhydride takes place, and only three acetyl groups are eliminated; if, however, hydrochloric acid be used instead of caustic potash, tetramidobenzene was formed. This proves the body to be a true tetracetyl derivative. The urea and thio-urea formed by the action of carbonoxychloride and carbon bisulphide on tetramidobenzene are greyish-white powders, insoluble in all solvents but caustic alkalis.

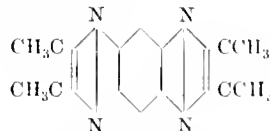
Quinoxalines and Azines from Tetramidobenzene.—Phenanthrenequinone acted only on two of the amido-groups, whilst the two others remained intact. Neither did other orthoquinones as naphthoquinone, rhodizonic acid yield well defined bodies of the double azine series. Ketones of the fatty series, as diacetyl, pyruvic acid, benzil, however, formed according to the conditions mono- or double quinoxalines.

If diacetyl be added in aqueous solution to a solution of tetramidobenzene hydrochloride and sodium acetate, a heavy precipitate consisting of orange-yellow needles separates at once. It is dimethyldi-amidoquinoxaline—



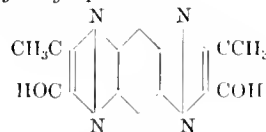
soluble in hot water, subliming between 130° and 140° C. with partial decomposition. Hydrochloric acid dissolves it with a red, sulphuric acid with a violet colour, which on dilution changes through red into orange. From alcohol it crystallises with one molecule of that compound. Acetic anhydride forms a compound which is either a diacetyl product or an anhydride derived therefrom.

Tetramethyldiquinoxaline.—

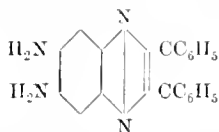


is obtained by heating dimethyldi-amidoquinoxaline with an excess of diacetyl. It is nearly insoluble in water, alcohol, and ether, soluble in hot aniline and crystallising from it in reddish-white plates, melting above 300° C., and subliming in crystalline plates, soluble in sulphuric acid with a bluish-green colour, turning blue on dilution.

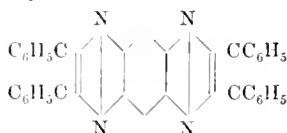
Dimethyldihydroxydiquinoxaline.—



obtained by the action of pyruvic acid on tetramidobenzene, is soluble in caustic alkalis.

Diamidodiphenylquinoxaline.—

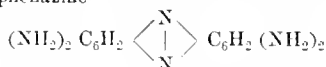
is formed by acting with benzil on tetramidobenzene. A precipitate separates, which when treated with alcohol of 50 per cent., dissolves this compound, whilst tetraphenyldiquinoxaline remains undissolved. Yellow plates, melting at 245° C. By the action of acetic anhydride a diacetyl compound is formed.

Tetraphenyldiquinoxaline.—

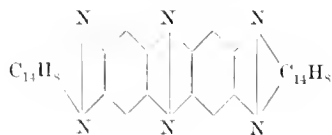
melting at 289° C., with difficulty soluble in glacial acetic acid, easily soluble in this solvent after addition of a few drops of hydrochloric acid, soluble in concentrated sulphuric acid with a blue colour, changing through red into orange, after dilution.

Oxidation products of Tetramidobenzene.—10 grms. of tetramidobenzene dissolved with 20 grms. of sodium acetate were dissolved in 200 cc. of water, heated nearly to boiling, and then a current of air passed through the solution for 2–3 hours. Green needles, the acetate of a new base, are thus obtained, soluble in water with a red colour, from which the base is precipitated by alkalis in brownish yellow plates, with difficulty soluble in hot water and alcohol. Purified by crystallisation from boiling aniline it forms long yellow needles containing aniline of crystallisation, which is removed by washing with alcohol. After solution in glacial acetic acid and precipitation with alkali, the substance was analysed. Its formula is $C_{12}H_{12}N_6$. The nitrate was found to be $C_{12}H_{12}N_6(HNO_3)_2 + 2H_2O$.

The base belongs probably to the class of the amidoazines or eurhodines discovered by Witt, and it is probably a tetramidodiphenazine—



It forms a tetra-acetyl compound, an orange yellow powder, nearly insoluble in all indifferent solvents. If the above be the correct formula, this compound ought to be able to form compounds with orthoquinones. This was proved to be the case with benzil and phenanthrenequinone, of which two molecules acted on one of the eurhodine. Phenanthrenequinone forms a compound containing 11 rings, of the formula—

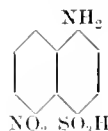


—A. L.

On the Nitration of Naphthion Acid. R. Nietzki and J. Zübelen. Ber. 22, 451–452.

When naphthionate of soda is heated with acetic anhydride, an acetyl compound is formed, which when mixed with five times its weight of concentrated sulphuric acid and nitrated with the calculated amount of nitric acid forms a nitro-acetyl compound. The temperature was not allowed to rise above zero. On boiling with dilute caustic alkali the acetyl group is eliminated, and on addition of acids the free nitronaphthylamine sulphonic acid separates. Nitrous acid converts it into a diazo compound, capable of combining with phenols and amines. On reduction of the

nitronaphthylamine sulphonic acid a naphthylenediamine sulphonic acid is formed. The nitronaphthylamine sulphonic acid loses the sulpho group on boiling with dilute sulphuric acid, and forms a nitronaphthylamine melting at 119° C., identical with the one described by Beilstein and Kuhlberg. The sulphonic acid has therefore the constitution—

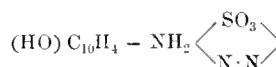


—A. L.

On Beta-naphthol-alpha-sulphonic Acid. R. Nietzki and J. Zübelen. Ber. 23, 453–456.

The authors produce alpha-naphthol from the beta-naphthylamine-alpha-sulphonic acid in the same way as Pfizinger and Duisberg (this Journal, 1889, 277).

The beta-naphthol-alpha-sulphonic acid forms with dilute nitric acid a nitro compound known in the trade as Bayers' "Croceine yellow." This is a dinitro-beta-naphthol-alpha-sulphonic acid. On reduction of this body a di-amido-naphtholsulphonic acid is obtained. Ferric chloride and other oxidising agents convert this body into an imido compound. The diamido-compound forms on addition of nitrous acid a diazo compound, one amido group only being diazotised—



—A. L.

On the Examination of Non-Basic By-products obtained from the Last Runnings of Aniline and Toluidine. C. Hell and Th. Roekenbach. Ber. 22, 505–514.

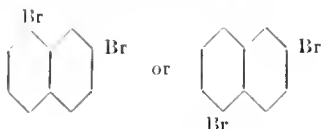
The authors examined two non-basic liquids obtained from the last runnings of the aniline and toluidine distillation by treating them, after saturation with hydrochloric acid, with steam. A distillate was obtained which yielded, in the case of the aniline product, after repeated distillation a fraction boiling between 258° and 263° C. It was however observed that it was not a uniform product. The oil was therefore oxidised with a solution of 5 per cent. of potassium permanganate until on boiling no more decolourisation of the oxidising agent took place. An oil remained and the liquid contained two acids, terephthalic acid and an acid of the formula $C_{10}H_{10}O_4$, which on account of the minute quantity obtained could not be further examined. From the oil crystals were obtained, which were recrystallised from ether and absolute alcohol. It contained two substances, one melting at 122.5° C., the other at 66° C. The latter could not be examined on account of its small quantity. The former contained sulphur, was soluble in concentrated sulphuric and nitric acids, and was reprecipitated by water. It was insoluble in alkalis. The compound is probably a sulphone. After removing these bodies from the oil it was distilled again, part boiling at 255°–259°, part at 259°–264°. The analysis of the lower boiling portion gave figures for the formula $C_{14}H_{22}$. On nitration with a mixture of sulphuric and nitric acids a nitro-compound, melting at 228° C., and on reduction an amido-compound were obtained. On treating the hydrocarbon with a mixture of four parts of concentrated and one part of fuming sulphuric acid a sulphonic acid was prepared.

In a similar way the product from toluidine was examined. It boiled between 240° and 270° C. On oxidation a mixture of volatile fatty acids, principally acetic acid, was obtained. The oil remaining after oxidation was rectified, the fractions boiling between 259–261.5° C. and 255°–259° C., the former being the larger. Analysis proved the formula $C_{14}H_{22}$, which is the same as that of the by-product from the making of aniline. No solid nitro-compound was formed on nitration.—A. L.

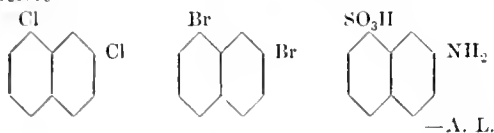
On Beta-naphthylamine-alpha-sulphonic Acid.

S. Forsling. Ber. 22, 619.

On diazotising beta-naphthylamine-alpha-sulphonic acid and treating the diazo-compound with cuprous bromide and concentrated hydrobromic acid, the corresponding bromo-naphthalenesulphonic acid was obtained, which was converted in the usual manner into a dibromonaphthalene melting at 75° C. This compound is either—



according to Meldola. A dichloronaphthalene analogously obtained by the author has, according to Erdmann, the chlorine atoms either in the same ring or in the position $\beta_1 = \alpha_1$. As these halogen derivatives were prepared in the same way, they must have the chlorine and bromine atoms in the same position, and the constitution of these halogen derivatives and of the naphthylaminesulphonic acid is therefore—



—A. L.

On Tetrahydro-alpha-naphthylamine. E. Baumberger and F. Bortt. Ber. 22, 625—634.

ALPHA-TETRAHYDRONAPHTHYLAMINE has the properties of an aromatic base. It combines with diazo compounds and forms colouring matters, distinguished from the analogous derivatives of alpha-naphthylamines in a certain way.

Phenylazo-alpha-tetrahydronaphthylamine is obtained by the action of diazobenzene chloride on the hydrochloride of the base. Steel-blue needles little soluble in water, benzene, chloroform, abundantly in glacial acetic acid and alcohol.

Sulphophenylazotetrahydronaphthylamine obtained from diazobenzenesulphonic acid and the hydro base. The acid is little soluble in water, more so in alcohol, with a dark orange colour. The sodium salt crystallises very beautifully.

Tetrahydronaphthylamine can be diazotised itself, and it also combines with amines and phenols.

Alpha-tetrahydronaphthylazo-alpha-naphthylamine.—Two bodies were obtained, one with difficulty soluble, the other easily soluble in alcohol. The latter melted at 135° C., forming brick-red needles, and was the desired compound.

Alpha-tetrahydronaphthylazoresorcinol forms brick-red plates, decomposing at 219° C., and soluble in concentrated sulphuric acid, alcohol, and alkalis with a dark claret-red colour.

The diazo-compound of the hydro base is capable of undergoing all the reactions characteristic of ordinary aromatic diazo bodies. Thus the amido group can be replaced by the hydroxycyan-, thiocarbonyl-, carboxamide-, carboxyl-, and hydrazine-groups, and also by hydrogen.

By the action of cuprous cyanide on the diazo compound Alpha-tetrahydronaphtholnitrile is obtained by Sandmeyer's reaction. The product of the reaction is a resinous substance, from which the nitrile is separated by steam. It is a colourless heavy oil, boiling at 277°—279° at 721 mm. pressure. As a by-product of this reaction tetrahydro-alpha-naphthol is formed. By the action of sulphuretted hydrogen on the nitrile Alpha-tetrahydronaphthoic thiamide is formed as a dark yellow oil.

Alpha-tetrahydronaphthoic Amide and Acid are obtained by saponifying the nitrile with alcoholic caustic potash at 160°—170°. On treating the resulting mixture with carbonate of soda the acid is dissolved whilst the amide remains. The latter melts at 182° C. and forms flat needles with difficulty soluble in cold, but with much more ease in hot water. The former crystallises in prisms, melts at 128° C., and is easily soluble in alcohol and boiling water, but with difficulty in cold water.

Alpha-tetrahydronaphthylhydrazine is formed by the action of the diazotised base on stannous chloride. White prisms, with difficulty soluble in water, easily in alcohol, ether, benzene, and hot petroleum spirit. It reduces Fehling's solution.

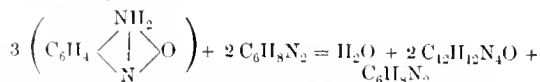
Tetrahydronaphthalene.—Experiments to prepare this body from the diazo compound met with but little success. But by acting with copper sulphate on tetrahydronaphthylhydrazine the compound was easily prepared. Five grms. of the hydrazine are suspended in boiling water, and a hot saturated solution of copper sulphate is gradually added, until the liquid remains blue. After acidulating, the hydrocarbon is distilled over with steam. It is purified by boiling it in etheral solution with sodium, and distils then at 205°—207° C. Colourless oil smelling intensely of naphthalene, absorbing bromine in chloroform solution, and decolourising potassium permanganate in a solution of dilute sulphuric acid instantly. Graebe and von Baeyer have already obtained tetrahydronaphthalenes, but whether they are identical with the one above described or not is still an open question.

The differences between alpha-naphthylamine and tetrahydro-alpha-naphthylamine and their derivatives are shown principally in their physical properties. The absorptive power for light of the coloured derivatives, whether in solution or on dyed silks, shows these differences remarkably well, and the authors explain the result of some spectrum examinations made by Althausse and Krüss.—A. L.

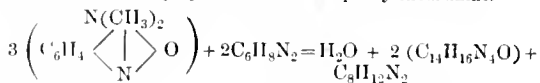
On the Action of Nitroso-bases on Phenylhydrazine.

O. Fischer and Leonard Waeker. Ber. 22, 622—625

NITROSO-BASES act on phenylhydrazine according to the following equations—



Nitroso-aniline Phenylhydrazine. Paraphenylenediamine.



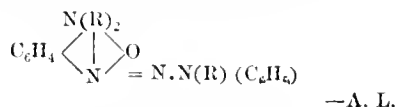
Nitroso-dimethylamine. Paramidodimethylaniline.

The resulting products act like diazo compounds. When boiled, phenol and the original nitro-bases are formed, as well as the corresponding diamines: paraphenylenediamine and dimethylparaphenylenediamine, according to the equation—



Diazobenzene-nitroso-dimethylamine. Nitrosodimethyl-aniline. Amidodimethyl-aniline.

Nitroso-aniline hydrochloride and phenylmethylhydrazine acetate mutually react in aqueous solution, the mixture being well cooled. A yellow precipitate is formed, which, after crystallisation from alcohol, melts at 151° C. It exhibits corresponding properties to those of the above-mentioned products. Nitroso-dimethylaniline and phenylmethylhydrazine yield, under the same conditions, a splendid yellow compound melting after crystallisation from alcohol at 141° C. The constitution of these bodies is—

*Derivatives of Hystazarin.* A. Schoeller. Ber. 22, 683—685.

THIS isomeride of alizarin dissolves in alkali with a beautiful blue colouration. For its discovery and earlier investigation, see this Journal, 1888, 669.

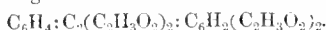
Hystazarinbarium, $\text{C}_{14}\text{H}_6\text{O}_4\text{Ba}$, is prepared by mixing an alcoholic solution of hystazarin, to which a few drops of ammonia have been added, with baryta water, as long as a precipitate falls. It is a dark blue powder.

Hystazarincalcium, $\text{C}_{14}\text{H}_6\text{O}_4\text{Ca}$, prepared in a similar manner, is a dark violet powder. Hystazarinether, pre-

pared by heating together hystazarin, potash, and ethyl iodide, is a yellow, crystalline powder.

Hystazarindithylether, $C_{14}H_{16}O_2(O.C_2H_5)_2$, makes up the bulk of this precipitate. It melts at 160° — 163° C. *Hystazarinmono-ethylether* ($C_{16}H_{18}O_2$) may be precipitated from the alkaline liquid from the last named substance by adding an acid. It crystallises from alcohol in yellow needles melting at 231° — 240° C. The mono-ethylether dissolves in alkalis to a red solution; baryta and lime water have the same effect, especially on warming.

Hystazarin tetracetyloxanthranol is formed by boiling together hystazarin, sodium acetate, acetic anhydride, and zinc dust. From alcohol it crystallises in large colourless needles, melting at 217° — 219° C. Its formula is—



When the acetyl groups are removed according to Liebermann's method with sulphuric acid free from nitroso-compounds, a substance results crystallising from alcohol in small dark yellow plates. It contains somewhat less hydrogen than is necessary for oxanthranol; so that it is either oxanthranol partially oxidised to hystazarin, or a definite intermediate compound of the formula $C_{28}H_{18}O_8$.

—H. T. P.

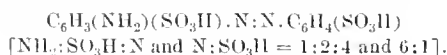
On the Preparation of Meta-Nitrotoluene. K. Buehka. Ber. 22, 829—833.

THE author describes improvements in the preparation of meta-nitrotoluene according to the Beilstein-Kuhlberg method. Pure meta-nitrotoluidine, melting at 116° , is mixed with three times its weight of alcohol and the same amount of concentrated hydrochloric, or, still better, sulphuric acid. After cooling a slight excess of the theoretical quantity of sodium nitrite in saturated solution is added, and the mixture is carefully heated on the water-bath, after first standing for a short time. As soon as the evolution of nitrogen is finished the alcohol is distilled off and the meta-nitrotoluene driven over by a current of steam. The yield was 84 per cent. of the theoretical.

—A. L.

On some Derivatives of Paranitrometa-amidobenzene Sulphonic Acid and the Constitution of "Fast Yellow." F. Eger. Ber. 22, 847—852.

ON nitration of acetylmeta-amidobenzene sulphonic acid a para-nitro compound is obtained which is converted by reducing agents into a paraphenylenediamine sulphonic acid. The diazo-compound of the paranitrometa-amidobenzene sulphonic acid was prepared in the usual way. It crystallises in light yellow needles, exploding on heating, and containing one molecule of water. With Schäffer's β -naphtholsulphonic acid an orange colouring matter is formed. It combines also with β -naphthol and the solution of the azo-dye in caustic soda is coloured violet. By reducing paranitrometa-amidobenzene sulphonic acid with stannous chloride and hydrochloric acid paraphenylenediamine sulphonic acid is obtained in white crystals, soluble in water, with difficulty soluble in dilute, insoluble in absolute alcohol. The author proved further that the phenylenediamine sulphonic acid obtained from amidoazobenzene sulphonic acid or "Fast Yellow" is identical with that above described. According to the author's speculations "Fast yellow" has the constitution—



—A. L.

On the (1:1' or 1, 8) Naphthylenediamine. O. Hinsberg. Ber. 22, 861.

THE naphthylenediamine obtained from dinitronaphthalene and melting at 170° C. has the constitution—



It shows the properties of an orthodiamine. The author has, however, observed that with phenanthrenequinone it does not form an azine; however, the conditions may be varied.—A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Wood Cloth. Eng. and Min. Jour. 47, 215.

MITSCHERLICH has applied the bisulphite process to wood for the production of a fibre which can be spun. Thin boards free from knots are cut into strips in the direction parallel with the grain, and are then boiled with a solution of sulphurous acid or bisulphite. The wood after boiling is partially dried in the open air or in drying rooms, to strengthen the fibre, which is originally very weak and tends to break with the slightest strain, but on drying becomes comparatively strong, and does not resume its very breakable condition on the addition of water. The damp masses on the frames are transferred on a travelling endless cloth to a pair of rollers, which may be plain or corrugated. Cutting of the fibre by the corrugations is prevented by passing the endless cloth over the lower roller and covering the upper one with canvas. The pressed masses are passed through other rollers, preferably to the number of six pairs. By the continued treatment the fibre becomes so pliable and separated that they may be employed directly for coarse filaments. For obtaining a perfect separation of the fibres without material deterioration, the boiled and pressed masses must be completely dried, and then combed in a manner similar to the combing of flax and cotton, but with the difference that the pins of the combing machine must be very strong. The separation of the extractable matter from the fibre produced by the boiling can be effected at any time, but preferably after the fibre has been spun into threads.

—G. H. B.

On the Theory of Dyeing. R. Hirsch. Chem. Zeit. 13, 432 and 449.

KNECHT has established beyond a doubt that the dyeing of animal fibre is a chemical process. Such being the case there is no reason why dyes alone should be regarded (in the restricted sense of the term) as capable of dyeing, unless all dyes have something in common, from a chemical point of view, which distinguishes them from other compounds. Nietzki has indeed endeavoured (Chem. d. org. Farbst., 2nd Edit.) to show that such a relationship exists. But the author considers this hypothesis untenable owing chiefly to the impossibility of including the nitro-bodies in such a system. Nietzki meets this objection with the statement that "nitrophenols probably have a similar constitution to the nitrosophenols, which latter are now generally represented as quinone oximes." But against this view several facts may be advanced: thus, three isomeric nitrophenols are known, which, as regards dyeing, differ only in strength; by the action of one mol. of nitrous acid on phenol, di- and trinitrophenols are also generated; moreover, nitroso bodies and quinones are never obtained in the meta position.

Experiments were made to ascertain whether wool has any affinity for organic substances. Some woollen yarn was boiled with 100 times its weight of water containing 1—2 per cent. of β -naphtholsulphonic acid R, calculated on the weight of the wool. By adding a drop of sulphuric acid, absorption took place more rapidly. The bath was not exhausted after prolonged boiling, but the larger portion of the sulphonic acid had united with the fibre, and could not be removed by boiling with cold water. This wool was now placed in a solution of diazobenzene or diazoxylene, and on adding a few drops of ammonia the dye developed perfectly. The shade and strength was found to correspond to wool dyed with 1 per cent. of scarlet or orange. It is interesting to observe that in presence of lime, baryta, or sodium carbonate formation of the azo-compound takes place very slowly. Caustic soda acts better, and ammonia most rapidly.

Colour reactions in acid solution were produced by immersing the wool, previously treated with naphtholsulphonic acid, in an acidified solution of sodium nitrite; the wool assumed the same light yellowish-brown shade that would be caused by boiling with a 2 per cent. solution

of nitrosonaphthol-sulphonic acid. After washing, the yarn was boiled with a slightly acid solution of ferrous sulphate, and thereby coloured green (Naphthol green of Cassella).

Naphthionic acid is fixed by wool both in acid and alkaline solution. The wool is coloured a dirty yellow-red, even if the purest crystallised product be employed, which points to a decomposition of the acid. But the change it undergoes must be slight, as after diazotising on the fibre an alkaline solution of β -naphthol dyes the wool the shade of roseellin. The property of combining so readily with wool is not shared by all bodies. Thus sulphanic acid is only absorbed in concentrated solutions. This new method of dyeing is of no technical importance, and the author does not intend to prosecute his researches further.

G. H. Hurst has recently stated that on boiling cotton, wool, or silk with benzidine sulphate, and then precipitating the solution with barium chloride, he obtains almost all the sulphuric acid contained in the sulphate, whence he concludes that benzidine has united with the fibre. It is obvious, however, that in either case, whether the benzidine remained in solution or not, he must have found the same quantity of sulphuric acid.—A. R.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Progress in the Colour Manufacturing and Dyeing Industries.
H. Erdmann. Chem. Ind. 12, 124—126.

THIS is a report upon the advance made, during the second half of the year 1888, in the technology of colour manufacturing, dyeing, and calico printing.

Regarding the *azo-dyes*, it is stated that an application in dyeing has been found for Carminaphte (β -naphthylamine-azo- β -naphthol), which hitherto has been used solely for making lakes or varnish stains. As the colour is easily removed from the fibre, Gilliard, Monnet, and Cartier are selling the dye for the purpose of colouring woollen yarns which are to be woven with yarns of a different twist, the various threads being then easily distinguished. The colour disappears on the fabric being heated above 80° C.

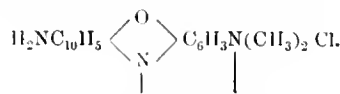
In contrast to this dye, on the other hand, certain *azo-dyes* exhibit a high degree of resistance, for example, the dye (sodium salt of naphthionic acid-azo- β -naphthol-disulphonic acid), known under the names of Fast Red D, Bordeaux S, Amarant, and Azo Acid Rubine, is characterised, even in its most delicate shades of pink, by its great resistance to light.

The demand for the *tetrazo* substantive cotton dyes still increases. Their use in the dyeing of pure and mixed woollen goods is extending, as shades fast to milling are obtained on the animal fibre. The dyes have also been recommended for dyeing cotton hosiery and paper pulp (this Journal, 1888, 843). In consequence of the extraordinary success of these dyes, endeavours are being made to substitute new bases for benzidine, tolidine, anisidine, &c.; Kalle and Co., for example, patenting diamidotolan, $\text{H}_2\text{N} \cdot \text{C}_6\text{H}_4 \cdot \text{C}(\text{C}_6\text{H}_4)_2 \cdot \text{NH}_2$, and A. F. Poirrier and D. A. Rosenstiel, diamidobenzil, $\text{H}_2\text{N} \cdot \text{C}_6\text{H}_4 \cdot \text{CO} \cdot \text{CO} \cdot \text{C}_6\text{H}_4 \cdot \text{NH}_2$. The compound of diamidobenzil with α -naphthylamine can be again diazotised and combined with α -naphtholsulphonic acid. It is doubtful whether the diamines mentioned above can be prepared on an industrial scale. Other substantive dyes, whose natures have not yet been completely made out, have been prepared. The Mikado Brown of Leonhardt and Co. is made by reducing β -nitrotoluene sulphonic acid in alkaline solution with pyrogallol, gallic acid, tannic acid, sumac, &c., when a mixture of bodies is obtained, which dyes unmordanted cotton brown. Mikado Orange is also made in several shades. This dye is recommended for dyeing pure and mixed silk and for calico printing, on account of its fastness to light and soap; it has the peculiarity of not possessing any affinity for wool.

Of more importance is the discovery of a new class of substantive dyes which contain sulphur in combination;

the "Primuline" of Brooke, Simpson, and Spiller, Dahl and Co.'s "Chromogen," and Geigy's "Polychromine" are of this class. Primuline is not an azo-dye, but a diazotisable primary amine. On dry distillation it yields thiop-toluidine. Very similar, therefore, if not indeed identical, is the sodium salt of thio-*p*-toluidinesulphonic acid patented by Dahl and Co., which, like primuline, dyes a bright yellow on unmordanted cotton. The yarn dyed yellow and rinsed is worked in a diazotising bath of nitrite of soda strongly acidulated, and then in dilute alkaline baths of the naphthols or naphthol-sulphonic acids, when deep red (ingrain red) shades are produced; the hydrochlorides of α -naphthylamine and *m*-phenylenediamine give brown, while β -naphthylamine and β -naphthylaminesulphonic acids give yellow-reds and oranges; the shades are fast to milling and fairly fast to light.

To the Badische Anilin und Soda Fabrik is due the honour of introducing the derivatives of *m*-amidophenol as dyestuffs. The phthalicins or rhodamines of this group surprised those interested by the delicacy and fastness of their shades, and now another member, Nile Blue, is much admired for its beauty and purity of tint. This dye belongs to the oxazines. It is manufactured from nitroso-dimethyl- (or diethyl-) *m*-amidophenol and naphthylamine, and has the constitutional formuln—



It dyes cotton mordanted with tannic acid and tartar emetic, and surpasses methylene blue in brightness of shade. Another rival of Methylene Blue is K. Oehler's Ethylene Blue. It differs from Methylene Blue in possessing less resistance to steaming and treatment with alkalis, properties due to its containing some of the Methylene Azure described by Berthelsen.

Amongst the *Indulines* the Paraphenylene Blue of Dahl and Co. is much heard of. The most valuable property of this dye is that it can be darkened on the fibre by oxidation with chromic acid, the shades so produced being exceedingly fast.—E. B.

PATENTS.

Improved Machine for Dyeing Yarns. T. Wolstenholme, Camden, New Jersey, U.S.A. Eng. Pat. 2060, February 5, 1889. 8d.

A DYE-TANK of suitable shape and construction is provided on its outside with a main driving shaft. At each end of the shaft there is fixed a crank arm pivotally connected by rods with beams mounted so as to swing on top of the tank at each end. The inner ends of the beams support a yarn-stick frame in such a manner that the frame can be easily attached to, or detached from, the same.

The frame is preferably rectangular in shape, and in the upper part of it longitudinal beams are placed to hold the yarn-sticks, which rest in notches in the beams. The lower part of the frame is provided with beams which slide vertically, and which have notches in them for receiving yarn-sticks.

The hanks of yarn are placed on the sticks and then on the frame whilst the latter is out of the tank. Then the frame is lowered into the tank, and an up and down swinging motion imparted to it by the mechanical arrangements which are described in detail in the specification, with drawings.—E. B.

Improvements in Sanitary Materials or Preparations for Preventing the Decomposition and Deterioration of Sizes and similar Finishes for Fabrics and the like, and for preventing the Access of Infectious Disease. R. Hannan, Glasgow. Eng. Pat. 3159, February 22, 1889. 4d.

See under XVIII. C., page 411.

VII.—ACIDS, ALKALIS, AND SALTS.

On Existing Tables for Aqueous Solutions of Ammonia at Different Specific Gravities. H. Grüneberg. Chem. Ind. 12, 97—100.

THE growing application of ice-machines has created a large trade in concentrated solutions of ammonia. The tables of Ure and Carius, which are mostly used, differ so widely as to be no longer suitable for trade purposes, and the present investigation was undertaken with a view of supplying the urgently-felt want of more trustworthy tables. The analytical determinations were performed partly by estimating ammonia as ammonio-platinum chloride, and partly by titration, the former method proving more accurate than the latter. Both Davy and Dalton at one

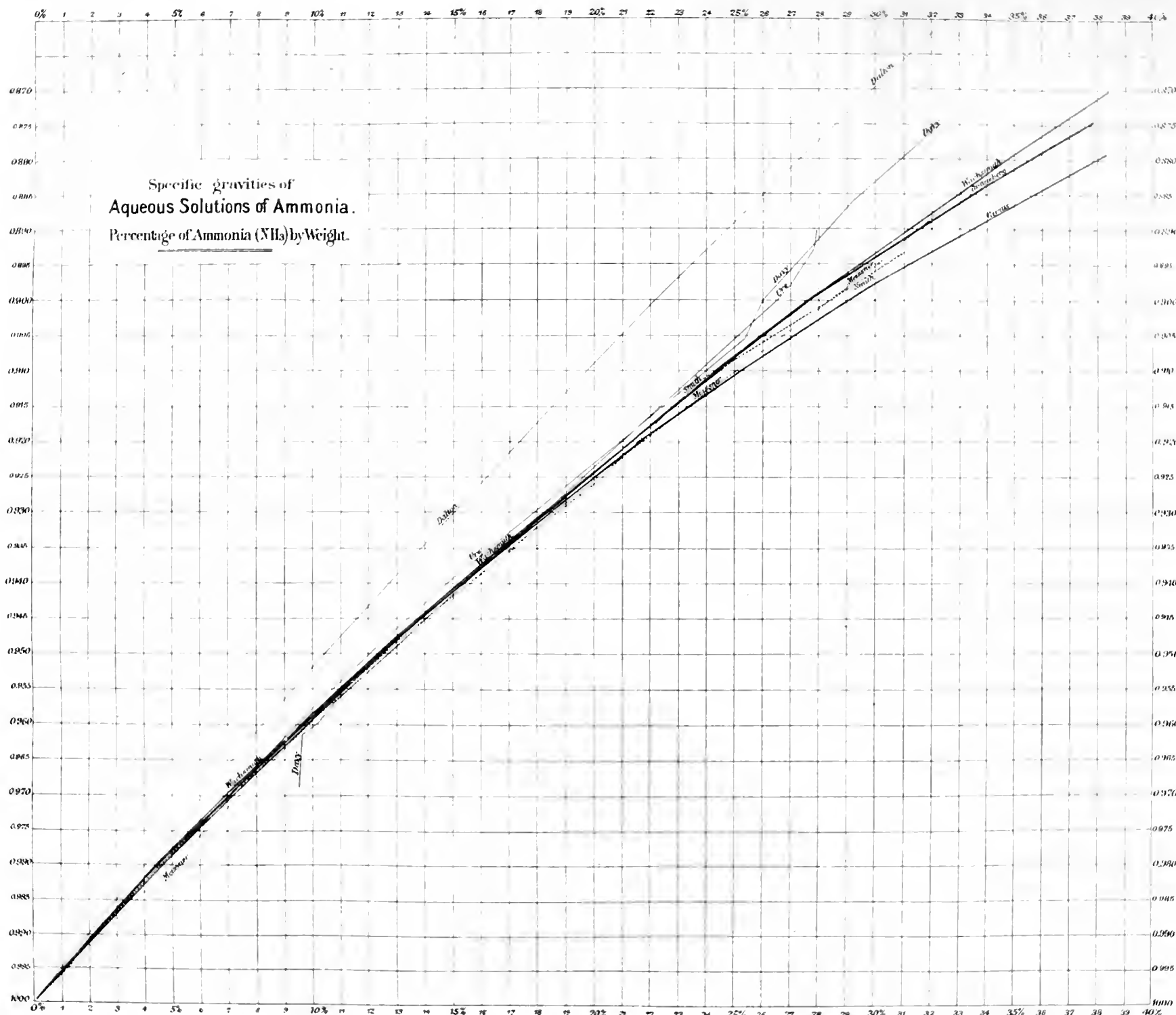
time investigated the same subject, and stated their results in a tabulated form. However, they overlooked the fact that an alteration of volume takes place in mixing concentrated solutions of ammonia with water, and their results are therefore wrong. Ure and Meissner took the alteration of volume into consideration, and although their table approaches more nearly to actual facts, their analytical determinations lack the accuracy required at the present day. Carius and Wachsmuth later on tried to improve on the work of their predecessors, but they unfortunately worked at different temperatures. The latest investigation is published by Lunge and Smith in 1883. In the higher degrees of concentration their results, which were calculated by interpolation, lie between those of Carius and Wachsmuth, whereas Grüneberg's figures, obtained by actual analyses with platinum chloride, agree with those of Wachsmuth. Grüneberg's table is as follows:—

Specific Gravity at 15° C.	Ammonia. Percentage by Weight.	Specific Gravity at 15° C.	Ammonia. Percentage by Weight.	Specific Gravity at 15° C.	Ammonia. Percentage by Weight.
0·890	2·15	0·916	22·50	0·885	33·50
0·974	6·10	0·910	24·40	0·882	34·80
0·950	12·54	0·900	27·70	0·880	35·50
0·926	19·50	0·890	31·40	..	..

COMPARATIVE TABLE of the PERCENTAGE of AMMONIA in AQUEOUS SOLUTIONS of AMMONIA at different SPECIFIC GRAVITIES.

Specific Gravity.	Davy.	Dalton.	Ure. 15·55° C.	Carius. 14° C.	Wachsmuth. 12° C.	Smith. 14° C.	Grüneberg. 15° C.	Differences.
0·880	30·90	..	..	..	34·72	..	35·50	2·10
0·885	29·50	..	..	35·65	32·94	..	33·40	2·00
0·890	28·25	24·7	28·10	33·35	31·16	..	31·40	1·90
0·895	27·15	..	27·40	31·10	29·43	30·35	29·50	1·80
0·900	26·00	22·2	26·50	29·00	27·73	28·40	27·70	1·70
0·905	25·40	..	25·10	27·10	26·09	26·45	26·00	1·60
0·910	24·00	19·8	23·75	25·20	24·49	24·40	24·40	1·55
0·915	22·50	..	22·45	23·40	22·91	22·95	22·85	1·55
0·920	21·10	17·4	21·00	21·70	21·34	21·60	21·30	1·50
0·925	19·65	..	19·40	20·00	19·81	20·25	19·80	1·45
0·930	18·25	15·1	17·85	18·40	18·29	18·70	18·35	1·45
0·935	16·85	..	16·30	16·85	16·79	17·15	16·20	1·45
0·940	15·50	12·8	14·80	15·40	15·29	15·60	15·45	1·45
0·945	14·15	..	13·85	13·95	13·84	14·20	14·00	1·40
0·950	12·75	10·5	12·00	12·55	12·42	12·70	12·60	1·40
0·955	11·40	..	10·70	11·20	11·05	11·30	11·20	1·40
0·960	10·10	8·3	9·50	9·80	9·70	9·85	9·80	1·40
0·965	9·55	..	8·30	8·55	8·35	8·50	8·40	1·35
0·970	9·50	6·2	7·10	7·20	7·02	7·10	7·05	1·30
0·975	..	..	5·90	6·00	5·77	5·80	5·75	1·25
0·980	..	4·1	4·75	4·80	4·53	4·60	4·50	1·20
0·985	..	..	3·50	3·50	3·30	3·40	3·30	1·15
0·990	..	2·0	2·35	2·40	2·10	2·20	2·15	1·10
0·995	..	..	1·20	1·20	1·05	1·10	1·05	1·05
1·000	..	0·0	0·00	0·00	0·00	0·00	0·00	

291



As already mentioned, the different tables cannot be exactly compared with each other owing to the different temperatures used by the various investigators, and to different statements referring to varying percentages and specific gravities. Carius' table, for instance, states specific gravities with uniformly increasing percentages, whereas Wachsmuth's table states percentages with proportionally increasing specific gravities. A more convenient and more general comparison between the different results is obtained by representing them graphically, as shown in the diagram.

In conclusion, a strange and little-known phenomenon is mentioned, which may be observed on neutralising an ammoniacal solution with acid. If litmus solution be used as an indicator, it appears that there is a difference whether the acid is added to the ammonia or whether ammonia is added to the acid. If a standard acid solution be added to ammonia, the litmus solution indicates the neutral point sooner than if ammonia be added to the same standard acid. The use of litmus solution as an indicator with ammoniacal solutions is therefore unsafe; red litmus paper acts more satisfactorily, whereas methyl-orange can be highly recommended.—S. H.

On Magnesium Chloride. K. W. Jurisch. Chem. Ind. 12, 100—103.

THIS article is a criticism of Eschellmann's paper (this Journal 1889, 190—193), which according to Jurisch contains several mistakes. Eschellmann's calculations are somewhat false, and therefore cause wrong conclusions. The right method of calculation is thus:—If

W = grms. of water in magnesium chloride used,

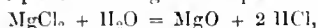
C = grms. of chlorine driven off as hydrochloric acid,

G = loss of weight in grms.,

x = grms. of water driven off undecomposed,

y = grms. of water in residue,

and if the decomposition of magnesium chloride by means of steam take place according to the equation—



so that 18 grms. of water are decomposed for every 71 grms. of chlorine liberated, we obtain the following equations:—

$$\text{I. } G = x + C + \frac{2C}{71} = x + \frac{73C}{71} \text{ or } x = G - \frac{73C}{71}.$$

$$\text{II. } W = x + y + \frac{18C}{71}.$$

If we substitute the value of x into the equation II., then

$$y = W - G + \frac{55C}{71}.$$

The author further objects to Eschellmann's statement of the formation of a distinct chemical compound of the formula $2 \text{MgO} \cdot 4 \text{MgCl}_2 + 3 \text{H}_2\text{O}$, if magnesium chloride be heated between 250° and 350°C . The mass is not a chemical compound at all, but a mixture, the composition of which agrees only temporarily with that formula. As a matter of fact, another of Eschellmann's experiments gives a body which has the formula $3 \text{MgO} \cdot 7 \text{MgCl}_2 + 4 \text{H}_2\text{O}$. Eschellmann's calculation of the cost price of potassium chlorate is also open to objection, as he takes no cognisance of the fact that the price of hydrochloric acid is subject to fluctuations.

In reply to these remarks, Eschellmann admits his mistake as to calculation, but shows that the mistake is so small as to alter his results only in the first decimal place. So slight a mistake cannot upset his conclusions. He yet maintains the formation and existence of a chemical compound of the formula $2 \text{MgO} \cdot 4 \text{MgCl}_2 + 3 \text{H}_2\text{O}$. It is not permissible to take one experiment out of a large number and bring it forward as an argument against the formula. In investigations of this kind every experiment must be considered when drawing conclusions therefrom. Schloesing, in treating magnesium oxychloride with dry hydrochloric acid, obtained a body of a similar composition, and if magnesia, which contains small quantities of

potassium chloride, be chlorinated at high temperatures, the chlorination is arrested as soon as a body of the formula $\text{MgO} \cdot 2 \text{MgCl}_2$ is formed. All these facts speak in favour of Eschellmann's view. He still holds his calculation of the cost price of potassium chlorate to be thoroughly correct, and thinks Jurisch's recommendation of manufacturing potassium chlorate by the Hurter-Deacon process altogether impracticable. In the latter case 33½ tons of hydrochloric acid, containing as impurities copper, arsenic, iron, chlorine, and sulphuric acid, would be recovered as a by-product for every ton of potassium chlorate, and it is not an easy matter to find a regular sale for such large quantities of an impure acid.—S. H.

On the Solubility of Salts. H. Le Chatelier. Compt. Rend. 108, 565—567.

ROOZEBOM has stated that at a given temperature the same salt may have two distinct coefficients of solubility. Thus, he maintains that the hydrate of calcium chloride, $\text{CaCl}_2 \cdot 6 \text{H}_2\text{O}$, at temperatures below its melting point, $30 \cdot 2^\circ$, presents a curve of solubility formed of two distinct branches, which unite at the melting point of the hydrate. The author shows that the above is opposed to the general laws of chemical equilibrium formulated by himself on different occasions. Were Roozeboom's conclusions correct, the heat of dissolution would have to be infinite, which, of course, is out of the question. Actually, the curve shows an angular point, but this is due to the existence of two curves, which meet at the melting point of the salt. One represents the solubility of the hydrate $\text{CaCl}_2 \cdot 6 \text{H}_2\text{O}$, in water, the other a mutual solubility of the same hydrate and the anhydrous salt, or one of its lower hydrates.—A. R.

PATENTS.

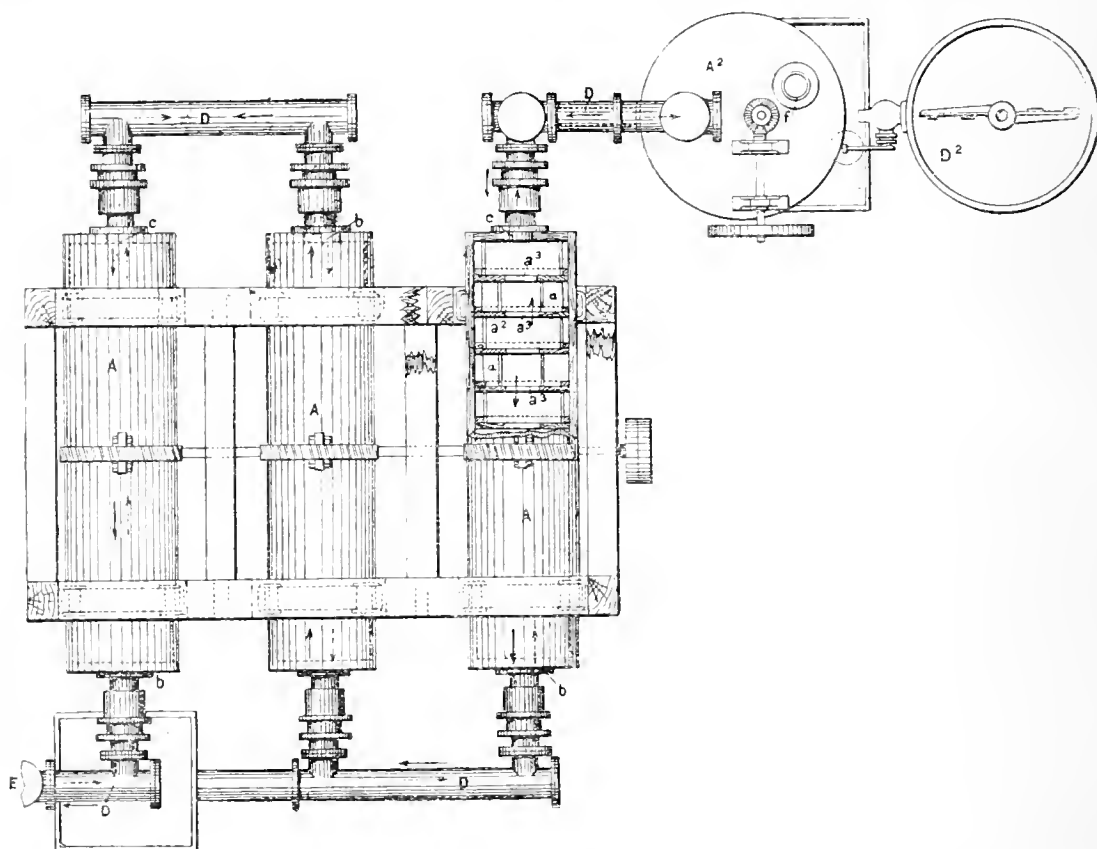
Improvements in the Manufacture of Chromates. W. J. A. Donald, Glasgow. Eng. Pat. 5086, April 5, 1888. 4d.

IN the manufacture of chromates from chrome ore, a waste product is obtained, commonly called chrome waste, which contains about 60 to 70 per cent. of lime and up to 5 per cent. of chromic oxide, which has escaped decomposition in the chrome furnace. The inventor has found that by roasting this waste residue, it may be repeatedly used in lieu of fresh lime in making up the charges for the chrome furnace. Thus, all the chromium compounds, along with any alkalis contained therein, are practically recovered, and contribute materially to the economy of the process.—S. H.

Improvements in Means to be Employed in the Production of Solutions Containing Sulphurous Acid or its Salts.

I. S. and J. T. McDougall, Chadderton. Eng. Pat. 5212 April 7, 1888. 11d.

THE object of this invention is to effect the absorption of sulphurous acid by a solution, the gas not being under pressure. This is accomplished by conveying the sulphurous acid gas through a series of closed oblong vessels, which are fixed in a horizontal or inclined position, supported in such a manner that they can be rotated. The diagram shows in plan an apparatus arranged according to this invention. A are three rotary vessels and A² one stationary vessel. Attached to the interior of the vessel A are projections a, intercepted by transverse partitions a², with central apertures a³, to allow of the passage of the gas and liquid through the vessel. These projections, as they move, carry with them a portion of the liquid and shower it upon the gas, whilst the transverse partitions prevent an immediate flow of the liquid from one end to the other. The level of the latter is such as to leave a passage for the gas above the liquid. D are connecting pipes for the passage of the gas and liquid from vessel to vessel. The liquid to be treated is stored in the tank D², and its flow is regulated by a tap. A continuous current of sulphurous acid enters the apparatus at E, and meets successively a shower of liquid in the



rotating vessels, the liquid, as will be noticed, travelling in a direction opposite to the current of the gas, and when it leaves the apparatus is obtained in a condition most highly saturated with the gas. The course of the gas is shown by the dotted arrows, and of the liquid by the full arrows.

—S. H.

Improvements in the Production of Alkalis and Alkaline Salts from the Slag resulting from the Manufacture of Ingot Iron and Steel. T. Twynam, London. Eng. Pat. 5386, April 11, 1888. 6d.

See under X., page 399.

Manufacture of an Ammonia Carbonate applicable as Baking Powder. R. E. Chatfield, Sewardstone. Eng. Pat. 6151, April 25, 1888. 6d.

AMMONIA is first prepared by heating ammonium sulphate with magnesia in excess, to 240° F. The ammonia passes off, and is "condensed in aqueous solution." Carbonic acid gas, in the proportion of 19 parts to 17 parts of gaseous ammonia, is then admitted into the vessel containing the aqueous ammonia, and the whole allowed to crystallise. The crystals are then treated with a further quantity of carbonic acid gas, when they become friable and inodorous.

—S. G. R.

Process for the Conversion of Chloride of Calcium into Chloride of Magnesium and Carbonate of Lime by Means of Oxychloride of Magnesium and Carbonic Acid. G. Borsche and F. Brünjes, Leopoldshall-Stassfurt, Germany. Eng. Pat. 7046, May 11, 1888. 4d.

BURNT or precipitated magnesia is treated with magnesium chloride to form the oxychloride. This is then mixed with the chloride of calcium liquors and carbonic acid gas passed in with the formation of calcium carbonate and magnesium chloride.—S. G. R.

Improvements in the Construction of Apparatus for Making Bisulphites or other Compounds used in the Treatment of Wood Pulp and other Fibrous Materials and the like. I. S. and J. T. McDougall, R. K. Hartley, and T. Sngden, Oldham. Eng. Pat. 7060, May 11, 1888. 11d.

THE object of this invention is the absorption of sulphurous acid by a solution, without using a contrivance for forcing the gas through a depth of liquid. A series of vertical towers is provided, as to interior arrangement, with perforated plates. These towers are made with coned bottoms terminating in pipes, which are fitted with a pumping device. The pipes extend upwards, and open into the top of the tower. The solution to be treated is run into the coned part of the last tower, and the pump conveys it to the top, whence it gradually descends through the plates to the bottom. The different coned bottoms are connected by pipes, so that the liquid may flow from one tower to the next. The gas enters at the bottom of the first tower, and after rising upwards, escapes from the top to the bottom of the next, and so on. The gases and liquids are thus passed in opposite directions, the number of towers being regulated according to the degree of saturation required.—S. H.

Improvements in Metallic Drums, and Lids therefor. R. Jackson, Rainhill. Eng. Pat. 7317, May 17, 1888. 6d.

A DRUM for containing caustic soda or other like substances has an aperture in the drum-head having inward-turned edges. The lid is made with one or more projecting clips and guide-pieces, by which it is readily and securely applied to the drum head. The lid has also an aperture on one side for the insertion of a wrench, by which it may be easily prised off.—E. S.

Improvements in or relating to the Manufacture of Vinegar. E. Barbe, Paris, France. Eng. Pat. 17,549, December 1, 1888. 11d.

THE invention consists of apparatus for automatically feeding the acetifying arrangement with liquor at intervals by means of feed vessels containing siphons brought into action by the periodical compression or rarefaction of air. For details, the specification and four sheets of drawings must be referred to.—J. M. H. M.

Improvements in Apparatus for Evaporating Brine, and for similar Purposes. H. H. Lake, London. From J. M. Dunan, Silver Springs, Wyoming, U.S.A. Eng. Pat. 785, January 16, 1889. 8d.

See under I., page 380.

Improvements in the Manufacture of Salts of Alumina. E. Augé, Montpellier, France. Eng. Pat. 1189, January 22, 1889. 4d.

THE object of this invention is the manufacture of salts of alumina free from iron. Finely-pulverised bauxite is treated with sulphuric acid. After the reaction is finished, usually after five hours, the mass is diluted with water and run off into a settling-tank. If the whole of the iron be not converted into peroxide, some oxidising agent is added. It is important that no free sulphuric acid be present. A certain quantity of bauxite, such as that employed in the first stage, is then introduced into the aluminium sulphate solution, along with some potassium salt, the quantity being regulated according to the quantity of iron to be precipitated. The solution is energetically agitated, allowed to stand for a time, when the iron is slowly eliminated. At the end of about 25 days the amount of iron is quite inappreciable.—S. H.

Improved Manufacture of Porous Surfaces for the Absorption of Liquids and Gases. F. H. Glew, London. Eng. Pat. 4609, March 26, 1888. 6d.

THE porous surfaces are made by coating gutta-percha sheet with fine pieces of coke, pumice, or sponge. The pieces of coke or pumice, after being properly sifted, are placed on an iron plate heated to such a temperature as to soften the gutta-percha when pressed upon it by a pad of leather or cloth. The particles of coke then adhere to and become embedded in the surface of the gutta-percha sheet. Such surfaces, when saturated with a liquid, are used to charge the air or any gas brought in contact with them with the vapour of the liquid. When it is necessary to carry on the evaporation of the liquid at a temperature which would melt the gutta-percha, the surfaces are made of porcelain or stoneware coated with particles of coke or pumice.—H. S. P.

Improvements in the Manufacture of Porous Artificial Stone for Use as Indestructible Wicks or Burners for Lamps, or as Filter Partitions and the like. W. D. Gooch, F. H. Varley, and F. B. Lidstone, London. Eng. Pat. 5214, April 7, 1888. 6d.

THE ingredients employed to make the porous stone may be used in the following proportions by weight:—12 parts of fine sand, 4 parts of asbestos, $1\frac{1}{2}$ parts of borax, $2\frac{1}{2}$ parts of red lead or litharge. These proportions may be varied, and clay, rotten stone, emery, or corundum may be used instead of the sand and asbestos, and glass and suitable flux instead of the borax and lead oxides.

The ingredients are first thoroughly mixed, reduced to a fine powder, and then heated to incipient fusion, allowed to cool, and again reduced to powder. This powder is packed into moulds of a suitable shape and heated to a bright red heat. The particles of powder are amalgamated and a stone of fine texture and of high degree of capillarity is produced.

—H. S. P.

An Improved Process for Painting on Glass, Porcelain, Tin, and the like. W. Michaelson, London. Eng. Pat. 338, January 8, 1889. 4d.

See under XIII., page 403.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Turbid Glass. F. Knapp. Chem. Zeit. 13, 388.

NORWEGIAN felspar, when smelted, gives a glass which is not transparent, while at the same time it does not resemble milk-glass. Microscopic examination shows the opacity to be due to the existence in the glass of a large quantity of small bubbles. By mixing lime with the felspar, however, the character of the glass is completely altered, the change varying with the quantity of admixed lime. Small additions of lime have the effect of producing a clear, colourless glass perfectly free from bubbles; a further addition produces rich opalescence, whilst a still further addition gives an opaque glass without opalescence, but possessing a good surface. These facts show, the author points out, that the milkiness in this glass is in no way due to phosphates or fluorine compounds.—T. L. B.

PATENTS.

A Special Disposition of Furnace for Annealing Thick Plate Glass by letting it Cool gradually and by Annealing it with Gas Heat. D. Gilles, Marches-les-Dames, Belgium. Eng. Pat. 1449, January 31, 1888. 8d.

THE annealing furnace is a construction of masonry about 97 ft. long and of a width regulated by the length of the plates to be annealed. These latter are introduced direct from the casting table into one end of the furnace, which may be heated by special fires (gas or otherwise) or by the waste heat from the melting kilns. Plates of $\frac{1}{8}$ in., $\frac{3}{16}$ in., $\frac{1}{4}$ in. thickness can be annealed in 1, $1\frac{1}{2}$, and 2 hours respectively.—A. R. D.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Influence of Frost on Portland Cement. Böhme. Mittheil. d. Königl. techn. Versuchs. 1889, 43—49.

EXPERIMENTS were made on 10 samples of cement in the following directions:—

I. The general properties of the samples. II. Their strength in tension and compression, alone and in admixture with three times their weight of normal sand after seven and 28 days, with and without an exposure for a part of that time to a temperature of -12° C. to -15° C. III. Their power of enduring attrition. Tests were made on the pure cement and on mixtures of 1 part by weight of the cement to 1, 2, 3 and 4 parts by weight respectively of normal sand, all of which, including the cement alone, were subjected to the following conditions during setting:—(a), exposed to moist air; (b), left 24 hours in the air, then transferred to water; (c), left 24 hours in the air, then exposed for 20 hours to a temperature of -12° to -15° C., placed in water at 18° C. for four hours, again frozen for 20 hours, thawed once more for four hours, and left for the rest of their allotted time under water.

The attrition to which they were subjected was obtained by the use of a revolving iron plate supplied with a fixed quantity of emery powder, loaded with a constant weight, and run for a given number of revolutions. The results are recorded in very lengthy tables, and the conclusions to which they point are—

(1.) That the chief effect of the frost is to retard the setting of the cement, causing it to remain soft, and reducing its tensile strength and resistance to compression.

(2.) That this retardation has little permanent effect, the cement becoming nearly equal to the unfrozen specimens after the lapse of 28 days.—B. B.

PATENTS.

Improvements in certain Fire-resisting Materials. F. M. and D. D. Spence, Manchester. Eng. Pat. 5917, April 20, 1888. *Sd.*

THE invention consists in forming into solid compact cakes a mixture of sulphate of alumina or "aluminoferric" (a commercial sulphate of alumina containing a notable proportion of ferric sulphate) and sawdust. These cakes are to be used for filling the hollow jackets of fire-resisting safes, boxes and chests, the cavities of fire-resisting doors, &c., instead of the packing powder of granulated alum and sawdust that is usually used.—H. S. P.

Improvements in Waterproof Roofing Material. E. Edwards, London. From F. Meyer, Ostritz, Germany. Eng. Pat. 18,708, December 21, 1888. *Ad.*

WOVEN fabric of jute, flax, or other spun material is soaked in a solution containing 1 part of tungstate of soda and 10 parts of sulphate of ammonia to 100 parts of water, to render it "sufficiently incombustible." It is then dried and asphalted by passing through a heated mixture of Trinidad asphalt, tar, oil, and sulphur, in the proportions, by weight, of 1,000 of asphalt to 400 of tar, 10 of oil and 3 of sulphur. Any superfluous of asphalt mixture is removed from the surfaces of the fabric by passing it, whilst still hot, through a heated stripping frame. It is then sanded on both sides, pressed between iron rollers, and cut into suitably-sized pieces.—H. S. P.

X.—METALLURGY, MINING, Etc.

An Investigation of the Construction of the various kinds of Cupolas that have been used for the Melting of Pig-Iron. M. A. Gonvy, Jr. *Mémoires et compte rendu des travaux de la Société des Ingénieurs Civils.* Paris, 1887, 723—766.

THIS is a long historical paper giving illustrations and short descriptions of a large number of cupolas, from the early "calabash," consuming 40 lb. of coke for every 100 lb. of cast-iron melted, down to the modern forms of cupola with a consumption of about 6 to 15 lb. of coke for the same quantity of metal. There are 43 drawings in the paper. Among the early kinds of cupolas were those having superposed tuyeres for the purpose of accumulating large quantities of iron for large castings. Modifications were also introduced for the use of a hot blast and for the utilisation of the waste heat at the throat for producing the same. These, however, have been gradually abandoned as it was found that no economy of fuel took place. The hot blast only served to increase the temperature of the zone of fusion, with the formation of a larger quantity of carbon monoxide in the waste gases. Drawings are given showing suggestions as to the position, shape and size of the wind box, from the Woolwich cupola, in which it surrounded nearly the whole furnace the air entering at top, to that which possessed simply an annular chest round the tuyeres.

The influence of the profile of the furnace is next entered into, and the cupolas of Gerhardt, Ireland, and the St. Gervais foundry are described, in each of which the cylindrical section is replaced by one showing bosses and a narrow crucible part, after the style of the ordinary blast furnace. Gerhardt also supported the upper part of his furnace on angle irons to facilitate repairs to the lower

portions. Other improvements have been introduced for the purposes of cooling the walls, equally distributing the blast, &c. In the Gmelin cupola, water circulates in an envelope of plate iron from the bottom to the top of the furnace. Lawrence places, immediately above the principal tuyeres, three rows of orifices of rectangular section, each row being narrower than the one below it, for the purpose of obtaining an equal distribution of the blast. Bocard aims at the same object by a continuous slit round the circumference of the cupola between the upper part and a movable crucible. Krigar in his early forms ensures regular distribution of air by an annular box with vertical rectangular orifices, and collects the melted iron in a separate crucible. Herbertz also employs an annular tyere which can be adjusted according to height of fused material. He also produces a forced draught by means of an ejector. (See this Journal, 1886, 451.)

There is an objection to the Herbertz cupola in the fact that the waste gases contain a large amount of oxygen. Analyses of gases from the tops of Krigar and Ireland systems range from 12.4 to 16.5 per cent. in volume of CO_2 , 2.5 to 11.7 per cent. of CO, and oxygen nil, while the Herbertz shows 10.7 to 11.5 per cent. of CO_2 , 0.0 to 3.4 per cent. of CO, and 6.7 to 8.2 per cent. of oxygen, which means that 37.7 cubic feet of useless air is drawn in for every 100 cubic feet which traverse the furnace. Woodward employs a steam ejector over the centre of the throat of the eupola and has a side charging hopper, but the furnace seems to give irregular results, probably from the same cause as the Herbertz.

A new form of Krigar cupola with a forced draught is shown in Fig. 1. This furnace possesses a separate crucible for the melted iron, over which part is a chimney with a steam ejector, by which the air is drawn through the tuyeres downwards, and the products of combustion, passing over the melted iron, keep up the temperature of the metal. The disadvantage of this system apparently is that the charge is not heated until it reaches the zone of fusion, but on the other hand it is maintained that there is less waste of iron and that there is less decarburisation as the metal is not subjected to the oxidising action of an ascending current of air.

The next series of furnaces are those which have been constructed with a view of ensuring complete combustion of the carbon. Voisin appears to have been about the first to give attention to this matter. He placed a second row of tuyeres above the zone of fusion on a level with the height at which most carbon monoxide was produced, with the idea of burning it into carbon dioxide again, and so creating a second zone of fusion. Good results were obtained, and cupolas on this principle were built at Angers, and by Hamelins and Stewart, the latter of which possessed three rows of tuyeres, the top row being provided with regulating valves. But above this second zone and even the third, carbon monoxide becomes again formed, although to a less extent than before. To obviate this, Norris constructed a furnace in which the tuyeres were not in a horizontal plane but were placed in helical form around the eupola, so that the air was introduced at different heights. This arrangement, however, did not give good results, and entailed a considerable loss of iron.

In the Greiner and Erpf cupola, built somewhat after this principle, the difficulty seems to be overcome, and further good results appear to be attained. This eupola possesses a horizontal row of tuyeres near the base, so as to keep the zone of fusion low as in the usual forms, and from 50 to 60 inches above this commences a series of small tuyeres arranged in a helix, which terminates some distance higher up. These small tuyeres supply the air to burn the carbon monoxide at different levels, and the heat which is produced, being thus distributed, is insufficient to raise the coke to a red heat so that no further reduction of the carbon dioxide takes place. In the early furnaces these small tuyeres were supplied from a helical wind box. The more modern forms provide for the regulation and control of the blast through them by connecting each one separately by a vertical tube with the wind chest of the lower tuyeres. Fig. 2 illustrates

Fig. 1.

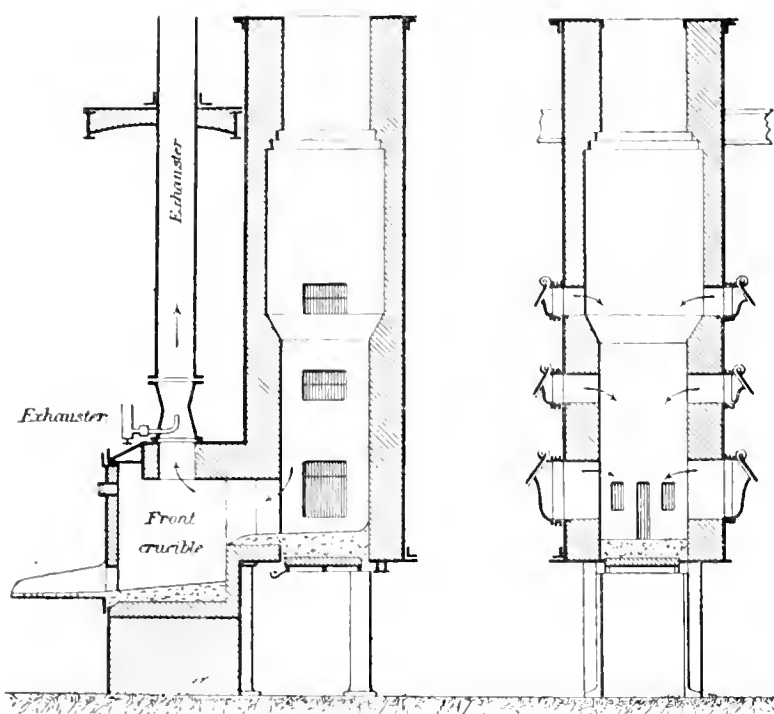
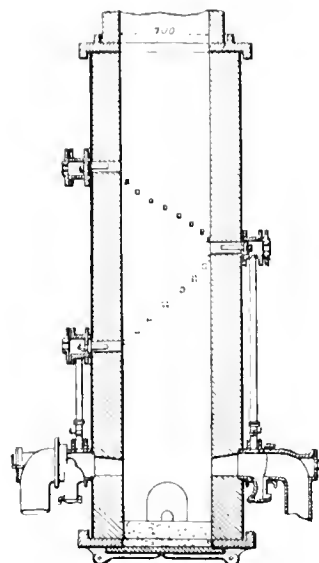


Fig. 2.



this cupola. Each small tuyere possesses a glass back by means of which the necessity of admitting air can be readily ascertained. The waste gases are very cool and contain very little and sometimes no carbon monoxide. There are, however, no analyses obtainable. The theoretical amount of coke necessary to melt 100 lb. of iron is

four pounds. An instance is given in which this cupola melted 100 lb. of iron with three pounds of coke, the apparent anomaly being explained by the fact that the carbon monoxide produced from the coke required to heat the bed is utilised. The following table shows the comparative results of this system with some others:—

	Chisnyoviz Cupola.		Westphalia Union Society.		Greiner and Erpf, Société de Construction à Prague.	Greiner and Erpf, Fonderie de Schlick, Budapest.
	Old System. Two Tuyeres.	The same changed to Greiner and Erpf.	Common Ireland Cupola.	The same changed to Greiner and Erpf.		
Number of charges	207	136	Mean of 3 months.	Mean of 7 heats.	414	213
Weight of iron per charge in lb.....	882 to 1,102	882 to 1,102	..	..	882	882
Weight of coke per charge in lb.	74 to 119	22 to 33	..	..	35	35
Coke for melting in per cent. of iron	9.46	2.80	9.65	5.26	3.95	3.88
Total coke (bed included) in per cent. of iron	12.28	6.27	15.71	9.18	5.97	6.68

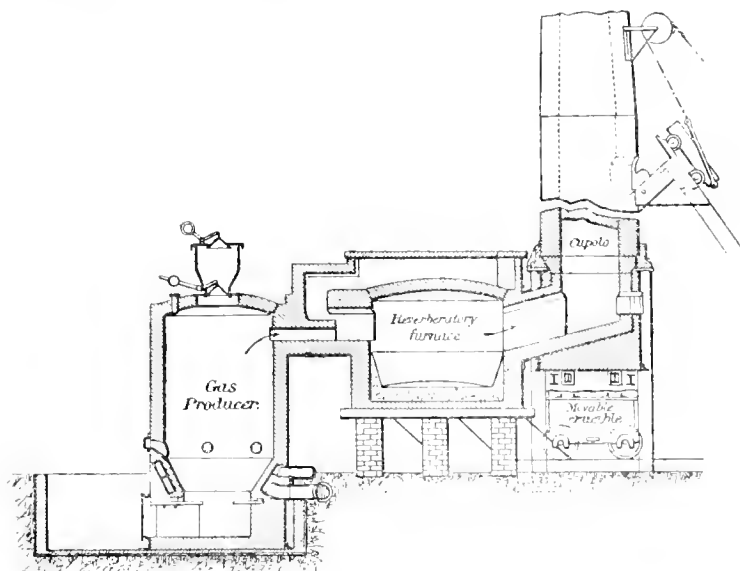
Gas cupolas have been constructed in various forms, such as the Dufréné (see this Journal, 1882, 411), which is furnished with a gas producer; the Besson (see this Journal, 1882, 410), which is a kind of huge blowpipe, and the Bramhall, wherein the regenerative system was suggested on the supposition that the waste gases were at a higher temperature than they should be. Krigar patented a cupola with two shafts, one closed and containing coke, the other open and in which the pig-iron is placed. The air is forced through the lower portion of the closed shaft containing the incandescent coke, and rises through and melts the iron in the open shaft.

Riley adapts the gas producer to the reverberatory and cupola furnaces combined for the production of open hearth steel. Fig. 3 illustrates this arrangement. Pig-iron and steel scrap is charged without any solid fuel into the

cupola, and is melted there by the heat from the reverberatory. The metal runs down on to the bed of this latter and there becomes converted into steel. The time of open hearth operation is accelerated 10 per cent., due to the fact that the oxidation of the carbon and silicon takes place in the cupola. Siemens mentions experiments with this furnace, in which coke was charged into the cupola with the iron, but they were not successful because decarburisation did not take place in the cupola, but only in the reverberatory under a layer of slag. The consumption of fuel in the gas producer was reduced to 7.2 per cent. of the pig iron charged, and the product per hour was two tons.

Other systems of cupolas are mentioned, wherein the object has been to produce metal of a required composition. The Batty, the Voisin-Bichon, the Herdlitschka, in which

Fig. 3.



the regenerative system is proposed, and the Ibbruger where the gas is directed downwards after the principle of the Krigar. Lastly, the Krupp system, intended specially for the purification of iron. The iron mixed with oxide of iron is melted in an upper eupola and runs down into the purifying eupola, both of which are made of neutral bricks,

with a basic or neutral lining. The oxide of iron may or may not be mixed with lime or oxide of manganese. The silicon, manganese, sulphur and phosphorus are in great part removed. The results obtained in a small temporary apparatus were the following :—

—	C.	Si.	Mn.	Cu.	P.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Impure Iron	3.730	0.470	3.500	0.250	0.600
Purified iron. 1st trial	3.000	0.004	0.128	0.250	0.136
„ 2nd „	3.400	0.005	0.210	0.250	0.187
„ 3rd „	3.400	0.002	0.470	0.250	0.210

The cinder obtained from one of these contained P_2O_5 , 5.28 per cent.; MnO , 26.30 per cent.; FeO , 41.28 per cent.; SiO_2 , 17.60 per cent.; CaO , 1.46 per cent.; MgO , 0.36 per cent.; and S, 0.66 per cent.

In conclusion the author states that the result of this study shows that the lowest net cost of melting iron in a eupola has been obtained in the Greiner and Pipf forms,

and further, that the employment of blast heated by the waste gases, the substitution of a natural or a steam exhaust draught for a pressure blast, the injection of various materials at the tuyeres or otherwise do not appear to be attended with economy. Finally, the following table is given, showing the dimensions, particulars, working cost, &c., from practical results of 33 different eupolas :—

A COMPARISON OF VARIOUS CUPOLAS.

Designating Number.	Kind and Location of Cupola.	Dimensions of the Cupolas.			Tuyeres.		Charges.	
		Useful Height.	Diameter of the Shaft.	Diameter at the Zone of Fusion.	Number.	Diameter in Inches.	Iron per Charge.	Coke per Charge.
1	Royal Foundry at Gleiwitz.....	In. 86.61	In. 24.8 to 30.7	In. ..	2	..	Lb. 330.71	Lb. 85.98
2	Royal Foundry at Berlin.....	..	24.8	..	4	1.57	275.58	44.09
3	K. Marienhütte Zwickau.....	120.86	31.49	..	2	4.64	606.29	99.21
4	K. Marienhütte Zwickau.....	110.23	48.81	..	3	4.64	1,047.14	165.35
5	Hungary works.....	177.16	39.37	35.43	4 + 4	3.93	1,102.36	176.37
6	Magdeburg works.....	86.61	37.00	..	..	..	661.42	55.42
7	Ireland, eupola at Hörde.....	185.43	43.20	..	4 + 8	..	1,102.36	143.30
8	Gerhardi (Ireland)	123.41	37.79	..	4 + 8	{ 2.67 } { 5.11 }	511.18	55.11

A COMPARISON OF VARIOUS CUPOLAS—*continued*.

Designat- ing Number	Kind and Location of Cupola.	Dimensions of the Cupolas.			Tuyeres.		Charges.	
		Useful Height.	Diameter of the Shaft.	Diameter at the Zone of Fusion.	Number.	Diameter in Inches.	Iron per Charge.	Coke per Charge.
		In.	In. { 13'38 } { 5'40 }	In.			Lb.	Lb.
9	Portable cupola at Saint Gervais.....	66'14	{ 13'38 } { 5'40 }	10'42	3	2'55—2'75	110'23	13'22
10	Ireland, at Borsig's works.....	145'90	37'00	..	4 + 8	..	1,653'55	110'23
11	Krigar, at Zwickau.....	181'10	37'00	..	..	..	1,102'36	92'59
12	Krigar, in Prussia.....	122'04	31'49	23'62	2	15'74 / 1'07	220'47	13'22
13	Krigar, in Silesia	161'42	30'89	30'84	4	6'18	1,047'24	77'16
14	Krigar.....	137'79	20'47	19'68	2	14'17 / 3'97	..	..
15	Ireland, at Britannia Foundry	146'06	45'00	27'00	20	..	2,240'00	167'56
16	Krigar, in Westphalia.....	145'07	43'30	29'13	1	..	1,102'36	79'37
17	Voisin	179'12	35'43	..	4 + 4	..	..	..
18	Novers Foundry	129'92	{ 17'71 } { 29'52 }	18'89	6	5'51	661'42	46'29
19	Foundry at Saint Gervais.....	140'67	{ 25'59 } { 46'15 }	32'28	6	7'87	1,763'78	123'46
20	Krigar, at a works in Saxony.....	144'49	37'40	29'52	3 + 6	0'62 and 0'27	2,204'73	160'94
21	Woodward, at Liverpool	150'00	29'92	27'16	4 + 8	{ 7'00 } { 2'96 } —1'96	1,102'36	55'11
22	Ibbruger, at Gleiwitz .....	..	..	..	36	..	661'42	55'11
23	Sheffield, hot blast.....	144'00	{ 18'03 } { 53'93 }	48'03	4 + 4	..	1,102'36	169'76
24	Gmelin, at Budapest.....	157'48	33'46	33'46	2	7'87	..	..
25	Voisin, at Pompey, I.....	159'44	{ 35'43 } { 37'79 }	{ 37'79 } { 25'98 }	4 + 4	3'14—1'96	Large fragments.	
26	Voisin, at Pompey, II.....	159'44	{ 29'55 } { 29'52 }	{ 29'52 } { 21'65 }	4 + 4	3'14—1'96	..	..
27	Angers, Ecole des Arts et Métiers.....	157'48	23'62	18'89	4 + 4	{ 2'75 } { 2'75 } —2'16	1,102'36	55'11
28	Herbertz, at Cologne, a	140'15	35'43	27'55	1	{ 2 Tgr. = 94'48 } { h = 0'59—0'78 }	1,102'36	138'89
29	Herbertz, at Cologne, b.....	140'15	35'43	27'55	1	..	1,102'36	55'11
30	Common cupola, at Chisnyoviz.....	141'73	27'55	27'55	2	{ 8'45 } { 7'48 }	992'13	99'21
31	Greiner & Erpf, at Chisnyoviz.....	141'73	27'55	27'55	2 + 11	{ 8'45 } { 7'48 } —0'98	992'13	27'55
32	Greiner & Erpf, at Budapest.....	..	33'46	..	4 + 15	..	881'89	35'27
33	Greiner & Erpf, at Prague .....	..	31'49	..	4 + 4 + 15	..	881'89	35'27

Designat- ing Number.	Kind and Location of Cupola.	Pressure of Blast in Inches of Water.	Consumption of Coke.		Mean Product per Hour in Tons.	Remarks.
			For Melting.	Total.		
			Per Cent. 20'0	Per Cent. 27'7		
1	Royal Foundry at Gleiwitz	16'0	22'0	..	From Le Calendrier Allemand "Hütte."
2	Royal Foundry at Berlin .....	..	16'4	19'2	2'0
3	K. Marienhütte, Zwickau.....	..	15'8	18'0	3'0	
4	K. Marienhütte, Zwickau.....	..	15'3	17'02	..	
5	Hungary works.....	..	8'83	15'00	2'75	From "Hütte."
6	Magdeburg works .....	..	13'0	14'0	..
7	Ireland, cupola at Hörde .....	..	15'74	13'5	2'4
8	Gerhardi (Ireland)	15'74	10'0	13'5	2'4	According to M. Maillard.
9	Portable cupola at Saint Gervais .....	..	..	13'48	..
10	Ireland, at Borsig's Works.....	..	5 to 7'5	13'0	..	According to "Hütte."
11	Krigar, at Zwickau .....	..	8'4	13'0	..
12	Krigar, in Prussia	19'68	6'5	13'0	2'0	According to M. Fehland.
13	Krigar, in Silesia	17'71	7'4	13'0	2'7 to 4'0	

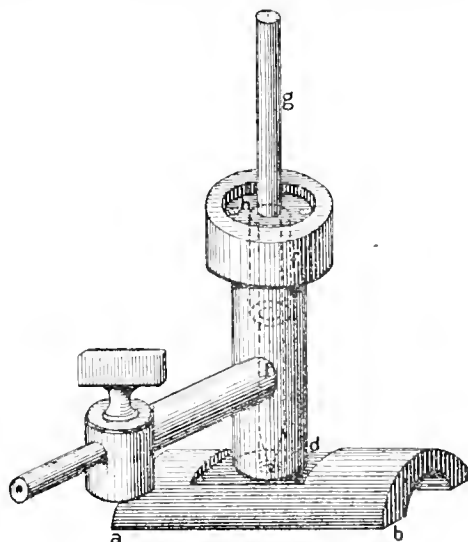
A COMPARISON OF VARIOUS CUPOLAS—*continued*.

Designating Number.	Kind and Location of Cupola.	Pressure of Blast in Inches of Water.	Consumption of Coke.		Mean Product per Hour in Tons.	Remarks.
			For Melting.	Total.		
14	Krigar	Per Cent. 6'0	Per Cent. 13'0	..	} According to M. Kerpely.
15	Ireland, at Britannia Foundry .....	..	8'0 to 9'0	10' to 12'	6'1
16	Krigar, in Westphalia	9'84	7'2	12'0	5'5	} According to M. Fehland.
17	Voisin	9'05	8'0	11'0	..	
18	Nevers Foundry	6'49	6'26	10'63	1'35	} According to M. Maillard.
19	Foundry at Saint Gervais .....	..	5'71	11'28	..
20	Krigar, at a works in Saxony	7'3	9'8	..	} According to "Hütte."
21	Woodward, at Liverpool .....	..	5'0	8'12	..
22	Ibbringer, at Gleiwitz	24'40	..	10'0	..	} "Dingler's Polyt. Journal."
23	Sheffield, hot blast .....	..	6'0 to 7'0	..	..
24	Gmelin, at Budapest	14'75	7'5	..	4'8	} According to "Stahl und Eisen."
25	Voisin, at Pompey, I. ....	..	9'5	11'0	3'0
26	Voisin, at Pompey, II.	7'5	9'0	2'5 to 2'8	} According to "Stahl und Eisen."
27	Angers, Ecole des Arts et Métiers	8'66	..	9'3	4'0	
28	Herbertz, at Cologne, a	-2'55	10'4	12'7	..	} According to "Stahl und Eisen."
29	Herbertz, at Cologne, b	-2'55	5'0	9'9	..	
30	Common cupola at Chisnyoviz	9'46	12'28	..	} Certificates of these establishments.
31	Greiner & Erpf, at Chisnyoviz .....	..	2'8	6'27	..
32	Greiner & Erpf, at Budapest .....	..	3'88	6'68	..
33	Greiner & Erpf, at Prague .....	..	3'95	5'97	..

—A. W.

Occurrence of Gas in Iron Tubes Rolled by the Mannesmann Process. Finkener. Mitteil. d. Königl. techn. 1889, 41—43.

By the Mannesmann process iron tubes are rolled from a solid cylinder of the metal by dint of forcing the surface of the cylinder to increase so largely that to supply the necessary material rupture occurs and a cavity forms which eventually becomes the interior of the finished tube. This cavity is not vacuous as might be expected, but contains gas. In order to obtain this gas for analysis, recourse was had to the apparatus figured in the accompanying block. It



having been ascertained that the tube to be examined was free from cracks by exposing it under water to a vacuum, a place on it was filed nearly through, and the testing repeated. In the figure, *a, b* is a portion of a steel cylinder of such radius as to fit snugly saddle-wise on the iron tube; between the two is a piece of sheet-rubber to make the joint airtight, and they are bound together by rubber bands. *a, b* has the upright tube *d* screwed and sweated into it, and this contains a plunger *g* passing through a gland *h*, the packing of which consists of a piece of rubber tube. The tube *l*, carrying a stop-cock, serves to make or sever connexion with a mercury pump. The apparatus being in position, *g* is removed, a cork-borer inserted in its place, and a disc of rubber cut out by it from the sheet between *a, b* and the iron tube; *g* is then put back, the whole apparatus exhausted and left for an hour to see if it be tight. The cock is then closed, and the iron tube pierced by a few blows on *g*. The cock is now cautiously opened, the gas existing in the iron tube pumped out, collected and analysed. The iron tube is afterwards allowed to fill itself with air under ordinary pressure, its contents pumped out, measured, and its volume thus ascertained.

Of the two tubes thus examined, the first had a volume of 104.4 cc. and contained 12.51 cc. of gas; the second, of 123.4 cc., and held 9.11 cc. of gas. After disproving the existence of carbon dioxide, hydrocarbons, and air, in the gas from the first tube, the experiment was spoiled. An analysis of the gas from the second tube showed it to consist of 99.0 per cent. of hydrogen, and 1.0 per cent. of nitrogen.

The iron of which the tube was made contained—

	Per Cent.
Carbon	0.46
Silicon	0.25
Phosphorus	0.022
Sulphur	2.01
Manganese	0.23
Copper	Trace

—B. B.

Nickel Ores in the Ural. M. Stenbok. Chem. Zeit. 13, 430.

IN the neighbourhood of Ekaterinburg, in the Province of Perm, an apple-green clay containing nickel was long ago discovered. It contains a very pure hydrated nickel and magnesium silicate, and is free from cobalt, sulphur, and arsenic. 330,000 puds (1 pud = 40 lb.) of this ore have of late years been treated. By the metallurgical process a nickel containing 97 per cent. of the pure metal may be obtained. Large quantities of this ore occur in a quartz vein which, it is calculated, will certainly yield 200,000 puds of metallic nickel. Recent analyses by Huntington prove that the ore from the quartz vein contains about 7 per cent., and the soft ore 14–19 per cent. of nickelous oxide. It is proposed to prepare the pure metal electrolytically. Samples of the latter have given an excellent alloy with steel and aluminium. The alloy contains 60 per cent. of iron, 20 per cent. of nickel, and 20 per cent. of aluminium.—A. R.

Dry Concentration of Antimony Ore. J. Heard. Eng. and Min. Journ. 47, 187–188.

AFTER referring to the commercial impossibility of concentrating low grade stibnite ores by wet methods, the author describes the results of some experiments with one of Paddock's pneumatic jigs. (See Eng. and Min. Journ., 1886, July 3rd.) In crushing the ore it was found that the portion which passed through a 60-mesh screen required no further concentration, and attention was chiefly confined to the portion which passed a 24-mesh screen, but remained on the 60-mesh. This material contained 18.27 per cent. of Sb_2S_3 , and the result, after working at the rate of 120 pounds per hour, showed: heads, 78.34 per cent.; middlings, 16.54 per cent.; tailings, 7.5 per cent.; and the respective quantities were as 1:2:5. No clean particles of stibnite, free from gangue, could be discerned in the tailings, and only 3.81 per cent. out of the 7.5 per cent., was present as Sb_2S_3 , the remainder being there as oxide, which could not be expected to concentrate. Much, however, depends on the speed of the machine, the pitch, the feed, &c., the slightest variation in these producing marked differences in the results. The same material worked through at 1,908 pounds per hour, gave heads, 83 per cent. of Sb_2S_3 , and tailings, 10.73 per cent.

Coarser material did not work so well, the portion which passed a 12-mesh but remained on the 24-mesh sieve, and which contained 14.12 per cent. of stibnite, gave heads containing 74.53 per cent.; middlings, 18.26 per cent.; and tailings, 10 per cent.; rate of working 1,500 pounds per hour.

An experiment was made with a limestone of sp. gr. 2.77, containing 10 per cent. of garnet of sp. gr. 3.16; size between 24 and 60-mesh, and rate of working 930 pounds per hour. The heads contained 49.45 per cent. of garnet; the middlings, 8.65 per cent.; and the tailings, 2.75 per cent.

The best results were obtained with the ore which had passed a 24-mesh screen, and the best working conditions for this material were found to be:—machine running 540 strokes; 1,460 pounds per hour; stroke, $\frac{1}{2}$ inch; hopper in top-hole; pitch, 7°; dip, 2°. The experiments were abruptly suspended, but the results are considered satisfactory, although insufficient to show the cost of working.—A. W.

PATENTS.

Improvements relating to the Production of Metallic Compounds or Alloys. J. Sinclair and J. P. Smith, London. Eng. Pat. 2182, February 13, 1888. 6d.

The patentees claim the use of "hard spelter" in making copper, tin, and zinc alloys, and the use of potassium salts as fluxes in preparing the alloys.—H. S. P.

Improvements in the Method of making Aluminium Bronze. L. Q. Brin, Paris, France. Eng. Pat. 3547, March 7, 1888. 6d.

THE patentee heats a volatile salt of aluminium, such as the chloride, in a fire-clay retort, and conducts the resulting vapours into a muffle containing copper or some alloy of copper in the form of scrap, and which is set in a reverberatory or other suitable furnace heated to 800°–900° C. The copper is previously cleaned by pickling, and coated with a flux such as a mixture of two parts of borax, two of sodium chloride and one of sodium carbonate made into a paste with water. The aluminium salt is said to be decomposed and the nascent aluminium to combine with the copper, forming an aluminium bronze. Any waste vapours or gases pass into a cooled receiver of glazed earthenware, where any volatile salt of aluminium is condensed, and can be used over again.

With regard to working details, the retort may be charged with a mixture of 100 parts of clay (containing about 50 per cent. of alumina), 125 parts of sodium chloride or other suitable chloride, and 15 parts of fluorspar; an alternative charge consists of 100 parts of clay, 80 parts of sodium chloride, potassium chloride, &c., and 65 parts of powdered slag obtained as a residue in a previous operation. The vapours of the aluminium salt are carried over from the retort in which they are produced by a stream of inert or reducing gas such as is got by passing air through red-hot coke. A charge of 240 lb. in the retort suffices to convert 1,000 lb. of copper into 1½–2 per cent. aluminium bronze. By repeating the treatment the alloy may be enriched to any desired extent.—B. B.

Improved Apparatus for the Expulsion of Chlorine or other Noxious Gases from its Solution. W. D. Bohm, Acton. Eng. Pat. 4699, March 27, 1888. 8d.

THE gases are expelled by blowing air or steam through the liquid or semi-liquid mass containing them. The operation is to be carried on in a closed chamber, with an inlet pipe, dipping below the surface of the liquid in the chamber, and an exit pipe to take away the noxious gases. The method is specially adapted to the "Newberry-Vautin" chlorination process for extracting gold. (This Journal, 1887, 824.)—H. S. P.

Improvements in the Manufacture of Aluminium and Alloys of Aluminium. S. Pearson, J. Liddon, and J. H. Pratt, Birmingham. Eng. Pat. 5316, April 10, 1888. 6d.

ONE hundred parts by weight of cryolite are mixed with 50 parts of bauxite, kaolin, or aluminium hydrate, 50 parts of calcium chloride, oxide, or carbonate, and 50 parts of coke or anthracite, all being in powder. The resulting mass is heated to incipient fusion in a furnace or in a crucible made of, containing, or lined with carbon, in which case the carbon may be omitted from the mixture. The heating is continued for two hours, at the end of which time it is alleged that the aluminium is reduced and exists disseminated in minute globules throughout the mass. A mixture of 25 parts each of potassium and sodium chlorides is then added, and the temperature raised to bright redness; the aluminium collects at the bottom of the crucible. A better separation is, however, effected by powdering, washing and drying the melt, and adding it to fused zinc, which alloys with the aluminium and can afterwards be removed by distillation. If copper be used instead of zinc in this process aluminium bronze is obtained.

Other fluxes than those mentioned may be employed.

—B. B.

Improvements in the Production of Alkalis and Alkaline Salts from the Slag resulting from the Manufacture of Ingot Iron and Steel. T. Twynan, London. Eng. Pat. 5386, April 11, 1888, 6d.

THE phosphorus in phosphoric pig iron is removed by alumina in combination with some basic body such as lime or soda. The resulting slag consists largely of

aluminium phosphate mixed with silica, iron oxide, &c. This slag is ground and mixed with sodium chloride and coke-dust, moistened with water, made up into briquettes and dried. These are stacked in a enpola together with a little coke to serve as fuel. When the mass has attained a red heat, a current of superheated steam is introduced, and this together with the blast employed causes a reaction between the aluminium phosphate and sodium chloride, resulting in the production of sodium phosphate and sodium aluminate, hydrochloric acid being simultaneously given off. When the reaction is finished, the mass is withdrawn from the furnace, digested with water, and the dissolved phosphate and aluminate of soda separated by crystallisation. The sodium phosphate may be converted into calcium phosphate and sodium hydrate, whereas the sodium aluminate is decomposed by carbonic acid into sodium carbonate and alumina, which latter is re-used in the converter.—S. H.

Improvements in Treating Auriferous and Auvoargentiferous Ores. J. Weirich, Béziers, France. Eng. Pat. 6104, April 24, 1888. 6d.

A PROCESS for preparing for amalgamation auriferous minerals in which the gold is chiefly associated with antimony, arsenic, and sulphur, and from which the gold cannot be extracted by amalgamation after known methods of treatment. The ores are first roasted and then fused with sodium carbonate or calcium carbonate, or a mixture of these, with the addition of a small quantity of charcoal. Sometimes silica must be added to obtain fusion. The fused mass is ground to a powder, from which the gold and silver can be separated by amalgamation.—H. S. P.

A New and Improved Method of making Malleable Iron Castings. C. C. Townsend, Madras, E. Indies. Eng. Pat. 10,347, July 17, 1888. 4d.

WROUGHT iron scrap is melted down in crucibles with the addition of small quantities of phosphorus and silicon, and when cast gives a malleable material which is also capable of being chilled. The best mixture is:—22 lb. of scrap, 7 oz. of fine river sand, and 5 oz. of bone-ash, with a small quantity of glass as a flux.—A. W.

Improved Method of and Apparatus for Extracting Tin from Scraps containing it. L. A. Groth, London. From O. Leprévost-Bourgerel and E. Pierron, Paris, France. Eng. Pat. 13,234, September 13, 1888. 8d.

THE use of hydrochloric acid, dissolved in water or in the state of a moist gas, for the extraction of tin from tinned iron scraps, is unsatisfactory owing to the facility with which the iron is acted upon. The inventors employ dry gaseous hydrochloric acid, obtained by heating to 160° C. commercial hydrochloric acid with twice its volume of sulphuric acid of sp. gr. 60° B., or by drying with sulphuric acid of sp. gr. 60° B. the gas evolved by the action of sulphuric acid on a chloride. The scraps are placed in a series of closed chambers connected with each other by pipes for conveying the gas. The gas enters at the bottom of each chamber, passing out by a pipe at the top which is connected to the bottom of the next chamber in the series. The process is so arranged that the strongest gas comes first in contact with the scrap that has been most acted on.

When this scrap is sufficiently acted on the chamber containing it is disconnected from the rest, and the scale that has formed on the scrap is dissolved off with water. The tin is then separated from the solution of stannous chloride thus obtained by immersing in it zinc ingots covered with calico. The crystals of tin that are precipitated upon the calico are collected, pressed to remove adhering solution, and melted with zinc chloride, which protects the molten metal from oxidation, and can be used repeatedly.—H. S. P.

Improvements in and relating to the Utilisation of Waste Pickle from Tinning and Galvanising Works where Hydrochloric Acid is used in the Process of Pickling. H. J. Kirkman, Swansea. Eng. Pat. 14,061, September 29, 1888. 4d.

TO the waste pickle, milk of lime is added in sufficient quantity to neutralise the free acid and to precipitate the iron as hydrate. The oxide formed can be used for purifying illuminating gas, and for other purposes.—S. G. R.

Improvements in or relating to Protecting Surfaces of Iron or Steel from Oxidation and for giving them an Ornamental appearance, applicable for Gun Barrels and other bright work. J. Ewart, Birkdale. Eng. Pat. 16,451, November 13, 1888. 6d.

THE surface of the article is rendered perfectly smooth; it is then treated with nitric acid or other solvent until the grain of the metal appears, when it is washed, dried, heated to a dull red heat, avoiding oxidation, and immersed while hot into any, but preferably castor, oil till cold. The effect is a firmly adherent thin carbonaceous coating with a dull black appearance which can be made bright black by lacquering.—A. W.

Improvements in the Process of and Apparatus for Zincing Metal Articles. F. W. Koffler and A. Breden, Vienna, Austria. Eng. Pat. 16,674, November 16, 1888. 8d.

THIS is an improvement on Eng. Pat. 12,485 of 1885 (this Journal, 452) for zincing sheet metal by removing the surplus zinc from the sheet by revolving brushes whilst it is being withdrawn from the zinc-bath. The patentees now claim the process as applied to metal articles of various kinds besides sheet metal. Zincd articles treated in this way may at once be coated with another metal by mere immersion in a bath of the molten metal (a result which must otherwise be obtained by plating or electro-plating), the reason being that by brushing off the surplus zinc a clean alloy of the remaining zinc and the metal of the article is obtained, having a melting point high enough to bear immersion in the bath of metal with which the article has to be coated; but if the surplus zinc be not removed it burns when the article is dipped in the bath and the zinc oxide formed prevents further alloying. Drawings are given of the machinery used in the operation.—H. S. P.

Improvements relating to the Desulphurisation of Ores and to the Decomposition of Metallic Salts and similar Compounds. H. H. Lake, London.—From O. B. Peck, Chicago, U.S.A. Eng. Pat. 17,069, November 23, 1888. 8d.

THE object of this patent is to overcome, by centrifugal force, the chemical affinity of the various elements in compounds such as regulus, sulphides, pyrites, sulphates, mattes and speise. The molten material, such as copper regulus, is run into a kind of revolving bottle and there subjected to great centrifugal force, by which it is claimed that the metals come out of combination with the sulphur and arrange themselves in the order of their densities. It is also maintained that the sulphur, which in the ordinary smelting process is lost, can be recovered as such in a "greater or less state of purity."—A. W.

Improvements in Crucible Furnaces. C. A. Piat, Paris, France. Eng. Pat. 18,414, December 17, 1888. 8d.

THE furnace consists essentially of two crucibles, one above the other, whereby the waste gases from the fuel employed to melt the charge in the lower are made to heat a fresh charge in the upper crucible. The lower crucible revolves on trunnions, as in the ordinary Piat furnace, so that it may be emptied without removal from the furnace, and the upper crucible, with a removable base and a few holes

in its sides to permit circulation of the hot gases through the charge, is lowered down so as to form a lid to the former. Drawings are given.—A. W.

Improvements in and relating to a New and Useful Process for Treating Crude or Low Grade Steel to Produce a Refined or High Grade Steel. H. M. Redemann and R. J. Tilford, Louisville, U.S.A. Eng. Pat. 2068, February 3, 1889. 6d.

This process is for converting Bessemer and other mill steels with "coarse grain" into a more refined material with a "fine grain and silky fracture," and with an increase in carbon, "tensile strength, elasticity, toughness, and ductility." The metal is heated to a white heat and plunged into a bath capable of yielding a hydrocarbon gas. The bath consists of glycerin and water in the proportion of 3 ozs. of the former to half a gallon of the latter, and while this gives good results, still better ones are obtained if to the above bath are added in various proportions, spirits of nitre, ammonia, ammonium chloride, zinc sulphate and ammonium alum. Many advantages are set forth in the specification, and the superiority is maintained of this process over the cementation method.—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Secondary Batteries. W. H. Preece. J. Soc. Arts 22, 510.

THE results of five years' experience of different forms of storage cells is summarised. One of the greatest difficulties with such cells has been found to be due to the formation of lead sulphate on the plates. The method first suggested by Barber-Starkey to avoid this evil has been tried. It consists in adding a solution of sodium sulphate to the dilute sulphuric acid with which the cells are usually charged. Comparative experiments have shown the immense benefit of the sodium sulphate. It completely prevents sulphating and at the same time does not impair the cells in any way. The electrolyte that gives the best results is made as follows:—To a quart of saturated carbonate of soda solution add slowly, during continuous agitation, 12 fluid ounces of strong sulphuric acid. This mixture constitutes the sulphate of soda solution. One part of it by volume is added to 19 parts of water and 5 parts of sulphuric acid. The electrolyte so made should have a specific gravity of 1.21.

—W. W. H. G.

PATENTS.

An Electrical Battery. N. G. Thompson, London. Eng. Pat. 3550, March 8, 1888. 6d.

CARBON, packed in with some such metal as copper, is employed as negative electrode, in a "chloridising" solution such as hydrochloric acid, common salt, &c. The metal employed must be electro-positive to carbon in the particular solution, and electro-negative to the zinc or other metal employed as positive electrode. The action with copper and carbon as negative electrode, is that the chloride of copper existing in suspension is decomposed, the copper being deposited and the chlorine uniting with the hydrogen adhering to the negative electrode. This deposited copper is, however, taken up by the unexpended portion of the "chloridising" solution, and the liquor thus regenerated. When crushed carbon is used with a weak "chloridising" liquor a "distributed conductor" may be used to lessen the resistance.—E. T.

Improvements in the Electrolytic Production of Metals. C. Hoepfner, Berlin, Germany. Eng. Pat. 4626, March 26, 1888. 6d.

This invention relates principally to copper, and depends on the fact that while hitherto copper has been reduced from ores and matte, and refined from the crude metal by the electrolysis of solutions which contain its salts in the cupric state, it is now proposed to use them in the cuprous condition, thereby economising the energy necessary. The process is carried out as follows: Chlorinated, roasted, waste ores are extracted with a strong solution of common salt, and the cupric chloride thus obtained reduced by any suitable means, such as sulphurous acid or ores containing metallic sulphides. Impurities, such as tin and arsenic, are precipitated by adding "sulphur compounds of the alkalis or oxides or carbonates of the alkalis, either in solid or liquid form;" and the precious metals are precipitated by iron or copper or by electrolysis. The purified solution of cuprous chloride is electrolysed with carbon electrodes, and yields 40 kilos. of copper per horse-power in 24 hours. At the anode, which is separated from the cathode by means of a parchment membrane, cupric chloride is produced, and is converted into cuprous chloride by the use of the reducing agents mentioned above, which may be used either within or without the decomposing vessel. If the ores to be treated contain gold, it is necessary to push the action at the anode further than is generally necessary, viz., until the liquid there contains free chlorine.

During the lixiviation of the ore, and afterwards during electrolysis, the solution is preferably agitated, and for this purpose gases containing no free oxygen should be used. Gases containing carbonic oxide are said to be best, because of the fact that the union of this constituent with the cuprous chloride aids the depolarisation of the electrodes.

Copper ores containing silver, or silver ores themselves, may be treated by the process, the silver being dissolved as chloride in the highly-chlorinated liquid at the anode, and precipitated from this solution by electrolytic or chemical means.

The same occurs with lead, using hot solutions, save that no special process for its precipitation is necessary, as it precipitates spontaneously on cooling.

The patentee claims the use of the other two halogens as well as that of chlorine.—B. B.

Improvements in Storage Batteries. H. Edmunds, London. Eng. Pat. 5191, April 7, 1888. 6d.

To prevent "spraying" in accumulator cells, paraffin wax, or any suitable insulator, is melted and poured upon the surface of the liquid in the cell, so that a solid cake may be formed over it. A hole is made, and covered by a cap, from which, if desired, the gases may be led away and utilised. If necessary, the cake may be strengthened by a suitable framework, or by ledges round the sides of the cell. The generation of gases during charging will cause liquid to rise through the hole and flood the top of the cake. If this is considered undesirable, some of the liquid may be siphoned out, so as to leave a space below the cake.—E. T.

Improvements in Galvanic Batteries. P. R. de Fauchaux D'Humy, London. Eng. Pat. 6322, April 28, 1888. 8d.

This invention is for facilitating the processes of emptying and filling a battery of many cells.

Each battery cell is divided into three compartments by two partitions of carbon, which themselves form the negative electrode. The middle compartment is meant to contain the depolarising liquor, and communicates at the bottom with an accessory cell at the side. The two outer compartments contain the positive electrode and the acid-working solution, and communicate in like manner with a second accessory cell on the other side. All the accessory cells of the different battery cells on one side communicate by separate flexible tubes with a trough that can be raised above the cells or lowered below them. When lowered the liquid from the cells flows through the accessory cells and

their flexible tubes to the trough, and the cells thus become emptied, or vice versa. The accessory cells on the other side, communicating with the other set of compartments, are connected in like manner with a second trough, that can be raised or lowered. At the top of the apparatus two supply tanks, containing the two liquors used, communicate, through flexible connexions controlled by screw pinch valves, with conduits, which, by short tubes ending above the different accessory cells, distribute to these fresh liquor when required. Each accessory cell is fitted with a lip, and any overflow passes by these lips into long troughs placed one on each side of the battery, and thence into general collecting vessels at the base of the apparatus.

The positive electrodes are attached to a shaft, and counterpoised, so that by moving a handle they can all simultaneously be removed from the cells. In the inventor's drawings there are two series of battery cells, one above the other, and similar moving parts in each are so connected as to move together by the movement of one handle.—E. T.

Improvements in Electric Batteries. B. Willeox, London. From B. A. Abakanowicz and A. d'Arsonval, Paris, France. Eng. Pat. 7876, May 29, 1888. 8d.

ELECTRODES exposing great surface, but with little internal resistance, are made by compressing small pieces of the material chosen in a tube or cylinder of porous material or perforated metal by a spring, weight or such device. In a typical device, the granules are covered by a plate, which is forced down by a spring, whose pressure is regulated by a nut screwing on a rod which passes down the axis of the cylinder, and is attached to its bottom.—E. T.

Improvements in Electric Batteries. A. Imshenetzky, St. Petersburg, Russia. Eng. Pat. 9381, June 27, 1888. 8d.

THE zinc in this cell is placed in a liquid that has a greater affinity for oxygen than zinc has, so that this liquid, and not the zinc, becomes the depolarising agent, and the zinc remains intact. The electrodes are zinc and carbon, and the exciting liquids (1) Solutions of sulphite or hyposulphite (thiosulphate) of sodium or potassium, these salts being converted during action into sulphates, which sulphates, by calcining with carbon and treatment with sulphurous acid, can be reconverted into hyposulphites, or into sulphites by conversion into carbouates and treatment with sulphurous acid, and (2) surrounding the carbon, a dilute chromic or manganic acid solution. The sulphate of potash formed after conversion into the carbonate and hydrate, can be calcined with manganese peroxide into potassium manganite. A solution of the latter salt on heating yields potassium manganate. Where facilities for utilising the by-products in this way do not exist, other well-known depolarisers may be used. The cell is divided into three compartments by two porous plates, the zinc occupying the centre one, and by an arrangement of tubes and cocks a continuous circulation of liquor is kept up.—E. T.

Improvements relating to Electric Secondary Batteries or Accumulators, and to the Manufacture of Electrodes therefor. L. Paget, New York, U.S.A. Eng. Pat. 17,223, November 27, 1888. 8d.

THE inventor casts a frame of lead with numerous thin vertical bars. These are completely imbedded in the pasted material, so that the whole plate has very little of its lead framework exposed. This is preferred for the negative plate. The positive is made of vertical strips of lead, corrugated obliquely, and so placed that the corrugations of adjacent strips cross each other. The strips are supported by a cross-bar at the top, but are free elsewhere. These plates, unlike the last, expose a very large amount of surface, can expand without buckling, and allow very free circulation of the liquid. They are "formed" in a fraction of the time required for Planté plates in "1 to 5 sulphuric acid" containing 10 per cent. of nitrite or acetate of ethyl, with a small amount of nitric or acetic acid (not more than 1 per cent. of nitric or 2 per cent. of acetic acid).

To get rid of sealing, the inventor constructs plates of numerous elongated stirrups or loops of transversely corrugated lead, the loops being packed with the paste, and attached above to a horizontal bar. These allow of free expansion. For portable accumulators, the containing case is made of conducting material, preferably lead or type-metal, and the alternate plates are soldered, burned, or otherwise metallically attached to it by their lugs at two or more places. The other set of plates are in the same way metallically connected by their top lugs with a lid or cover, insulated from the case. This arrangement has the additional advantage that if two or more cells be placed one upon the other, they are thereby at once connected in series.—E. T.

Improved Methods of Preparing Solution Compounds for Galvanic Batteries. W. P. Kookogey, Brooklyn, U.S.A. Eng. Pat. 320, January 8, 1889. 4d.

THE improvements are in the manufacture of dry battery compounds from bichromate of soda, sulphate of soda, and sulphuric acid, in a more homogeneous form. Taking these ingredients, in the proportions of 7 : 8 : 16, in the order enumerated, one method is to dissolve the soda salts in about half the quantity of warm acid, and when cold add the rest of the acid all at once. Another method is to make a supersaturated solution of the bichromate in water, add half the acid warm, and dissolve the sulphate of soda in the liquor, then add, all at once, the rest of the acid. In either case, after adding the second part of the acid, the liquid must be stirred as vigorously as possible till solidification takes place.—E. T.

Improvements in and relating to Electric Secondary Batteries or Accumulators. O. Lugo, New York, U.S.A. Eng. Pat. 746, January 15, 1889. 6d.

THIS accumulator is built on the principle of Grove's gas battery. Metallic zinc is suspended in a solution of chloride of lead in sodium chloride. Lead in a finely-divided or allotropic condition is thereby deposited on the zinc. A little copper sulphate is added, by which finely-divided copper is thrown down. The two metals, in their finely-divided state, occlude oxygen or hydrogen readily by a mere physical process, but resist oxidation or any change of form. Accumulators are made by packing this material into porous jars round metallic or metalloid plates.—E. T.

Improvements in the Manufacture of Electrodes for Secondary Batteries or Accumulators. L. Paget, New York, U.S.A. Eng. Pat. 2066, February 5, 1889. 6d.

TO produce a plate in which the active material merges into the supporting plate without any distinct line of demarcation, a two-part mould is taken, of the usual construction for casting plates, and the parts intended to form the lead-grid are packed with some substance which is able to reduce the active material when in a fused state. The fused active material being run into the mould, where it touches the reducing agent, it is reduced to lead, which acts as the supporting frame or grid, and must necessarily be in the most intimate possible contact with the active material. As reducing agents carbon or carbon and nitre are suitable for oxide of lead. For chloride of lead, powdered zinc, tin, or magnesium may be used.—E. T.

Improvements in Electric Contact and Alarm-Thermometers. M. Huhl, J. M. and F. Lautenschläger, Berlin, Germany. Eng. Pat. 2628, February 14, 1889. 6d.

THE object of this invention is to produce a thermometer that shall complete an electric circuit at any desired temperature with great accuracy. For this purpose, the capillary tube of the thermometer is contracted just below the lowest division of the scale. Immediately below this contraction a platinum contact wire is sealed in, while a second is sealed into the bulb. To set the thermometer to complete the circuit at a temperature of say 50°: it is first heated accurately to the point marked 50° on the scale and

then allowed to cool. In cooling the mercury column breaks at the constriction, and the mercury below the latter sinks past the platinum contact into the bulb. If, however, the temperature should rise to 50°, the mercury in the bulb expands till its end just touches the platinum wire at the constriction and so complete the circuit. To use the thermometer for a higher temperature the thermometer is merely heated to that temperature as before, but for a lower temperature the column of mercury must be joined by shaking before using.—E. T.

Improvements in Galvanic Batteries. E. D. Cross, Chicago, U.S.A. Eng. Pat. 2949. Feb. 19, 1889. 8d.

In the outer containing cell is placed a porous pot, and inside that a second. The cell is thus divided into three compartments. In the first, or outermost, carbon tubes are hung in a circle from a carbon ring which acts as a lid to this cell. In the second compartment are placed zinc rods suspended by screws from a ring of good conducting material which acts as a lid to this second cell. The electrodes of the third cell are of carbon, and form a repetition, on a smaller scale, of those of the first. The carbon tubes have a C cross-section. They are lined first with a layer of porous material, preferably paper, and then filled up with asbestos wool. The lids of compartments one and three are coated above and below with paraffin wax, which helps to steady the carbon tubes. A tube, of suitable material, passes from the top of the outer compartment to the bottom of the inner, which is packed with alternate layers of carbon and asbestos and then filled with water. The fumes from the outer compartment are thus absorbed by the liquor of the inner; this liquor acquiring thus strong oxidising properties, is able to supplement the outermost compartment, which contains nitric acid with a small proportion of ammonium nitrate. The porous pots may be painted with a gelatin solution to prevent too rapid diffusion.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

On Commercial Oleic Acid, Its Adulteration with Linseed Oil and Detection of the Latter. Granval and Valser. J. Pharm. Chem. 1889, 232.

See under XXIII., page 425.

The Determination of the Solidifying Points of the Fatty Acids from Tallow, of Beef Tallow, and of Lard. Finkener. Mitth. d. Königl. techn. Versuchs. 1889, 27—41.

See under XXIII., page 423.

PATENT.

Improvements in that Class of Detergent Compounds in which Ammonia is employed as one of the Ingredients. W. P. Thompson, Liverpool. From C. C. Parsons, Brooklyn, U.S.A. Eng. Pat. 7095, May 12, 1888. 6d.

Two ingredients which when together in contact with water, will evolve ammonia, are dried, granulated, and mixed, and there is then interposed between their particles a protecting medium, the object of which is to prevent contact between the substances, and thus postpone the evolution of ammonia until the desired moment. Such protecting media are heavy-bodied paraffin oil, resinous oil or varnish, glue, size, or paraffin wax. The compound produced by incorporating the granular salts (e.g., 66 parts of sulphate of ammonia and 60 parts of soda-ash) with the liquid medium may be used alone, or mixed with soap or soap-powder, and with insoluble detergents, such as sand, pumice, &c.—W. L. C.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

PATENTS.

Improvements in Preventative and Anti-Fouling Coatings for Ships' Bottoms. J. B. Hannay, Cove Castle. Eng. Pat. 7033, May 11, 1888. 4d.

This is an improvement on Eng. Pat. 12,499 of 1886 (this Journal, 1887, 601), in which patent a preservative coating was formed "by combining linseed oil, rosin, mineral naphtha, powdered metallic zinc, oxide of zinc, or magnesia, or oxide of iron, or other basic oxide or mixture of basic oxides, and red oxide of mercury." In the present invention mercurous chloride (calomel) is substituted for the oxide of mercury, as much calomel being used as of red oxide formerly. "The combining of mercurous chloride with any of the coating compositions in use renders them more satisfactorily anti-fouling."—B. II.

Improvements in the Treatment of Tar Oils for Use as Wood-Preserving Paints or Coatings. R. Avenarius, Ganalgesheim-on-the-Rhine, Germany. Eng. Pat. 7398, May 18, 1888. 6d.

This invention relates to the treatment of tar oils for use as a preservative paint ("carbolineum") for wood, and consists in subjecting the tar oil to the action of chlorine. By the action of the chlorine "the antiseptic property of the 'carbolineum' is greatly increased," and "the unpleasant smell replaced by an agreeable one." "The specific gravity, viscosity, and drying quality are increased, and a varnish-like lustre is imparted to the paint."—B. II.

Improvements in or relating to Bronze or other Metallic Paints. Lizzie H. Goggs and T. T. Irvine, Liverpool. Eng. Pat. 7708, May 26, 1888. 4d.

BRONZING has hitherto been performed by mixing bronze powder with a sticky material such as gum water, but in this invention an enamel that will fulfil the desired conditions is composed as follows:—Enamel varnish, half a gallon; terebene, one quart; turpentine, one quart. To this mixture is added a fourth of its weight of the bronze or metallic powder.—B. II.

An Improved Composition for Preventing the Fouling of Ships' Bottoms and other Submerged Structures. W. O. Wotton, Southampton. Eng. Pat. 11,554, August 10, 1888. 6d.

For the purposes of this invention the vehicle and the ingredients conferring the anti-fouling properties are kept separate till required for use. The vehicle consists of caoutchouc dissolved in turpentine or other suitable solvent, boiled linseed oil, and common rosin.

The anti-fouling ingredient is powdered metallic copper or alloy of copper, but preferably pure precipitated copper. With this metallic powder is mixed a suitable proportion of red lead. These powders are mixed dry, and when required for use a suitable proportion of the mixed powder is thoroughly incorporated with the vehicle or menstruum. The composition is applied with a brush over a priming coat composed of the vehicle with the addition of red lead to give it body.—B. II.

An Improved Process for Painting on Glass, Porcelain, Tin, and the Like. W. Michaelson, London. Eng. Pat. 338, January 8, 1889. 4d.

THE design is first drawn with etching ink on the article taken, and then after cleaning with turpentine, ordinary oil tube colours are laid on and allowed to dry. It is then brushed over well with turpentine and another coat applied either once or as often as may be required. The details of the drawing are now made out with transparent oil tube colours, and the whole varnished with white copal varnish.

—S. G. R.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENT.

Improved Apparatus for Tanning Hides and Skins by the Aid of Electricity. L. A. Groth, London. Eng. Pat. 742, January 17, 1888. 8d.

INSTEAD of placing the hides, &c. in a revolving drum, the patentee employs an open tank containing the tanning solution. In this tank and more or less immersed in the liquor is placed a rotating drum or cage composed of bars secured to suitable framework. The hides are placed in the cage, which can be arranged to rotate either horizontally or vertically. When arranged to rotate horizontally the interior of the drum is preferably provided with pegs projecting radially inward, to keep the hides from the internal surface of the cage and to prevent the hides from rolling into a ball shape. When arranged to rotate vertically the hides are suspended on the bars provided. Suitable electrodes are provided in the tank or in or on the cage. Drawings are given, and the inventor states that the hides or skins are tanned in four days.—B. II.

XV.—AGRICULTURE, MANURES, Etc.

Chili Saltpetre as a Manure for Wheat. A. Wolff. Brauns. landw. Zeit. 1888, 3.

From the results obtained in some experiments (no analysis of soil given) it was observed that phosphatic manures were required, but the yield with them was greatly increased when Chili saltpetre was also used. The phosphate, as ammonium superphosphate, was applied in autumn, the saltpetre in spring, but there were no comparative experiments.—D. A. L.

Origin and Properties of Humus. F. Hoppe-Seyler. Zeits. f. phys. Chem. 13, 66—121. (Compare C. G. Eggertz, this Journal, 1889, 293—294.)

IN support of the view that the humus arising from the decay of dead vegetation originates from the tannins and carbohydrates stored in the living plant, the formation and properties of humic substances from various sources are discussed. Cellulose yields humic substances by the action of acids, by heating with water at 180°—200° and by fusion with potash in presence of oxygen; in a sealed tube with water formic acid, catechol, and protocatechuic acid are also formed, the last two only when alkali is liberated by the action of the water on the glass. Many other carbohydrates, such as sugars, also yield humic substances by the action of acids and by caustic alkalis in presence of oxygen. Neither white beech gum nor cellulose yield humic substances by marshy fermentation. By the action of strong potash at 240° on cellulose in the absence of oxygen, oxalic, protocatechuic, formic, acetic, and other volatile acids are obtained with the evolution principally of hydrogen with a little marsh gas, but no humic substances are formed. All the humic substances obtained as above, yield when fused with potash at 250° *hymatomelanic acid*, protocatechuic, fatty, and oxalic acids, and catechol. *Hymatomelanic acid* is the provisional name given by the author to a brown amorphous acid which is soluble in alcohol, insoluble in ether, and swells in water.

Phlobaphene obtained from oak yielded protocatechuic, formic, acetic, oxalic, and hymatomelanic acids, also a fusible reddish-yellow crystalline acid soluble in ether. *Hymatomelanic acid* is also obtained from the brown substances produced by the action of ammonia and oxygen on pyrogallol and protocatechuic acid, and from the humic substances derived from dead plants, furfuraldehyde, peat, and lignite, but not from azulonic acid prepared from hydrocyanic acid.

The author classifies humus substances and phlobaphenes into three groups. Those of group I. are insoluble in both alcohol and potash, but combine with alkalis to form the slimy masses which are difficult to wash and obstinately retain alkali; by fusion with potash they are converted into substances belonging to the other groups. According to Mulder the humins and ulmins fall in this group. Group II. includes those substances which are soluble in alkalis even when very dilute, and are reprecipitated by acids. Phlobaphenes, humic and ulmic acids yield members of this group. In group III. are classed those members of group II. which after reprecipitation are dissolved completely and readily in alcohol. They form a wrinkled skin on the surface when the alcohol is evaporated, and when cool set to a fissured gelatinous mass which melts when warmed on a water-bath; after drying they are incompletely or not at all soluble in alcohol. To this class belong phlobaphenes, portions of humic and ulmic acids, and hymatomelanic acid.

The author obtained pure cellulose, pure gum, and lignin from fragments of an oak post which had been under water for centuries. Lignin may be regarded as an ether, probably of cellulose and lignic acid; it is remarkably stable, but is capable of quantitative resolution. Lignic acid liberated in this manner assists largely in the formation of humic acid in humus, peat, and lignite.—D. A. L.

Detection of Nitrates in Soils. Frank. Landw. Jahr. 17, 723—724.

See under XXIII., page 420.

Significance of Potassium in Plants. R. Lüpke. Landw. Jahrb. 17, 887—913.

PLANTS of *Phaseolus multiflorus* and *vulgaris* were grown in nutritive solutions with and without potash, and to minimise the supply of potash emanating from the seed, portions of the cotyledons were removed as early as possible.

The plants cultivated in the nutritive solutions without potash vegetated far better than in pure water, even producing starch in the assimilation organs, metamorphoses of material, &c., but they were nevertheless much behind the plants grown under normal conditions, inasmuch as the growth and production of organs was restricted.

The results indicate that potash does not stimulate some special function, but like nitrogen, phosphorus, sulphur, &c., is generally useful in the plant, probably taking part in the building up of every cell. The precise rôle played by potash is, however, still uncertain.—D. A. L.

Assimilability of the Phosphoric Acid in Basic Slag. Bull. d. l. stat. agronom. d. l'Etat à Gembloux, 1888, 1—23.

WHEAT and oats were grown on two soils of the following composition with various manures, including superphosphate and basic slag, containing 2.62 per cent. of citrate-soluble phosphoric acid, and 19.26 per cent. of phosphoric acid soluble in hydrochloric acid:—

	H ₂ O ₂	Org. Mat.	Fe ₂ O ₃ , Al ₂ O ₃	CaO	MgO	Na ₂ O	K ₂ O	P ₂ O ₅	SO ₃
Soil 1. Clay-sand.....	20.22	26.12	17.74	2.37	1.69	0.23	0.76	0.65	0.26
Soil 2. Sand.....	9.80	6.00	4.48	1.55	6.25	0.11	0.15	0.10	0.01

—	CO ₂	SiO ₂	Insol. cold conc. HCl.	Org. Nitrogen.	Ammon. N.	Nitrate N.	Total N. per 1,000.	
Soil 1. Clay-sand,.....	0.56	0.30	929.10	Per 1,000	0.204	0.069	0.026	0.299
Soil 2. Sand,.....	..	0.11	977.14	Per 1,000	0.16	..	..	0.16

The crops on both soils were much benefited by the phosphatic manures, the slag acting quite as well as the superphosphate; the effect on the poorer sand soil, No. 2, was more marked than on the clay-sand, No. 1. Anyway, finely pulverised basic slag proved an excellent manure, and although its lime was without action, the large percentage of ferrous and ferric oxide in it did not interfere either with the growth of the wheat or with the production of sugar in beet, or starch in potatoes.—D. A. L.

Relation between Inorganic Nitrogenous Salts and Plants.

H. Molisch. *Naturw. Runds.* 3, 256.

The author has investigated Berthelot and André's view that nitric acid can be produced in plants from other nitrogenous compounds. Cultivations in nutritive solutions containing ammonia, but free from nitrates, have led him to conclude that when a plant contains nitric acid, it must have obtained it from the soil, and if a plant contains more nitric acid than the subsoil, it is attributed to storage in the plant. The author has not found nitrites in plants, and these salts are not taken up by the plant from the soil, inasmuch as, if present, they are directly destroyed in the roots. Even when nitrites are presented to the plants in such a way that their oxidation is prevented before they pass into the plants, not a trace of nitrite is to be detected either in the surface, roots or other organs of the plant. Nitrates are likewise absent, therefore the disappearance of nitrites is evidently not due to oxidation, in fact, observations support the view that nitrites become reduced.

—D. A. L.

Preserving Green Fodder with Carbon Bisulphide.

A. Grete. *Chem. Zeit. Rep.* 13, 97.

See under XVIII., A., page 409.

On the Present Position of the Question of the sources of Nitrogen of Vegetation. Sir J. B. Lawes and J. H. Gilbert. *Phil. Trans. Royal Soc., Lond.* 1889, 1—107.

In addition to the experiments, an account of which the authors have already published (*J. Chem. Soc.* 1885), they now give further details of a similar series of experiments. Fallow-wheat was grown for eight years, without any addition of nitrogen, on land which for 30 years previously had received no artificial addition of nitrogen, in conjunction with three leguminous crops—*Trifolium repens*, *Melilotus leucantha*, and *Medicago sativa*. The total amount of nitrogen taken off with the leguminosæ was found, as in the former experiments, to exceed very considerably that removed in the wheat crop. The amounts of nitric nitrogen in these soils at the conclusion of the experiment was, in the case of the *Trifolium repens*, and the *Melilotus leucantha*, also very considerably greater than that in the wheat plots, the samples being taken to a depth of nine feet. In the case of the *Medicago sativa* plots, the amount of nitric nitrogen was less, which was however not altogether surprising since it is such a strong and deep-rooting plant, removing as it did eight times the amount of nitrogen that the wheat crops removed. That these crops feed to a large extent on nitric nitrogen is shown by the fact that in the case of the *Trifolium repens* plot there was much more nitric nitrogen in 1883, when the crop failed, than in 1885, after 100 lb. nitrogen had been removed in the crop. Further, the percentage of total nitrogen in the surface soils of all the plots was less in 1881 than in 1885, at the conclusion of the experiments. An experiment similar to the foregoing was made by growing barley and red clover on bean-exhausted land, in which case, again the amount of nitrogen in the soils at the conclusion of the

experiment was greater than at the commencement, besides which a large quantity of nitrogen had been removed in the crops.

Experiments were also made on the nitrification of the nitrogen of the soils, and it was found that the nitrogen is susceptible of nitrification, and that the nitrification is more active in leguminous than in graminaceous crop subsoils. At the same time the experiments did not indicate that the necessary conditions were adequately available to explain the very large accumulation of nitrogen which were made by, for instance, the lucerne and the red clover, and experiments were therefore made to see if possibly nitrogenous organic matter is dissolved by the juice of the plant root, which is acid, and thus more directly assimilated. The result of such a series of experiments, in which the solvent action of dilute formic, acetic, oxalic, malic, citric, and tartaric acids was estimated, showed that nitrogenous organic matter is soluble in such solutions, but that the solvent action is limited. Such a series of experiments are, however, not altogether comparable with the action, if it actually take place, of the acid plant juice in the field.

—J. W. L.

XVI.—SUGAR, STARCH, GUM, Etc.

On the Sugar found in Different Kinds of Mushrooms.

E. Bourguelot. *Compt. Rend.* 108, 568—570.

The author has examined eight different kinds of mushrooms, belonging to the genus *Lactarius* and *Boletus aurantiacus*. They are first dried in the air, then at 50°—60° in a stove. After extracting with 80 per cent. alcohol, the latter is evaporated and the residue placed in an exsiccator. The crystals that separate after a few days are recrystallised several times from alcohol, and appear to be mannite. The quantity of this sugar found in the various specimens varies from 2.14—15 per cent. One of the above species of mushroom was extracted with boiling water shortly after it had been gathered. The filtrates were evaporated, the residue mixed with 80 per cent. alcohol, and otherwise treated as above. The product was found to be trehalose. The author concludes, that when gathered this mushroom contains trehalose, but by drying, the latter undergoes a change, which may be put down to maturing, since, like fruit, mushrooms continue to live for some time after they are gathered.—A. R.

American Vacuum Apparatus. Lippmann. Oesterr.

Zeits. f. Zuckerind. 1889, 760.

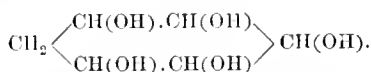
The construction and general arrangement of some sugar boiling apparatus employed in America are described. A vacuum pan of this sort is constructed of cast-iron rings which consist of separate segments, and there are four superimposed heating coils with 91½ square metres of heating surface. It yielded within four hours, at a temperature of 51.1° C. and 28½ in. pressure, 77,000 kilos. of syrup. A similar but larger apparatus made up of 12 cast-iron rings, and which was 14 metres high and 5½ metres diameter, yielded 175,000 kilos. of syrup in 2½ to 3 hours. The heating system consists of 72 coils, the condenser being 2½ metres diameter and 9 metres high. The cheap, safe, quiet, and regular working of this apparatus, and its durability, are much praised.—A. W.

Preparation and Use of Pure Grape Sugar. Seyberlich.
Zeits. f. Zuckerind. 39, 84.

STARCH is best saccharified by boiling with dilute nitric acid in vats, and, after neutralising, filtering, and evaporating the syrup to 36° B., crystallised at 20° C. The residue is submitted to hydraulic pressure in cloths, when a yellowish crystalline mass remains containing 88 per cent. of sugar, 10 per cent. of water, and 2 per cent. of impurities. The redissolved sugar previously treated with 10 per cent. of animal charcoal is refined in the same manner, and crystals may be obtained either anhydrous or with their water of crystallisation. 100 parts of starch give 90—95 of anhydrous sugar. Raw maize, rice, or sago may be similarly treated. Nitric acid is readily removed with sulphurous acid. The method is cheap and gives a very pure product. —A. R.

Quercite. H. Kiliani and C. Scheibler. Ber. 22, 517—520.

QUERCITE is a pentahydric alcohol according to Homann (Ann. 190, 282) and Prunier (Ann. Chim. Phys. V. 15, 1). Kannonikow found that on reduction it was chiefly converted into aromatic compounds, and assigned to it the constitution—



If Kannonikow's formula be correct, quercite is closely related to inositol, and on oxidation should yield similar products to those obtained from the latter by Maquenne (Ann. Chim. Phys. VI. 12, 1).

When quercite is treated with nitric acid of sp. gr. 1.39, first for 12 hours at 20°, and then for 36—48 hours at 30°, it yields mucic acid and trihydroxyglutaric acid, but no aromatic compounds could be obtained either by oxidation or any other chemical process. Only very small quantities of the two acids are formed, most of the quercite being converted into unstable compounds similar in behaviour to those obtained from sorbinose and levulose.

These results seem to show that quercite has not the constitution given to it by Kannonikow.—F. S. K.

Oxidation of Galactose-carboxylic Acid. H. Kiliani
Ber. 22, 521—524.

GALACTOSE-CARBOXYLIC acid is best prepared in large quantities as follows:—The crude product obtained by treating galactose with hydrocyanic acid (Ber. 21, 915) is decomposed with lime, the ammonia driven off, and the calcium precipitated in the cold with oxalic acid. The filtrate is boiled for a long time with lead carbonate, filtered, evaporated to a small volume, and then agitated with a small quantity of the pure lead salt. The latter is obtained by boiling a small quantity of the pure acid, prepared as already described (*loc. cit.*) with lead carbonate and recrystallising. After 1 to 2 days the crystals are separated, pressed, and purified by recrystallising from boiling water with addition of animal charcoal. The pure salt is dissolved in 5 times its weight of water, decomposed with sulphuretted hydrogen, and the pure acid obtained by evaporating over sulphuric acid. If the solution be evaporated at 100° the acid is partially converted into the lactone.

Carboxygalactonic acid, $\text{C}_7\text{H}_{12}\text{O}_9$, is formed when galactose-carboxylic acid is warmed at 50° for about 24 hours with $\frac{1}{2}$ times its weight of nitric acid of sp. gr. 1.2. The nitric acid is driven off by evaporating at 100°, the residue freed from oxalic acid by adding the necessary quantity of chalk, and, after neutralising with potash, evaporated to a syrup and mixed with excess of acetic acid. The hydrogen potassium salt, $2\text{C}_7\text{H}_{11}\text{O}_9\text{K} + 3\text{H}_2\text{O}$, separates after 12 to 24 hours, on rubbing, and is readily purified by recrystallising.

The crystalline cadmium salt, $\text{C}_7\text{H}_{10}\text{O}_9\text{Cd} + 2\text{H}_2\text{O}$, can be obtained by neutralising a solution of the pure acid potassium salt with potash, and, after concentrating, precipitating with cadmium nitrate.

The free acid, prepared by decomposing the cadmium salt with sulphuretted hydrogen and evaporating in a partial vacuum, crystallises in microscopic prisms and is sparingly soluble in cold water, but much more readily than mucic acid. It frits together at 168°, melts at 171° with evolution of gas, and does not reduce alkaline copper solutions.

The neutral potassium and sodium salts could not be obtained in a crystalline condition. The barium salt crystallises with three molecules of water.—F. S. K.

Seminose. R. Reiss. Ber. 22, 609—613.

It is well known that in many seeds the cell walls of the endosperm or the cotyledons are considerably thickened. In the case of some seeds it has been shown that this extra material serves as reserve food for the embryo, whilst in other instances this proof has not been forthcoming. The thickened cell walls consist either of amyloid or cellulose. The author has examined a number of those seeds which contain cellulose as reserve material. This cellulose differs considerably from ordinary cellulose. On hydrolysis with sulphuric acid, a dextro-rotary sugar is obtained. It reduces Fehling's solution and is capable of fermentation. The author gives to it the name of *Seminose*. It has not yet been obtained in the pure state, so that its properties are not accurately known, but it yields several readily crystallisable derivatives. Phenylhydrazine acetate mixed with an aqueous solution of seminose in the cold gives a very considerable precipitation of a colourless hydrazone. It is soluble in 80—100 parts of boiling alcohol of 50—60 per cent., but the greater part separates out again on cooling. It crystallises in small rhombic plates, melting at 185°—186° C. It is composed of one molecule of $\text{C}_6\text{H}_{12}\text{O}_6$ united to one of phenylhydrazine with separation of one molecule of water. Its formula is $\text{C}_{13}\text{H}_{18}\text{N}_2\text{O}_6$. A neutral aqueous solution of seminose gives with basic acetate of lead a white gelatinous precipitate, soluble in excess of the reagent. Its composition is $\text{PbO}(\text{C}_6\text{H}_{12}\text{O}_6) + \text{H}_2\text{O}$. Seminose readily yields an isonitroso-derivative in colourless crystals of the following formula, $\text{C}_6\text{H}_{13}\text{O}_6\text{N}$. It is fairly soluble in water, and melts at 176° C. with blackening. These facts conclusively prove that seminose is a distinct sugar. The formation of seminose is easily detected by the insolubility of its phenylhydrazone, which is a ready means of distinguishing the reserve food cellulose from ordinary cellulose and amyloid. Seminose was obtained from the following families of plants:—Palmaeae, Liliaceae, Iridaceae, Loganiaceae, and Rubiaceae. Seeds containing amyloid as reserve food do not give seminose on hydrolysis.—H. T. P.

A Sugar from Laminaria. R. W. Bauer. Ber. 22, 618.

A QUANTITY of laminaria taken from the sea about the end of August 1885 at Heligoland, was first extracted with alcohol and then heated with sulphuric acid on the water-bath. The solution was then neutralised with chalk, evaporated and extracted with alcohol. The author thus obtained a syrup, which solidified to a mass of crystals when a crystal of dextrose from lichenin was introduced. The substance had a sweet taste. Its specific rotary power was determined, with the following result:— $(\alpha)_D = +46.71^\circ$ at 14° C., concentration 1 grm. per 15 cc. of solution. The phenylhydrazone was also prepared; its melting point was about 140° C. On these grounds the author is of opinion that the formation of dextrose from laminaria has been proved.—H. T. P.

PATENTS.

An Improvement in Saccharometers. A. Horn, London.
Eng. Pat. 7411, May 19, 1888. 8d.

THIS invention consists in fixing a scale indicating percentages of sugar, alongside the Beaumé scale, on the hydrometers usually employed for ascertaining the density of saccharine solutions, so as to avoid the trouble of referring to tables.—W. M.

Improvements in and Relating to Centrifugal Machines for Use in the Manufacture of Sugar. G. F. Redfern, London. From W. P. Abell, Essequibo, British Guiana. Eng. Pat. 8052, June 1, 1888. *Sd.*

This invention relates to mechanism whereby the sugar discharged through the bottoms of centrifugals is conveyed to an ordinary elevator, or elsewhere as desired, without manual labour. The principal feature is the employment of a "conveyor in the form of a spiral or helical bar or rod, which is connected at two or more points with the driving shaft, but which throughout the greater part of its length is unattached to the shaft, and is at sufficient distance therefrom to permit the passage of the sugar between it and the shaft." This spiral works in a trough placed under the centrifugals, and it is claimed that the spiral does not triturate or damage the sugar in the same degree as screw blades or endless bands. Descriptions are also given of various arrangements for preventing the molasses from getting into the troughs along with the sugar and for discharging the sugar at will, either into the conveyor or out of the trough, but the specification and accompanying drawings must be consulted for the detailed manner in which these arrangements are carried out.—W. M.

Improvements in Evaporating Pans. G. Fletcher, Litchurch. From G. Brocklehurst, Barbadoes. Eng. Pat. 8053, June 1, 1888. *Sd.*

This is an improvement in open evaporating pans, and consists principally in constructing a hollow drum at the bottom of the pan, in which are a number of heating tubes and a large central tube through which the liquid circulates; the steam surrounds these tubes and a large heating surface is thus obtained. Drawings accompany the specification.

—W. M.

Apparatus for Cleansing Filtering Media. H. J. Allison, London. From the Casamajor Filter Company, New York, U.S.A. Eng. Pat. 18,860, December 27, 1888. *Sd.*

The invention described in this specification embraces a method and suitable apparatus for thoroughly cleansing the sawdust or finely-divided woody fibre used as filtering media for the removal of organic and suspended impurities from a solution of impure sugar. The sawdust containing the impurities is thoroughly agitated in a mixing vessel with a large volume of water; the vessel is of the usual type employed for such purposes. From thence it is transferred into a second agitating vessel where it is operated upon whilst suspended in water, by means of a current of air or steam distributed through the mass. When by these operations the dirt and foreign substances are removed and held in suspension in the water, the sawdust is separated from the contaminated water in an octagonal rotating sieve suspended horizontally; here it is subjected to a washing by clean water, and subsequently passed through two other similar apparatus, in each of which it is further purified by washing. Finally the cleansed sawdust is dried on a filter illustrated in the specification, resembling the ordinary form of vacuum filter.

The patentee claims the process as described, and the combination of the various steps and portions of the apparatus.—C. C. H.

XVII.—BREWING, WINES, SPIRITS, Etc.

Artificial Diastase. A. Reyher. Ber. 22, 414-419.

By the action of dilute acids on the gluten of wheat, at a temperature of 30°-40° C., for several hours, a considerable portion of the gluten is dissolved to an opalescent liquid. This solution is not coagulated on boiling. A few drops of a weak solution of potassium hydrate give a precipitate, soluble in a slight excess of potash. A few volumes of alcohol clear the solution, whilst a large quantity of alcohol

generally renders it turbid. Potassium ferrocyanide gives a precipitate soluble in much acetic acid. Mercuric chloride seems to have no effect. Guaiac tincture and hydrogen peroxide give an intense blue colouration. This reaction was not obtained when the gluten solution was boiled, or rendered too acid. According to Lintner this behaviour is characteristic of diastase. The solutions possess considerable diastatic activity, which is destroyed by boiling, and also destroyed, or at least retarded, by excess of acid or alkali. In one instance, the gluten of 20 grms. of wheat flour was digested for several hours with 100 cc. of a solution containing 1 gm. of potassium monophosphate in 500 cc. After solution had been effected 2 cc. of the artificial diastase were added to 2 grms. of starch gelatinised with 250 cc. of water, and the mixture digested for five hours at 40°-50° C. At the end of this time the solution was capable of reducing 135 cc. of alkaline copper solution. The author was unable to obtain an active ferment from other nitrogenous bodies, such as albumen and gelatin. Lintner's diastase reaction can be obtained from the soluble albuminoids contained in wheat flour. A slight proportion of acid increases the diastatic activity. The soluble nitrogenous constituents of ungerminated barley also possess diastatic activity, which is increased by a small quantity of acid. In two tables the author gives the results obtained on estimating the reducing power of a number of mashes made with barley, maize and malt, separate and also mixed, as well as mixtures of these with starch. The mashing liquor was in some cases water, in others a solution of acetic or metaphosphoric acid, containing 1 gm. per litre of the acid.—H. T. P.

Examination of Malt Extract. E. Dieterich. Hefen-berger Ann. 1888.

See under XXIII., page 424.

PATENTS.

Improvements in the Treatment of Brewers' or Distillers' Worts. W. Hucks, London. Eng. Pat. 6026, April 23, 1888. *Sd.*

This invention has for its object the removal of insoluble matters from wort after it has left the mash-tun. The apparatus consists of a continuous travelling band of some porous material, constructed somewhat like a paper machine. The wort flows over the gauze, through which it soaks, leaving the insoluble matter behind. The thick residue on the travelling gauze is removed by means of scrapers or brushes, after which it can be washed with clean water. If necessary, the wort is further treated in a centrifugal machine, which consists of a disc, on which are fixed a number of tubes radiating from the centre. The ends of these tubes can be closed during the rotation of the disc at the ends nearest the circumference. The wort flows continuously into these tubes about half-way between the centre and the circumference of the wheel. During its passage to the centre of the wheel the particles are precipitated to the ends of the tubes and retained till the ends are removed.—H. T. P.

Improvements in the Manufacture of Effervescent Wines and Beverages, and in Apparatus therefor. W. Gerbel, Korschach, Switzerland. Eng. Pat. 2785, February 16, 1889. *Sd.*

The inventor employs grape stalks as ferment bearers. For this purpose the bunches, after the grapes have been removed, are washed with water at 30° C. and partially dried. They are then sprinkled with sweet wine or other similar liquid and allowed to ferment. In order to completely ferment a liquid containing 4-5 per cent. of sugar, about 2 per cent. of the weight of the liquid of stalks are required. The advantage resulting from the employment of these stalks is that they constitute a filtering medium and attract the yeast formed.

In the manufacture of effervescent wines an apparatus is employed consisting of a wooden cylindrical vessel of about

220 gallons capacity. It is surrounded by a metal jacket capable of resisting eight atmospheres pressure, and is closed by a tight-fitting lid which closes both vessels. In the interior of the inner vessel is a cylinder to hold the grape stalks. This inner cylinder is the fermenting vessel, and it communicates with three other vessels of similar construction but only half the size, one of which is a sort of feed chamber for the fermenting vessel, while the other two act as recipients for the fermented wine. These are connected in their turn to a bottling apparatus. When the fermenting vessel is filled with wine and provided with ferment carrier, the lid is fastened down and the space between the inner and outer vessels filled with water. After about 8—10 days the wine is ready for transfer to the other two vessels mentioned above. All these apparatus are connected in such a manner that the same pressure exists in every part, so that the liquids can be transferred from one to the other without violent disturbance. The invention is employed with great advantage in the manufacture of champagne and other sparkling beverages. Wines may be bottled with the addition of grape stalk ferment and sugar without becoming turbid. The principal advantages are:—

- (a.) A rapid and uniform fermentation is produced in about six weeks.
- (b.) Deterioration of the wine is avoided owing to the rapidity with which fermentation takes place.
- (c.) The operation of bottling can be performed at all seasons of the year.—H. T. P.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A)—CHEMISTRY OF FOOD.

Oleomargarin Manufacture. Eng. and Min. Jour. 47, 210-212.

THIS description is taken from the Report of the Commissioner of Internal Revenue of America. The ingredients used are: Oleo oil, neutral lard, some liquid vegetable oil, as cotton-seed, sesame or peanut, butter, in the higher grades, cream and milk, together with salt, and annatto or other colouring matter.

The manufacturer of oleomargarin usually buys the refined materials in the open market. The manufacture of oleo oil is generally carried on in connexion with the large slaughter and packing houses situated in or near the principal cities. The caul and suet fats are removed from the freshly slaughtered heeves and placed in tanks filled with water at 75° to 85° F., where they remain from two to three hours before being transferred to other tanks containing iced water. By this procedure the fats are gradually deprived of their animal heat, and the danger of their becoming rancid is avoided, as would happen if the mass of fat were suddenly chilled by being placed directly in iced water. The caul, long or slaughter fat, is kept separate from the suet fat, which yields an inferior grade of oil.

A Texan steer will yield on an average 65 lb. of caul and suet fats, from which are obtained 28 lb. (43 per cent.) of oleo oil, 21 lb. (32 per cent.) of oleo-stearin, and 12 lb. (20 per cent.) of high-grade tallow. The chilled fat, after thorough washing from blood, is fed into hashers working at high speed, from which it issues through fine sieves into the rendering tank. No fat remains on hand longer than 14 hours, usually not more than four hours, before being rendered. The rendering tank is a steam-jacketed upright kettle of 2,000 to 5,000 lb. capacity, provided with revolving blades. Steam being let into the jacket, the hashed fat is continuously fed in, and kept in motion by the stirrer. When the tank is full, and the contents thoroughly melted, the temperature being 120° to 150° F., the fat is allowed to rest for the water and scrap to settle. The clear fat is drawn off from the top, and run into the graining or seeding cars of 400 to 600 lb. capacity. The temperature of the room in which

these cars are stored is maintained at 85° to 95° F., and the whole contents of the car will be in a semi-solid condition in from one to three days. This fat is free from all "greasy" taste. It is now taken to the press-room, kept at 70° to 80° F., where it is ladled out on a stout linen cloth, which is folded up ready for placing in the screw-press. When the press is filled, pressure is gradually applied, and the expressed oil constitutes the "oleo oil." This liquid fat is allowed to cool in barrels, and at ordinary temperature forms a soft, granular, tasteless and nearly colourless fat. The hard fat remaining in the filter bags forms the beef or oleo-stearin, which is used for making "refined lard" by the addition of cotton-seed oil, or is sold to the soap and candle maker.

The manufacture of "neutral lard" is conducted by essentially the same machinery and at about the same temperatures as for oleo oil, but only the leaf fat of freshly slaughtered hogs is used. A hog yields from 5 to 15 lb. of leaf lard, of which 100 lb. yields 90 lb. of "neutral." The screw-press is not employed to separate the stearin, but the melted fat is run directly from the rendering tank into a very strong iced brine, where it remains for 24 hours before being placed on shelves to drain. The "neutral" is a white, slightly granular, tasteless, solid fat.

The by-products of the oleo oil and neutral lard manufacture, namely, stearin, tallow, and lard, are standard merchantable articles. Only fresh and sweet fats are used, and great cleanliness is observed through all the processes. The vegetable oils employed are refined by ordinary methods, whereby a product of a light straw colour and bland taste is obtained. The butter used is always selected for its high flavour. The granular character of oleo oil requires the addition of a softer fat, such as neutral lard or cotton-seed or other vegetable oil, in order to approach more closely to the consistency of butter. The proportions in which these ingredients are used vary with the season of the year, the grade desired, and the formula of the manufacturers. The charge of milk or cream, however, is the same for all grades manufactured by any particular factory, and varies from 10 to 20 per cent. The milk or cream is allowed to become slightly sour.

The mixing of the materials to form the butter substitute is conducted in a steam-jacketed churn of from 1,200 to 2,500 lb. capacity. The oleo oil and neutral lard are melted in separate vessels at 90° F. The charge of milk or cream is first run into the churn, and the paddles are kept in motion until the butter begins to form. Then the oleo oil is added and stirred, next the neutral lard, and finally the annatto to give the desired colour. The butter is either added to the churn or worked in subsequently. The temperature is carefully regulated, beginning at about 85° F. and increasing gradually to 105° F. at the end of the operation, when the whole charge has the appearance of a yellowish creamy fluid. From 20 to 90 minutes are occupied in the churning. The finished charge is run into tanks containing chopped ice and constantly stirred, or is met by a stream of iced water as it issues from the churn, the object being to give the mass a fine grain by the sudden cooling. The chilled mass is then placed on wooden trays to drain. Here the salt is added and allowed to work itself in, which generally takes from 12 to 24 hours. The salted mass is then thoroughly worked by mechanical rollers to remove the buttermilk and water.

Oleomargarin is placed on the market either "solid packed" or in prints or rolls. Four grades are generally made, known as "dairy" and "extra dairy oleomargarin," "creamery," and "extra creamery butterine," the last two containing from 10 to 25 per cent. of the best creamery butter. In the lower grades from 25 to 60 per cent. of neutral lard, 20 to 50 per cent. of oleo oil, 5 to 25 per cent. of vegetable oils, and in some cases from 2 to 10 per cent. of butter, with 10 to 20 per cent. of milk or cream, are the proportions used. Some factories employ no vegetable oils in their oleomargarin, preferring to use a larger proportion of neutral lard with a small amount of butter to obtain the desired butter consistency. In the higher grades the proportions of oleo oil are reduced, the vegetable oils are discarded, and creamery butter is used to make up the charge.—G. H. B.

Preserving Green-Fodder with Carbon Bisulphide.

A. Grete. Chem. Zeit. Rep. 13, 97.

Two bricked silos ($1.8 \times 1.5 \times 1.6$ metres respectively) were filled with good clover, which was just about to bud, and two kilos. of carbon bisulphide gradually added with a hand syringe. The fodder was then covered with well fitting boards and some roofing-felt. No special pressure was applied. After six months the fodder was found to be absolutely free from mould, not a leaf being spoiled. Moreover, it had an agreeable odour, and was slightly acid. The cows took it readily and without the slightest ill-effects. An analysis also proved this means of preservation to be a good one, since almost the total crude protein substances originally present had remained unchanged. The author believes that it will be possible to prevent the fermentation of hay by carbon bisulphide, without spoiling it. Experiments on a large scale are being carried out, with a view of ascertaining the utility of this process.—A. R.

PATENTS.

Certain Improvements in the Manufacture of Butter, and in the better Flavouring, Colouring, and Preserving of the same, and in the Cleansing, Flavouring, Colouring, and Preservation of Rancid Butter, Margarin, and all other Artificial Butters, and Apparatus therefor. T. Adair, Belfast. Eng. Pat. 4495, March 24, 1888. 11d.

In applying this method, the cream is raised by heating, and after cooling is removed and placed in a bath of water and heated at 90° – 92° F. to melt the butter globules, while it is agitated to free the butter fat from the milk. The wash-water is then separated, preferably by use of the apparatus, which forms a part of the invention (drawings of which are given), and the process of washing repeated till the wash-water shows but a very slight opalescence. The butter so obtained is uniform in texture, colour and consistency, but without scent or flavour. To remedy this defect the butter is flavoured when at a temperature of 65° – 80° F., in the washing process, when a few drops of any essential oil, essence, or substance imparting an agreeable odour and taste to the butter, or preferably the purified butter essence, the preparation of which is described below, is added. At this stage also a little colouring matter, e.g., annatto, may be added if needful. In order to dissolve the casein which may be present in the melted butter fat, a little "albumen solvent," caustic lime, potash, or soda, is added, preferably when the wash-water has been drawn off, and before admitting fresh water.

Rancid butter and margarin are purified in the same way, by this process of washing the melted fat. In the case of rancid butter, the "butter essence" distils off and is collected from the top of the washing vessel, the butter fat being washed finally with water at 163° F., which drives off the last remaining odour of rancid butter. It is this distillate which is used for flavouring the fresh butter fat.

A press has also been devised for expelling the last of the water from the butter fat when cold, and consists essentially of a screw-press, with a compartment round it for maintaining the butter at a desired temperature while pressing, that recommended being 56° – 57° F. From the bottom of the press a series of needles pass automatically upwards into the butter, which opens it so as to facilitate the expulsion of the last portions of water from the butter.

—J. W. L.

Process for drying Organic Substances such as Potatoes and other Roots or Fruits. O. Inray, London. From G. Richter, Falkenberg, Germany. Eng. Pat. 6734, May 5, 1888. 6d.

THE potatoes, turnips, kohlrabi, or other produce, are peeled, then steamed, or boiled on a perforated sieve, the water is then run off, and the vessel exhausted of air until the potatoes, &c. cool down to 18° C.—J. M. H. M.

Treating Dangway Beans (Cassia tora, Cassia occidentalis) as a substitute for Coffee. Sir E. B. Sladen, London, R. McLeod and C. H. White, Burmah. Eng. Pat. 15,364, October 25, 1888. 4d.

THE seeds of *Cassia tora* or *C. occidentalis*, abundant in British Burmah, are ground and roasted and used like coffee.—J. M. H. M.

(B)—SANITARY CHEMISTRY.

Metropolitan Main Drainage. Sir H. E. Roscoe. Reports to the Metropolitan Board of Works.

1. *Deodorisation of Metropolitan Sewage at the Outfalls.*—In this report the proceedings taken in 1888 are recorded. Deodorisation was commenced at both outfalls, Crossness and Barking, May 7th, by the addition of 3 grains of bleaching powder to the gallon of effluent sewage, and continued until the stock of that material in hand (839 tons) was exhausted. After May 24th, at the northern outfall, and June 17th at the southern outfall, manganate of soda, in the same proportion, was added until July 11th, the weight used being 1,178 tons. The low temperature of the river water and the heavy rainfall had at that date materially improved the condition of the river. Deodorisation was resumed on July 16th, and continued until October 13th, 893 tons of manganate of soda having been used to deodorise about 52 million gallons of crude sewage discharged daily on the flood tide.

The value of the chemicals used in 1888 was 24,357*l.*, as compared with 42,467*l.* in 1887, a saving of 18,110*l.* (including a saving of 1,850*l.* due to reduction on the contract price of manganate of soda), whilst in 1887 a saving was effected of 38,604*l.* over the previous year. Thus the expenditure in 1888 as compared with the expenditure in 1886 shows a reduction of 56,700*l.* in this item of chemicals, without apparent deterioration of the river.

The use of manganate of soda without the addition of sulphuric acid in the proposed proportions was found not less effective on the putrescent matters of the sewage.

Concerning the effect of the manganate of soda on the general state of the river the author expresses the opinion that no amount of chemicals which can with any show of reason be added is sufficient, or nearly sufficient, to convert the whole of the fecal matter into harmless forms. One gallon of pure river water contains nearly four times as much oxygen as that supplied by three grains of manganate of soda (25 per cent.). The oxygen in the manganate is immediately consumed, both in removing the putrescent odour of the sewage and in preparing a condition of things favourable for starting a process of natural oxidation. This latter, however, involves the further supply of free oxygen, and this the river is called upon to contribute, inasmuch as the deodorised sewage contains none. Hence we can hardly look to the addition of the above quantities of chemicals for any improvement in the general condition of the river; rather must we seek for this improvement in some process of effluent aeration.

The purification of the river is chiefly effected by living organisms requiring free oxygen for their growth. These may be said to effect the changes generally ascribed to animal life. But other organisms of a vegetable character, such as algæ, &c., are always present in river water. These evolve oxygen during their life, and they are also potent instruments in the natural purification of the river; indeed, they are capable of oxygenating the water far above its normal amount, and thus aiding in supporting the life and growth of the former class of organisms. Both forms, therefore, assist each other in ridding the water of dead organic matter, both soluble and insoluble, and thereby bringing it into a healthy condition.

The author was not consulted as to the methods of chemical precipitation proposed to be used on a large scale, both at Barking and Crossness. If this can advantageously be adopted for the whole of the sewage of the Metropolis, and if, moreover, it should be proved practicable to carry out the whole of the sludge to sea, the author still leans to

the opinion, looking to the question of the *permanent* disposal of the sewage, that the sewage, whether previously clarified or not, must either be filtered through land, or discharged into the estuary at a point not higher than the sea reach.

The determination of dissolved oxygen in the river water, by a modification of Schützenberger's method as described by Dupré, is re-investigated by the author, who finds the source of error in the method is owing to the fact that when aerated water is introduced into an atmosphere of hydrogen (a necessary part of the process), the dissolved oxygen diffuses into that gas, and only a portion of the original oxygen is estimated. This portion is variable, and depends on the amount of exposure of the water to hydrogen gas, so that slight differences in the duration of an experiment may cause serious errors in the result. A method has been devised by which this error has been eliminated. This depends on the introduction of the water to be examined *beneath the surface* of a liquid containing a measured quantity of hyposulphite of soda, and a little reduced indigo carmine as an indicator.

Diagrams are given showing, in the form of curves, the amount of dissolved oxygen in the river water at Crossness at different periods of the year; the changes in the volume of fresh water coming into the river, as indicated by the quantity of sea salt present at low tide, the temperature, and the rainfall, and the conclusions adduced therefrom considered.

2. *The Chemical Examination of the Foreshores and Mud Deposits of the River Thames and its Estuary.*—It appeared to be of great importance in view of the proposal to carry the sludge out to sea, and of questions which may arise thereon, to be in possession of scientific data as to the condition of the foreshores of the Thames, from Barking down the river, to the mouth, including the whole of the estuary.

Samples of mud were collected at points where, in consequence of the set of tides, sewage sludge would, in the engineer's opinion, be most likely deposited on the foreshores and banks; and from Clacton, Walton-on-the-Naze, and Harwich, as positions which, in the judgment of competent persons, were those where sewage sludge would be found if it were discharged at sea, and should it then reach the shore. The investigation was made, with the assistance of F. Seudder, in September and October 1888. The samples divide themselves into two classes. First, those collected on the foreshores of the river proper, from Barking and Crossness down to Southend on the north, and Jenkin Sand on the south. Second, those on the estuary from Shoeburyness to Harwich on the north, and from Warden Point to Margate on the south, including two sandbanks known as "Little Sunk" and "Gimblect."

The Royal Commission stated a conclusion "that foul mud, partly composed of sewage matter, accumulates at Erith and elsewhere, and adheres to nets, anchors, and other objects dropped into it." This conclusion is also borne out by the well-known appearance of black patches of offensive matter in the river, which are at times raised to the surface. These are, without doubt, derived from sewage sludge which has settled down in the bed of the river and undergone putrefaction, whereby gases are evolved, which become entangled with the material and raise it to the surface. Analyses of 59 samples of the mud and deposits collected from the foreshore of *sections of the river of considerable length* were made, the average composition of which indicates that a gradual diminution occurs in the impurity of such deposits from the outfalls downwards. The reliability of four different means adopted for ascertaining the existence of sewage impurity in the deposits is considered in detail. These were:—1. The volatile matter. 2. The oxygen absorbed from potassium permanganate. 3. Percentage of nitrogen. 4. Phosphoric acid. The conclusion obtained from a comparison of all the numbers taken together is of distinct value as enabling one to obtain a general view of the relative chemical condition of the foreshores; and a table has been constructed to show the *average relative amount* of the organic impurity in various sections of the river and of the estuary. Taking the total values or average impurity of section 1 as 100, that of section 2 is 90, that of section 3 is 49, that of section 4 is

16, there being a total percentage loss of impurity in passing from the outfalls to Southend of 84 per cent. As a further proof that sewage impurity exists in the river deposits, the presence of manganese was detected in 8 out of 11 samples taken between Crossness and Erith, the manganese being derived from the manganate of soda which is added to deodorise the sewage before being discharged into the river at the outfalls.

The conclusions arrived at from the chemical examination are in the main borne out by the independent microscopical evidence obtained by the Board's chemist, which forms part of the appendix to the report. A large amount of detailed information is set out in tabular appendices, accompanied by a sketch map of the Thames and its estuary, on which is indicated, in the first place, the approximate position at which the samples were collected. Secondly, the four sections into which the river as far as Southend has been divided, with the relative amount of impurity in each section. Thirdly, a comparison of the purest sample from the sandbank "Little Sunk" (taken as the unit) with those collected at other points in the estuary, and also with the averages of the four sections of the river.

3. *Deodorisation of Sewer Emanations and on Sewer Ventilation.*—In a previous report (June 16, 1888), the author directed special attention to the necessity of ventilating the sewers, and to the advisability of removing all obstructions from the ventilators, thereby more fully utilising the available means of ventilation at command, and further called attention to the desirability of utilising a system of pipe ventilation in aid of surface ventilation. The total number of charcoal boxes or other obstructions to ventilation removed was 473.

In this report the author states "that in spite of the fact that all obstructions to the escape of sewer emanations have been removed, the number of complaints made during the past year in consequence of such removals was only 52, and those of ventilators which had always been opened were 35, as compared with 43 from open ventilators in 1887. These numbers, considering the large area covered by the Board's sewers, may be regarded as inconsiderable. Moreover, the majority of the complaints arise from districts in which noxious trades are carried on, whilst in purely residential districts few complaints occur. Many of these complaints have reference to the same ventilator, so that instead of there being 87 separate ventilators complained of, the actual number was 49. The system of pipe ventilation has been carried out to some extent. There is, however, a difficulty in obtaining in many cases the consent of the property owner to allow these pipes to be carried up the side of the premises, and it appears desirable that Parliamentary powers for this purpose should be obtained.

Experiments with liquid sulphurous anhydride used in the form of apparatus supplied by Messrs. Boake, Roberts and Company have been satisfactorily carried out in deodorising the emanations in the sewers on the Chelsea Embankment. They have shown that when it is desirable to deodorise the air in a sewer rapidly, the apparatus works well, and in such cases its adoption is strongly recommended.

The author is in accord with those who desire to see the general condition of house drains placed under public inspection, so that as the landlord is responsible for the structural safety, so ought he to be for the sanitary safety.

—F. S.

The Action of Artificial Colours on the Animal Organism. T. Weyl. Ber. 21, 2191.

Naphthol Green B. (Casella and Co.) is innocent, even in the stomach.

Manchester or Martius Yellow can be resisted by rabbits but is poisonous for dogs.

Naphthol Yellow S. is non-poisonous.

The Safranines are poisonous.

The Azo Colours. No azo colour has been observed to be poisonous.

Picric Acid, belongs to a group of poisonous nitro-colouring matters, as has been known for a long time.

Aurantia is poisonous and injurious to the skin of certain individuals, if indeed this selective action is not merely apparent and the difference really due to the appearance in the trade of two isomeric hexanitrodiphenylamines, the one like that prepared by the *Actiengesellschaft für Anilinfabrikation* in Berlin, being non-poisonous to rabbits, the other, like that prepared in Basel, been excessively injurious to the human subject.—W. S.

(C)—DISINFECTANTS, &c.

PATENTS.

Improved Means and Method of Precipitating and Disinfecting Sewage Matter. G. W. Bremner, London. Eng. Pat. 5861, April 19, 1888. 6d.

THE sewage is mixed with a precipitant as it flows into the tanks and is there charged with compressed air or oxygen alone or mixed with other gases, by air compressors and distributors; the tanks may have covers with ventilating shafts. The precipitants mentioned are the "*Piombina*" and "*Terra Gallia*" found among the volcanic debris of Mount Vesuvius, phosphate of alumina, lithomarge and other ferruginous substances, dissolved in hydrochloric, sulphuric, or nitric acid; manganese preparations of potash or soda; bleaching powder, black ash, chlorides or sulphates of potash, sulphates of soda. The phosphate of alumina may be prepared according to Eng. Pat. 13,761 of 1885. The sludge is pressed, dusted with some of the above materials in a dry form, to prevent loss of ammonia and to absorb moisture, and ground for manure.—J. M. H. M.

Improvements relating to Disinfectants. H. H. Lake, London. From C. H. Shaw, Brooklyn, U.S.A. Eng. Pat. 6407, April 30, 1888. 8d.

A CANDLE of sulphur is enclosed in a casing and is provided with fibres of combustible material distributed throughout its mass, and with transverse wicks laid radially on the upper concave surface of the candle, with turned-up ends.

—J. M. H. M.

An Improved Antiseptic Compound for Preserving Perishable Articles. W. H. Daniels, Chicago, U.S.A. Eng. Pat. 17,843, December 6, 1888. 4d.

THE compound consists of the following:—Sulphur, one pound; sugar, four ounces; sassafras, four ounces; cinnamon, two ounces; and potassium nitrate, two ounces. The ingredients are reduced to a fine powder and then mixed to form a homogenous mass. In using it, the substances to be impregnated are enclosed in an air-tight vessel together with some of the compound "which is vaporised by any suitable apparatus."—J. W. L.

Improvements in Sanitary Materials or Preparations for Preventing the Decomposition and Deterioration of Sizes, and Similar Finishes for Fabrics and the like, and for Preventing the Access of Infectious Diseases. R. Hannan, Glasgow. Eng. Pat. 3159, February 22, 1889. 4d.

"QUADRIBORATE of soda" (about 40 parts) and salicylate of soda (about 1 part) are mixed with 1,000 parts of solid gelatin, size or the like, and dissolved for use in sizing, the object being to prevent the mildewing of the materials, and also to disinfect such bodies as are in contact with the sized material.—J. W. L.

An Improved Insect Destroying Compound, and Method of preparing same. A. M. Clark, London. From E. Bean, Jacksonville, U.S.A. Eng. Pat. 3470, February 26, 1889. 4d.

CAUSTIC lime is slaked with water, and while slaking, powdered sulphur is added, the latter combining with the lime and forming a compound soluble in water.

About 2 lb. of sulphur are added to 8–10 lb. of lime, and the mixture finally made up with 100 gallons of water.

It is applied to plants and trees for the purpose of destroying insects.—J. W. L.

Improvements in Blotting Paper, and in the Manufacture of the same. J. Hawke, New Barnet. Eng. Pat. 4768, March 28, 1888. 6d.

THE inventor claims the incorporating or combining of salts of iron or sodium with the pulp, from which blotting paper is to be made, or the impregnating of the manufactured paper with solutions of the above, whereby the efficiency is increased.—E. J. B.

Improvements in the Construction of Apparatus for making Bisulphites or other Compounds used in the Treatment of Wood Pulp or other Fibrous Materials, and the like. I. S. and J. T. McDougall, R. K. Hartley, and T. Sugden, Oldham. Eng. Pat. 7060, May 11, 1888. 11d.

See under VII., page 392.

An Improved Process of Preparing or Treating Vegetable Fibrous Material for Obtaining Fibre therefrom. J. Mactear, Westminster. Eng. Pat. 12,682, September 3, 1888. 6d.

THIS invention consists essentially in submitting the fibrous material, such as flax, hemp, jute, reed, &c., to the action of ammonia in presence of sodium or potassium hydrate, carbonate or borate. The solution is heated and kept in circulation by means of live steam. The action of the alkaline liquid is aided by a current of electricity sufficient to decompose water, the evolved gases acting on the gummy matter of the fibres in such a way as to loosen and destroy it.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Chemical Composition and Toxic Action of Urechitis Suberecta. M. Egasse. Nouv. Rem. 1888, 555.

FROM *Apocynce Urechitis Suberecta* occurring in Jamaica, Bowrey isolated a crystalline and very poisonous glucoside urechitine, $C_{25}H_{45}O_{10}$, also a body resembling the glucosides termed urechitoxin, $C_{23}H_{29}O_5$, equally poisonous. Minkiewicz also found a resinous acid, smelling like vanillin. This acid kills cats in doses of 0.006–0.001 grm. per kilo. of animal weight, though no remarkable change was noticed in the dead body by autopsy. Solutions containing 0.002 per cent. of the glucoside contract the vessels of warm-blooded animals. Both the glucoside and the resinous acid are true heart-poisons. They are antidotes for curare, and closely resemble strophantus.

—A. R.

On α - and γ -Chloro-aceto-acetic Ethers. An Attempt to prepare Citric Acid Synthetically. A. Haller and A. Held. Compt. Rend. 108, 516–518.

BY the action of chlorine on aceto-acetic ether both the α - and γ -chloro-aceto-acetic ethers are produced. The latter is best obtained by passing dry chlorine into well cooled aceto-acetic ether contained in a broad vessel. The delivery tube should only be immersed to the extent of 3–4 cm. in the liquid. Chlorine is rapidly absorbed, and after about half an hour the weight of the ether has increased by 30 per cent., as required theoretically. The product is washed and rectified. The portion boiling at 188°–189° contains the most mono-chloro-derivative; a di-chloro-derivative is found in the fraction boiling from 195°–200°. By treating the former with potassium cyanide,

a mixture of the γ -chloro-derivative with a small quantity of the α -derivative is obtained. The product resulting from the action of the cyanide is dissolved in alcohol saturated with hydrochloric acid. When all the ammonium chloride has separated, the ether is treated with hydrocyanic acid, and then again with alcoholic hydrochloric acid. Finally an oil is obtained which distills in vacuo at about 200°. This after saponification yields a substance which has the characteristic property of citric acid, viz., the solution of its lime salt becomes turbid on heating and clear again on cooling.

—A. R.

On the Physiological and Therapeutic Action of o-Methylacetanilide. Dujardin-Beaumetz and G. Bardet. *Compt. Rend.* 108, 571—572.

THE *o*-methyl derivative of acetanilide known as "Exalgine" melts at 101°, is slightly soluble in warm water, very soluble in water to which a little alcohol has been added. Rabbits are killed by administering 0.46 grm. per kilo. of animal weight. In non-toxic doses it acts as an anæsthetic, and there is a progressive lowering of the temperature of the body. Compared with antipyrine, its action seems more thorough as an anæsthetic, and less so as an antipyretic. Quantities of about 0.5 grm. have very marked pain-killing effects in all cases of neuralgia. Hitherto its administration has not been followed by any of the unfavourable symptoms attending the use of antipyrine and acetanilide, with one exception. It eventually passes into the urine, and in cases of diabetes diminishes both the quantity of the urine as well as that of the sugar. "Exalgine" as an anodyne is superior to antipyrine. In conclusion, the authors briefly allude to the relations existing between chemical constitution and physiological and therapeutic effects of the various febrifuges. They ascribe antiseptic action to bodies of a phenolic nature (phenol, naphthol); febrifuges are nearly all amido derivatives, and finally anodynes are usually amido derivatives, in which one atom of hydrogen is replaced by a radical of the fatty series, notably methyl (*e.g.*, in antipyrine, acetphenetidine, exalgine).—A. R.

Hydrastin. M. Freund. *Ber.* 22, 456—459.

THE author has formerly (*Ber.* 20, 2400; this Journal, 1887, 381, 449, and 641) shown that hydrastinine, the decomposition product of hydrastin, when treated with potash, yields hydrohydrastinine, which is reconverted into hydrastinine by gentle oxidation. By oxidation with potassium permanganate in alkaline solution hydrastinine is converted into oxyhydrastinine. These reactions show that hydrohydrastinine, hydrastinine, and oxyhydrastinine bear the same relation to each other as an alcohol and its corresponding aldehyde and acid.

The behaviour of cotarnine with alkalis has also been investigated. The reaction does not proceed so smoothly as in the case of hydrastinine. The author has also failed to convert cotarnine by oxidation into a product of higher oxidation. Further experiments are in progress, however, in this direction.

On boiling together hydroxylamine hydrochloride, and hydrastinine in alcoholic solution, the corresponding oxime is obtained as chloride in beautiful crystalline plates. The hydrochloride is easily soluble in water; ammonia and sodium carbonate precipitate the free base; free alkalis in excess dissolve the base. It crystallises from alcohol in white needles, melting at 145—146° C. Its composition is $C_{10}H_{12}NO_2CH : NOH$. The platinum salt $(C_{11}H_{13}N_2O_3Cl)_2 PtCl_4$ forms as a crystalline precipitate on mixing solutions of the hydrochloride and platinum chloride.

Hydrastininehydriodide is formed by boiling hydrastinine with fuming hydriodic acid, or by precipitating hydrastinine hydrochloride with a solution of iodine in potassium iodide. It separates from dilute alcohol in splendid brown needles. Melting point, 132°—134° C. Dibromohydrastinine, obtained by the action of bromine vapour on hydrohydrastinine hydrobromide, crystallises from water in white, broad needles, melting at about 280° C. It is most probably a derivative of hydrastinine, of the formula $C_{11}H_9Br_2NO_2$.

Some time ago the author, in conjunction with W. Will (*Ber.* 19, 2802; this Journal, 1886, 677), described a neutral body obtained in small quantity from the root of *Hydrastis canadensis*. Further analyses have proved it to be meconin. The body obtained by the action of nitric acid on it is nitro-meconin.—H. T. P.

Constitution of Filicic Acid. E. Paternó. *Ber.* 22, 463—465.

DACCOMO (*Ber.* 21, 2970), who investigated filicic acid and a number of its derivatives, came to the conclusion that this acid is isobutyrylhydroxynaphthoquinone and its composition $C_{14}H_{16}O_5$. He prepared and analysed a compound $C_{14}H_{16}O(C_6H_5N_3H)_4$ by boiling the acid with phenyl hydrazine in ethereal solution. On treating an alkaline solution of the acid with zinc dust in the cold he obtained a yellow oil which rapidly oxidised and turned red on exposure to the air. The yellow oil he considered to be a reduction compound of filicic acid, probably $C_{14}H_{22}O_5$, and from an analysis of the barium salt of the red oxidation product he assigned to the latter the composition $C_{14}H_{22}O_{11}$.

The author severely criticises Dacomo's experimental results and theoretical conclusions. He points out that the composition of isobutyrylhydroxynaphthoquinone, which would be a neutral compound, is $C_{14}H_{12}O_4$, and draws attention to the fact that a hydroxynaphthoquinone or hydroxyhydronaphthoquinone derivative, which according to Dacomo takes up six atoms of hydrogen, would not be reduced so easily.

The compound $C_{14}H_{22}O_{11}$ could not possibly be formed, and Dacomo's analysis is worthless, as he overlooked the fact that some of the carbon remained as barium carbonate.

The author concludes by asking whether a hydroxynaphthoquinone could possibly combine with four molecules of phenylhydrazine, and states that in his opinion nothing is yet known of the constitution of filicic acid.—F. S. K.

Harmine and Harmaline. O. Fischer. *Ber.* 22, 637—645.

THIS paper is a supplement to a paper published four years ago by O. Fischer and E. Täuber (*Ber.* 18, 400) concerning the alkaloids of *Peganum harmala*. By the oxidation of harmine, a dibasic acid ($C_{10}H_8N_2O_4$) was obtained, from which, by separation of carbon dioxide, a base ($C_8H_6N_2$) resulted. Harmine takes up four atoms of hydrogen when treated with sodium and alcohol, and is converted into tetrahydroharmine. The latter substance forms interlaced needles, melting at 199° C. Its solution exhibits a faint bluish-green fluorescence, which is rendered more green by oxidising agents, such as ferric chloride or silver nitrate. A tetrabromoharmine, $C_{12}H_{12}N_2OBr_4$, has been formed. Sulphurous acid removes the bromine from this addition product. Alkaline carbonates have the same effect on warming, and even boiling alcohol reconverts the substance into harmine. Harmaline yields on reduction with sodium or zinc dust the same final product as harmine, namely, tetrahydroharmine. Harmalol is obtained as hydrochloride by the action of hydrochloric acid on harmaline. Harmine oxidised in glacial acetic acid solution with chromic acid yields harminic acid, $C_{10}H_8N_2O_4$. Harminic acid is also obtained from harmaline by a similar process. Harmine is produced by the partial oxidation of harmaline. Harminic acid yields on heating a beautiful crystalline base, apo harmine ($C_8H_6N_2$). Harmolic acid, $C_{12}H_{10}N_2O_5$, is produced by the fusion of harmol with caustic potash. It crystallises from hot water in small needles, which melt at 246°—247° C. with decomposition.

Many attempts were made to synthesise apoharmine or hydroapoharmine, but without success, nor are these substances identical with any known bodies of the same percentage composition, as for example Merz and Ris's tetrahydroquinoxaline, which not only possesses the same composition as dihydroapoharmine, but similar properties. (*Ber.* 20, 1190).—H. T. P.

Morphine. Nature, May 2, 1889, 14.

SKRAFT and Wiegmann have recently separated methyl-ethylamine, $C_2H_5(C_2H_5)NH$, from morphine, $C_{17}H_{19}NO_3$, itself long known to be a derivative of phenanthrene $C_{15}H_{13}$. Morphine may thus turn out to be an isonitrile of phenanthrene.

Morphine was heated for about five hours at $180^\circ C$. with 10 times its weight of a 20 per cent. solution of alcoholic potash. A volatile substance of an amine-like odour was evolved, and was driven over by a current of coal gas into sulphuric acid.

The filtered acid solution was then super-saturated with caustic soda and the purified amine distilled over by steam into a standard solution of hydrochloric acid, and the hydrochloride obtained was crystallised. Crystals also of a platino-chloride were obtained.—W. S.

Report on New Drugs and Fine Chemicals.

Merk's Bull. 2, 1—12.

Agaricic acid.— $C_{11}H_{17}(OH)(COOH)_2$. This substance is the active constituent of agaricin, which is itself obtained from *Fungus Laricis*. Pure agaricic acid melts at $138^\circ C$. and is but slightly soluble in cold water; more easily in hot water, from which solution the acid mostly crystallises out on cooling. Agaricic acid is equal to atropine in its action in suppressing dermic secretion.

Allyltribromide.— $C_3H_5Br_3$. This is identical with "Tribromhydrin." Wurtz obtained it by treating allyl iodide with bromine and Berthelot and Lucea by the action of phosphorus tribromide and pentabromide on glycerol. It is a slightly yellowish liquid of sp. gr. 2.130 at $15.5^\circ C$. and boils at $217^\circ C$. It is a strong sedative and anodyne, and is taken both internally and subcutaneously (Armand de Fleury).

Anagyrine. $C_{14}H_{18}N_2O_2$, is an alkaloid recently discovered by Hardy and Gallois in the leguminosa, *Anagris fatida*, the toxic properties of which were described by Arnoux in 1870.

The new alkaloid is a yellowish, amorphous substance, very hygroscopic, and soluble in water, alcohol, and ether. It forms salts which easily crystallise. It has powerful toxic action, ending in arrest of respiration and motion of the heart.

Chloral-Ammonium (Trichlor-amido-ethylie alcohol), $CCl_3CH(NH_2).OH$, is formed, according to Schiff, by the action of ammonia on a solution of chloral in chloroform.

Nesbit recommends the use of chloral-ammonium instead of urethane and chloral hydrate (Deutseh. Chem. Centr. 1888, 720). The reason for such substitution is that the action of the chloral hydrate on the respiration centres and the heart, is retarded by the introduction into that compound, of an amido-group.

Cineraria maritima.—The liquid extract of the juice of this plant, a native of Southern Europe and Central America, has been found of extraordinary efficacy in cases of cataract. The plant from which this extract was obtained was grown in Venezuela.

Condurangin.—This glucoside has been examined by Jukna of Dorpat. He found it to belong to that peculiar class of glucosides, the members of which are precipitated by a number of the general alkaloid reagents and by sodium chloride. It is a slightly yellowish powder, soluble in alcohol, and possessing an aromatic and bitter taste.

Condurangin influences neither the action of the heart nor the blood-pressure of warm-blooded animals, nor does it exercise any decomposing effect on the blood. It acts exclusively as a nerve poison, the influence of which seems to be confined to the brain and the medulla oblongata.

Coronillin. $C_{11}H_{12}O_5$, is a glucoside recently discovered by Schlagdenhauffen and Reeb in the European Papilionaceæ—*Coronilla scorpioides*. On boiling with dilute mineral acids coronillin is decomposed into glucose and coronillein. Coronillin is a heart-poison, whilst coronillein exercises no toxic action whatever.

Diphenyl methyl-pyrazole has been recently recommended as a substitute for antipyrine. It is distinguished from the latter by a very decided basicity and by a less distinct reaction with ferric chloride. It takes the form of white needles, melting at $150^\circ C$. with difficulty soluble in water, petroleum spirit, and ether, but with ease in alcohol and glacial acetic acid.

Eserine-Pilocarpine.—Researches by Ellenberger and Bass have recently demonstrated the eminently beneficial action of a mixture of pilocarpine with eserine (physostigmine) as a specific for the colic of horses. It is a white powder, very readily soluble in water, and is administered by injection.

Hedvigia Balsamifera is the name of terebinthinacea, native in the West Indies. In its alcoholic extract a resin and an alkaloid have been discovered, both possessed of toxic properties, those of the alkaloid being stronger than those of the resin. The aqueous extract of *Hedvigia balsamifera* is $2\frac{1}{2}$ times less powerful in its toxic action than the alcoholic; also the stem of the plant yields more toxic effect than the root.

Mercurthymol Salts.—(Mercurthymol acetate, -sulphate and -nitrate.) These salts have been found of great value in the treatment of syphilitic diseases.

The Acetate. $C_{10}H_{13}OHg—HgCH_3.CO_2$, has been most largely experimented upon. Like the other salts, it is crystalline, colourless, insoluble in water, but easily soluble in alkaline solutions. When administered subcutaneously it is prepared as an injection by suspension in liquid paraffin ($\frac{1}{2}$ grains to 15 grains of the paraffin). The salts were administered internally in pills.

There was no appreciable difference in the efficacy of the three salts named.

Phlorizin.—This glucoside is found in the bark of the apple, pear, plum-, and cherry-trees, especially in the root-bark. Mering, in 1885, discovered the fact that this glucoside given to dogs, causes intense *Mellituria* without otherwise affecting the animal's general health. Further researches (*Zeits. für klinische Med.* 1888, 405) have demonstrated relations of remarkable interest existing between the effects of Phlorizin and *Diabetes mellitus*. In short, it had hitherto been assumed that artificial diabetes could not be induced in an organism where the liver was devoid of glycogen, but Mering's researches have shown that intense *mellituria* may be induced by doses of phlorizin in the body of an animal whose liver and muscles are both totally devoid of glycogen.

Pyridine. C_5H_5N , is easily miscible with water in any proportion, and the aqueous solution shows an alkaline reaction. It is also miscible with alcohol, ether, benzene, and the fatty oils. When pure, it is strongly hygroscopic, readily attracting sufficient moisture from the atmosphere to slightly increase its specific gravity and greatly depress its boiling point.

Of the well-crystallised salts which it forms, the two following are used for internal application:—

Pyridine nitrate. $C_5H_5N.HNO_3$.—Slender, colourless needles, easily soluble in water, less so in alcohol.

Pyridine sulphate (C_5H_5N) $_2.SO_4H_2$.—Crystalline; soluble in all proportions in water and alcohol.

Distler found that pyridine is but very slightly toxic. Penzhoid found that pyridine acted as a general antiseptic, especially as regards *Myceles*. It appears that taken by inhalation pyridine acts as a respiratory sedative. It is successfully used as a topical antiseptic in diphtheria, also as a heart-stimulant.—W. S.

The Active Principle of Condurangin Bark. R. Kobert. Chem. Zeit. Rep. 13, 58.

There are at least three active substances, viz., two or three glucosides and a resin, which are all similar in their action.

The *Condurangin* of Vulpus is also not a simple substance, but a mixture of two of the above glucosides. It is observed that when its solution is heated to $40^\circ C$. it

coagulates like albumen, and it resembles this substance also in being precipitated when the solution is saturated with sodium chloride. Hot filtered solutions therefore contain very little or no conduragin.

Conduragin possesses marked poisonous action on the central nerve system. It interferes with the animal movements, destroys the appetite, produces a strong flow of saliva and vomiting. On the heart, blood-vessels, blood, &c., it is without action. The fatal dose for flesh-eating animals is 0.02 grm. for every kilo. of animal weight, and for the herbivorous about three times this amount.—A. W.

PATENTS.

Improvements in the Production of Mercury Compounds.

L. Merck and E. Menzel, Darmstadt, Germany. Eng. Pat. 3094, February 29, 1888. 6d.

This patent relates to the production of a somewhat unstable group of compounds, of which the thymol derivatives $C_{10}H_{13}OHg.HgNO_3$ and $C_{10}H_{13}OHg.HgC_2H_3O_2$ may be taken as typical. Similar derivatives can be obtained from phenol, resorcinol, β -naphthol, and other mono- and polyhydric phenols, and from mercuric salts other than the nitrate and acetate. They are prepared by adding a warm acid solution of the mercuric salt gradually, and with vigorous agitation, to a warm alkaline solution of the particular phenol until the precipitate barely redissolves. When the liquid cools, the mercury compound separates in a crystalline form, and can be purified by recrystallisation from a dilute solution of an alkaline hydroxide. These compounds are only slightly soluble in dilute acids, and are therefore precipitated when their solutions in alkalis are acidified.—C. H. B.

An Apparatus for the Extraction of Oxygen and Nitrogen from the Atmospheric Air. A. Brin, London. Eng. Pat. 3967, March 14, 1888. 8d.

This apparatus consists essentially of a cylindrical iron retort turning upon rollers at each end, and divided by vertical partitions into a number of compartments containing oxide of barium. Provision is also made at each end of the retort for the inlet or outlet of gas, and the upper and lower part alternately of each partition is perforated with a large number of small holes to facilitate the passage of gas throughout the retort. This latter is protected as to its exterior surface by a coating of asbestos and silicate of potash or soda, and is placed over a furnace so arranged that the heating is performed by carbonic oxide only. The heated products of combustion also generate steam for working fans or pumps to drive air through the retorts, or to produce a vacuum when it is desired to extract the oxygen from the peroxide of barium. An automatic lever arrangement worked by the expansion of the retort, regulates the supply of carbonic oxide and prevents the retort from becoming overheated.—A. R. D.

fogs the plates, even if the exposures were made in exceptionally bad light, as plates have been in this bath 8—9 hours without being fogged. Moreover it can be used for several successive plates. It can be preserved without alteration in stoppered bottles in the dark. Where it is desirable to accelerate the development, a little carbonate of soda should be added to the bath.—A. R.

PATENTS.

A Process of Photographing in Colours. J. B. G. Bonnaud, London. Eng. Pat. 4537, March 24, 1888. 6d.

TRANSPARENT negative and positive images of the object are prepared, and a glass plate is coated with a mixture of sugar or gum and potassium bichromate, dried, and exposed to light under the transparent positive for a sufficient length of time. The darker tints of the object are then applied in the form of finely-powdered vegetable colours, exactly as in the ordinary "dusting on" process. The plate is again dried if necessary, and now exposed to light under the transparent negative, which is reversed in order that the different parts of the image may correspond. When sufficient exposure has been given, the lighter tints are applied in the same manner as the darker tints, and the image is afterwards coated with boiled oil and varnish mixed with 10 times their weight of turpentine. Details may then be painted in with ordinary oil colours. The picture is next coated with collodion prepared by dissolving 2 grms. of pyroxylin in 40 cc. of alcohol of 62°, and 60 cc. of ether of 40°, and after a few minutes washed with water in order to remove all soluble matter. It is then placed for not more than a minute in a cold filtered solution of 20 grms. of soap and 20 grms. of bleaching powder in a litre of water, again washed, and then transferred to canvas, wood, or any other support. If it be desired to imitate an oil painting, the support is first coated with white paint, and the finished picture then shows brush marks. When a water-colour drawing is copied, treatment with oil and varnish is omitted.—C. H. B.

Improvements in the Production of Collodion Photographic Films or Surfaces of exalted Sensitiveness. R. Norris, Aston. Eng. Pat. 7044, May 11, 1888. 6d.

THE object of these improvements is to obtain collodion plates equal in sensitiveness to gelatin plates, and the improvements are carried out in several different ways. In the method which the author terms the alkaline-bath process, 7 grains of pyroxylin made at about 200° F. are dissolved in a mixture of 1 drachm of alcohol and 2 drachms of ether, and gradually mixed with a solution of 26 grains of silver nitrate in 80 drops of glycerol and 5 drachms of alcohol. The glycerol may be omitted and a larger quantity of alcohol used. The argentised collodion is spread upon glass or other suitable support, which is then immersed for 5 to 45 minutes in a solution of an alkaline iodide, bromide or chloride, or a suitable mixture of these salts, a small quantity of alcohol and ether being added to this solution with a view to gain increased sensitiveness. The temperature of the bath should be about 76° F. A haloid silver salt or a mixture of such salts is formed in the film, and during immersion changes from the molecular modification which transmits ruby light to that which transmits green and blue. The plate is then well washed, immersed for some time in a dilute solution of an alkaline hydroxide or carbonate, and afterwards in a solution of gelatin containing about two grains per fluid ounce. It is then placed for about 15 minutes in a dilute solution of an alkaline iodide or bromide, and finally washed with water. It may now be used as a wet plate, or may be treated with any of the well known organic preservatives and dried.

In the acid-bath process the plate or other support is coated with collodion containing a soluble chloride, bromide or iodide, and is immersed in a solution of silver nitrate

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Sodium Sulphite as a Developer. P. Poiré. Compt. Rend. 108, 513.

BATHS prepared with pure sulphite develop more slowly than those in which commercial sulphite of soda has been employed, the cause being that the latter always contains some carbonate. The author recommends a solution containing 25 per cent. of pure sulphite and 1—1½ grms. of pyrogallie acid. Though slowly developed, the image gradually acquires the desired intensity. This bath never

containing a large proportion of nitric acid and saturated with silver iodo-nitrate, bromo-nitrate or chloro-nitrate. These latter substances are prepared by saturating a hot solution of silver nitrate with silver chloride, bromide or iodide and allowing it to cool, when the so-called iodo-nitrate, &c. crystallise. The sensitising bath may contain in each fluid ounce 70 grains of silver nitrate and 80 minims of nitric acid. After immersion in this bath the plates are washed and may be used as wet plates or treated with a preservative and dried. The degree of sensitiveness obtained depends on the temperatures of the baths and the times of immersion.

The sensitiveness of collodion emulsion plates may be increased in a similar manner. In the case of emulsions prepared with an excess of bromide the plate is washed and then treated with the alkaline solution, gelatin and the iodide solution in the manner already described. Emulsions in which the silver nitrate is in excess must be prepared with the iodo-, bromo- or chloro-nitrate, washed and then treated with the gelatin and iodide solutions. In both cases the emulsion plates are treated with a preservative. In the preparation of the emulsions, alkaline bromides give greater sensitiveness than bromides of the heavy metals.

These plates are exposed, developed and fixed in the ordinary manner. It is claimed that they are equal to gelatin plates in sensitiveness, and that the operation of washing and drying can be carried out much more rapidly.

—C. H. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

Report of the French Commission for Explosive Substances on the Use of Explosives in Presence of Fire-damp.
Ann. des Mines, 5, 1888, 197—376.

The authors having satisfied themselves, both from the results of previous investigations and in some preliminary experiments, that mixtures of coal-dust and air were not as dangerous as mixtures of marsh-gas and air, have restricted themselves to the latter and more dangerous mixture. The experiments were conducted in a boiler which by suitable arrangements could be completely filled with a gaseous mixture of known composition, and the explosive under examination was suspended in the middle of the boiler and fired by the aid of electricity, the effect on the gaseous mixture being ascertained by the alteration in pressure observed on a pressure-gauge.

The marsh-gas was prepared from sodium acetate and soda-lime and stored in a gasometer; it contained per cent. 10.8 of air, 7.9 absorbed by bromine, no carbonic anhydride, and 81.3 of methane (by difference). The mixture introduced into the boiler contained generally about 10.3 per cent. of methane; this approximates to the most explosive mixture, whilst a 6 per cent. mixture verges on the limits of non-inflammability.

The first series of experiments were tried with unconfined explosives freely suspended in the gaseous mixture, this being the most dangerous condition; such experiments are useful to ascertain the actual safety of an explosive.

The explosives investigated were:—*Ordinary powder*. Dynamite containing 75 per cent. of nitroglycerol and 25 per cent. of silica. *Pandilles ammoniacal dynamite*, a mixture of varying proportions of nitroglycerol, ammonium nitrate, and of a carbonaceous substance destined to utilise the excess of oxygen produced by the detonation of the nitroglycerol and ammonium nitrate. *Gun-cottons* of the general formula $C_{24}H_{40-2n}N_8O_{20+2n}$ the maximum value of n would be 12, but in practice it does not exceed 11. The following table represents the number of cubic centimetres of nitric oxide evolved from 1 grm. of the various gun-cottons when examined by Schloesing's method; the value of n indicates the composition:—

	$n =$	Cc. N_2O_4
Endecanitric cotton.....	11	244
Decanitric ".....	10	203
Enneanitric ".....	9	190
Octonitric ".....	8	178
Heptanitric ".....	7	162
Hexanitric ".....	6	146
Pentanitric ".....	5	128
Tetranitric ".....	4	108

Military gun-cotton (205 cc. N_2O_4) corresponds approximately to the decanitric; *mining gun-cotton* (193 cc. N_2O_4) to the enneanitric; and a third gun cotton (173 cc. N_2O_4) investigated, to the octonitric. Tests were also made with *blasting-gelatin* consisting of gun-cotton and nitroglycerol and with *dynamite gelatin* consisting of blasting gelatin mixed with some such substances as a mixture of potassium or sodium nitrate with charcoal or sawdust. All these when detonated completely under the above conditions generally ignited the gaseous mixture, and must therefore be regarded as dangerous for use in mines where fire-damp may be expected. The last two compositions did not detonate completely in cold weather. Dynamite and also gun-powder even ignited the gaseous mixture when detonated in a Sottle's water-cartridge. *Hellhoffite*, a mixture of dinitrobenzene with $1\frac{1}{2}$ or $2\frac{1}{2}$ times its weight of nitric acid, made on the spot where employed, is anyhow not considered sufficiently convenient for use in mines; *Favier explosive*, 9 parts of mononitronaphthalene with 91 of ammonium nitrate; and *Bellite*, about 20 parts of dinitrobenzene and 80 of ammonium nitrate; these three explosives either did not explode at all, as was the case with the first two when freely suspended in air, or exploded incompletely, as in the case of bellite. Under exceptional circumstances finely-pulverised Favier explosive was made to explode and then ignited the gaseous mixture; the detonating mixtures used with this explosive is however of itself dangerous. Two powders consisting of gun-cotton and barium nitrate ignited the gaseous mixture, whilst a powder consisting of 60 parts of gun-cotton (175 cc. to 185 cc. N_2O_4), 30 parts of barium nitrate, 6 parts of saltpetre, 3 parts of gelose, and 1 part of paraffin, only inflamed the gaseous mixture twice out of 14 times. Various experimental mixtures were now investigated. Dynamite with an equal weight of either crystalline sodium carbonate, sodium sulphate, ammonia alum or ammonium chloride did not ignite the gaseous mixture, but with larger proportions of dynamite the ignition of the fire-damp generally ensued. Some interesting experiments were made with mixtures of coal-dust and dynamite. Three coals, containing respectively 40, 27.86 and 23.60 per cent. of volatile matter, mixed with equal weights of dynamite, did not set fire to the marsh-gas when exploded, even a mixture containing 4 of dynamite to 1 of the first coal in one experiment did not ignite it, but a mixture of 2 parts of dynamite with 1 part of a lignite (braunkohle) containing 62.4 per cent. of volatile matter, ignited the inflammable gaseous mixture. Mixtures of 20 of dynamite with 80 of ammonium nitrate detonate freely in the air without causing ignition of the marsh-gas; in this case both substances explode, but the temperature of the explosion of ammonium nitrate is lower than that of the dynamite, and therefore moderates the activity of the latter in the mixture. Mixtures of gun-cotton and ammonium chloride require so much of the latter to make them safe that they ultimately cease to explode at all.

Mixtures of gun-cotton and ammonium nitrate become safe when the former giving 173 cc. of N_2O_4 does not constitute more than 20 per cent. of the mixture. From these experiments it was concluded that simple explosives susceptible of igniting fire-damp will always fire gaseous inflammable mixtures, but that it is possible to produce binary explosives in which the temperature of detonation is sufficiently reduced to be safe.

It is pointed out that although the temperature of ignition of marsh-gas is $650^{\circ}\text{C}.$, the ignition is greatly retarded by admixture with another gas such as air or even oxygen; the retardation amounting to 12 seconds even if the temperature of the whole volume of gas is at 650° , whilst at lower temperatures it is still longer. It is for this reason that the immense temperature developed by an explosion does not ignite fire-damp, for this temperature is reduced with such great rapidity, some thousandths of a second, that there is not time to ignite mixtures of fire-damp, unless the initial temperature is sufficiently great—according to the observations of the present investigators about $2,200^{\circ}$ or over.

It is interesting to note that explosions not igniting fire-damp will ignite mixtures of coal-gas and air, these having a lower ignition point, and explosions igniting neither marsh-gas and air, or coal-gas and air, may ignite a mixture of hydrogen and air. The heat generated by

explosives is next studied, and methods and formulæ are given for its calculation. Calorimetric experiments with various explosives freely suspended in the air yielded results, some of which are tabulated below.

Wherever the heats found coincide with the theoretical, complete detonation has ensued, and therefore these results confirm and explain the behaviour of the various explosives already noticed. In explanation of the apparent anomaly of the lower nitrated gun-cottons giving higher temperatures than the more strongly nitrated ones, it is shown that the proportion of combustible gas in the gaseous mixture produced by the detonation increases as the proportion of nitrogen in the cotton diminishes, therefore the lower nitrated cottons should yield a more inflammable mixture which by its combustion would produce a great increase in temperature and might even account for those temperatures which exceed the theoretical in the above table.

	Weight of Cartridge.	Fulminate in Detonator.	Increase in Pressure after Explosion.	Heat in Cals. for 100 Grms. of Explosive calculated	
				From the Increased Pressure.	From Theoretical Data.
	Grms.	Grms.	Metres of Water.		
Dynamite.....	50	1.5	0.83	97.0	97.2
Military gun-cotton (205 cc. of N_2O_2) ¹	50	"	0.72	88.0	104.0
Mining " (193 cc. of N_2O_2).....	50	"	1.48	172.0	103.0
Blasting gelatin (Paulilles).....	40	"	0.56	80.2	153.5
" " ".....	50	"	0.69	80.6	"
Bellite.....	50	"	0.28	32.7	100.2*
".....	50	3.0	0.34	39.8	"
Pyroxyline powder (Moulin-Blanc).....	50	1.5	0.60	70.0	82 dissoc. of BaCO_3
" " ".....	65	"	0.61	54.7	" "
58 gun-cotton + 42 barium nitrate.....	50	"	0.70	82.0	81 dissoc. of BaCO_3
20 " (173 cc. of N_2O_2) + 80 ammonium nitrate.....	50	"	0.15	17.5	80
25 " " + 75 " " ".....	50	3.0	0.41	48.0	91
35 " " + 65 " " ".....	50	1.5	0.43	50.0	102
60 " " + 40 " " ".....	30	"	0.35	68.1	96
80 " " + 20 " " ".....	30	"	0.63	123.0	82
90 " " + 10 " " ".....	30	"	0.94	183.0	76
20 dynamite + 80 ammonium nitrate.....	50	"	0.225	26.4	50
67 " + 33 ammonium alum.....	50	"	0.445	52.0	63†
50 " + 50 " chloride.....	50	"	0.12	49.2	10‡
60 " + 40 " ".....	50	"	0.44	51.5	35
67 " + 33 " ".....	50	"	0.53	62.0	49

* Calculated for the proportions $175 \text{ C}_6\text{H}_5(\text{NO}_2)_2 + 825 \text{ NH}_4\text{NO}_3$.

† Allowing for complete combustion of the dynamite and simple dehydration of the alum.

‡ Complete combustion of dynamite, and decomposition of ammonium chloride into $\text{HCl} + \text{N} + \text{H}_2$.

A similar behaviour is observed with mixtures of gun-cotton and barium nitrate. A gun-cotton indicating by titration 180 cc. of N_2O_2 always ignites marsh-gas, because the temperature of detonation, about $2,000^{\circ}$, is increased by the combustion of the inflammable gas produced by the detonation; whereas the pyroxylin powder containing 60 per cent. of this gun-cotton, 30 per cent. of barium nitrate, and 6 per cent. of potassium nitrate ignites marsh-gas only exceptionally, owing, it is suggested, to the oxygen supplied to the mixture in the form of nitrates being sufficient to burn enough material so as to dilute the gaseous mixture produced by the detonation and render it non-inflammable; but by adding more barium nitrate, so as to provide enough oxygen to consume all the gas and admitting the subsequent dissociation of the carbonate, the temperature of detonation is raised to $2,550^{\circ}$, which is sufficiently high to ignite fire-damp. With regard to force

it is shown that the same amount of power may be produced at a lower price by the use of larger quantities of dynamite and ammonium nitrate than by employing smaller quantities of the more expensive dynamite.

Irregularities in explosives, such, for instance, as incomplete detonation, which produces indefinite reactions, are a source of danger, and are more common in mixtures than in simple explosives. These reactions vary under different circumstances, such as the amount of fulminate used for detonation, the temperature of the charge at the time of explosion, &c., therefore an explosive should not be considered safe if amongst its several modes of detonation in the open air there be one susceptible of igniting marsh-gas. The most suitable substance for reducing the temperature of detonation of an explosive is ammonium nitrate, as other substances, such as sodium carbonate, or sulphate, or alum, or ammonium chloride, only decompose partially, and their

effect is uncertain. Mixtures worthy of further consideration are: the pyroxylin powder; gun-cotton (173 cc. N_2O_5) with 80 per cent. of ammonium nitrate, giving a force of 7,550 grms. and a detonating temperature of 1,920; dynamite, with 80 per cent. of ammonium nitrate, f. = 6,260 grms., t. = 1,500; bellite, f. = 2,993 grms., t. = 2,186; Favier explosive, t. = 2,120°. The last two require to be further experimented with. Ammonium nitrate reduces regularly, as the proportions of it in the mixture increases both the temperature and power of dynamite and highly-nitrated gun-cotton; but with octonitric gun-cotton these reductions do not set in until 70 per cent. of nitrate is present. Curves illustrating this behaviour are given in the report.

Experiments were now made with the more dangerous explosives confined in tubes of lead or tin, closed below and open at the top. The explosive was placed and rammed in the tube, on a plug of marl or sand 5 to 6 centimetres thick. It was then tamped with clay or sand, or, in some cases, coal-dust, to the thickness of 10 to 12 centimetres. Tubes of various thicknesses were used, and exploded, as in the previous experiments, in the boiler. The portion of the tubes surrounding the explosive was blown to powder, whilst the upper and lower portions were generally found nearly intact at the bottom of the boiler. The following table of results illustrates the effect of the thickness and quality of the tube on the temperature of explosion:—

Explosive.	Description of Tube.		Material.	Effect on Mixture of Marsh-Gas and Air. I. = Ignition. N. = No ignition.
	Diameter.			
	Internal.	External.		
	Mm.	Mm.		
Dynamite.....	27	40	Lead	N.
“	30	40	“	I.
“	30	35	“	I.
“	25	40	Tin	N.
Mining gun-cotton.....	32	42	Lead	N.
“ “	30	35	“	N.
Blasting gelatin	25	40	Tin	I.
Dynamite gelatin	27	40	Lead	N.
Ammoniacal dynamite	25	40	Tin	N.

Other conditions being the same, the safety of the explosion increases with the thickness of the tube, owing, it is assumed, to the fact that much of the heat of detonation is converted into mechanical force, and so the temperature is reduced below the dangerous limit. Dynamite loses more than one-third of its initial heat of detonation in shattering the tube, and distributing the debris. To ascertain the effect of the density of a charge, the explosive was enclosed in a thin glass tube, and fixed by wads between the clay plug and tamping in the metal tube so as to leave an annular space between the metal sides of the tube and the exterior of the glass tube. Under these circumstances it was observed that the work done on the tube was greatly diminished, owing, it is suggested, to expansion of the gases within the tube, and instead of one-third, only one-fifth of the initial heat of the detonation of the dynamite was absorbed. The same result is observed with loosely packed explosives: for example, dynamite simply poured into a 32—42 mm. lead tube, and tamped, ignited fire-damp, whereas under the same conditions with the dynamite rammed in, no ignition ensued. This shows the importance of ramming and tamping well when using explosives. Altering the shape of the tube simply varies the work imposed on a unit volume of gas, the larger the proportion of surface, the greater the imposed work, but does not affect the density of the charge. Further experiments show that dynamite alone or mixed with 80 per cent. of ammonium nitrate, or 33 per cent. of ammonia alum, or 40 per cent. of ammonium chloride; bellite; pyroxylin powder (Moulin-Blanc); and gun-cotton (173 cc. N_2O_5) mixed with even 40 per cent. of ammonium nitrate, explode completely when confined in 25—40 mm. tin tubes, bellite, even in a 30—35 mm. lead tube; but blasting gelatin requires a stronger tube to ensure its complete detonation.

With regard to modes of igniting the charge. In using a fuse (Bickford) care must be taken not to place it in contact with the explosive; for under such circumstances gas and

flame may be projected through the tube into the external air, and so produce ignition of the fire-damp. Other objections to the Bickford fuse are the uncertainty of its composition, and the danger attached to lighting the exposed end. When electricity is used, preference should be given to currents of low tension so as to avoid sparking, and possible ignition of fire-damp. Detonating cords made of gun-cotton have been found uncertain. Lauer's friction cap has not yet been investigated by the Commission. Various detonators have been examined, and with the exception of those of Ruggieri and Scola, and ordinary 1.5 grm. fulminate caps, they do not ignite mixtures of marsh-gas and air when exploded by themselves. Strengthened fulminate caps differ from the ordinary ones chiefly in being made of stouter metal, and having the fulminate more compressed, and covered by a little metallic plate with a hole in the centre to allow access of fire; the gases from the explosion of these caps have therefore more work to do, and lose temperature, and consequently a strengthened 1.5 grm. cap, as might be presumed by the above hypothesis, does not ignite a mixture of either marsh-gas or even coal-gas and air, but does ignite a mixture of hydrogen and air; a larger charge, however, 5 grms. for instance, produces sufficient heat to ignite fire-damp. By imposing more work on the gases of detonation of an ordinary fulminating cap, a similar effect is produced. Thus by winding fine copper wire closely round the outside of an ordinary 1.5 grm. cap, this ceases to ignite fire-damp when detonated.

The conclusions arrived at have already been mentioned above, but special stress is laid on the importance of making the explosive do as much work as possible, and bearing in mind the uncertainty attached to the use of even the safest explosives, on the advisability of avoiding their use in presence of inflammable mixtures of marsh-gas and air, in fact the selection of the safest explosive "ought to be considered as diminishing the danger of explosion considerably; it ought not to be regarded as suppressing it absolutely."

Binary mixtures of ammonium nitrate with dynamite, or gun-cotton, or dinitro-benzene are recommended from a point of view of safety, although it is suggested that experiments should be made on the method of manufacture of these mixtures, on their durability, and on their behaviour in mines. All results of the numerous experiments are tabulated, and notes containing interesting theoretical considerations are appended, in which are given methods of calculating the force and temperature obtainable from explosives, and the results of such calculations are also tabulated. An objection to the use of water cartridges is the large bore-holes required.

Subsequent to the drawing up of the above report further experiments were made, using a mixture of coal-gas and air instead of marsh-gas and air, thus avoiding the expense of the manufacture of marsh-gas. The most explosive mixture of coal-gas and air contains 15 to 16 per cent. of the former; in the experiments it was more convenient to use a mixture containing 10 per cent.; the ignition temperature of this mixture appears to be about 2,100°. This was ascertained in the same way as the ignition temperature of marsh gas and air, namely, by exploding in it various cartridges of which the temperature of detonation, &c. could be calculated; the cartridge giving the lowest temperature and igniting the mixture being the one selected for fixing roughly the ignition temperature of the mixture. This mixture of gas and air is not much more inflammable than marsh-gas and air, therefore it is considered that it would not be too severe a test to make all explosives destined to be employed in presence of marsh-gas satisfy the condition of not igniting such a mixture of coal-gas and air when detonated while freely suspended in it.

In the first report it was suggested that moistness of the atmosphere aided the explosion of fire-damp, but further experiments have not confirmed this suggestion.

Remarks as regards dynamite are not altered in the second report, but as regards gun-cotton it is shown that although the gases from octonitric cotton burn in the air when the cotton is exploded unconfined, nevertheless when this explosive is confined in a tin tube, 25 mm. internal diameter, 31 mm. external, or thicker, not only does the gas not burn, but also the detonation is incomplete. By testing mixtures of dynamite and ammonium nitrate containing from 90 to 40 per cent. of the latter, it is shown that detonating power increases as this proportion decreases, and complete detonation of the unconfined mixture does not take place until 50 per cent. of dynamite is reached;

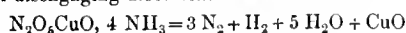
even increasing the amount of fulminate used with the 20 per cent. dynamite mixture scarcely improves the extent of detonation; in a 25 mm. × 31 mm. tin tube the condition of affairs is not much better, but in a 25 mm. × 40 mm. tin tube complete detonation of both dynamite and nitrate ensues. The gases evolved from this mixture do not react on one another; the same is the case with mixtures of dynamite and alum, ammonium chloride, &c., it is suggested that in such mixtures the non-explosive constituent, the one absorbing heat on decomposing, is decomposed only slightly, or not at all, during the propagation of the explosive wave; their decomposition only taking place in a closed tube. Various mixtures giving gases which react on one another were examined, such as mixtures of ammonium nitrate with combustible substances, gun-cotton, dinitrobenzene, ammonium picrate, naphthalene tar, heavy coal-oils, colophony, &c. In the open air they behave sometimes as if the explosive wave excited at one point exhausted itself before traversing the whole mass of the explosive; at other times, as if the explosive wave passed through the whole mass of the explosive, but stopped at the decomposition of the explosive constituent or constituents, the gases evolved being dispersed before reacting mutually; therefore, the detonation in the open air is incomplete. When, however, the gases are confined, as, for instance, when the explosive is put in a sufficiently strong metal case, then the reaction between the gases takes place, and the effect of a complete detonation is obtained. There are numerous results, tabulated, illustrating these points:— Mixtures of about 80 per cent. of ammonium nitrate with gun-cotton, or 83 per cent. with dinitrobenzene, do not detonate completely either in the air or in thin (25 × 31 mm.) tubes, but do in 25 × 40 mm. tubes. Mixtures of ammonium nitrate and picrate in the open air give an effect equal to the decomposition of the nitrate, but in the tube the result is equal to the decomposition of both. With tars, &c. the result is never much above that attributable to the ammonium nitrate.

Experiments were now made with increasing quantities of safety mixtures to test their capability of igniting the inflammable gaseous mixture; the various results are tabulated and discussed. In the following tables is given various data relating to the mixtures which proved safe; other mixtures already referred to are either too expensive or inconvenient, or improper as explosives as far as the present results indicate.

	Force in Kilos.	Heat from 1 Kilo. in Cals.	Grms. of Fulminate required for Detonation.
Dynamite (for comparison).....	8'490	1'109	....
30 of dynamite, 70 of ammonium nitrate.....	6'750	600	0'50
20 " 80 " "	6'260	530	0'50
20 of gun-cotton* 80 " "	7'610	810	1'50
15 " 85 " "	7'000	700	1'50
12½ of dinitrobenzene 87'5 " "	8'000	1'006	1'50
10 " 90 " "	6'700	750	1'50

* About octonitric.

Other mixtures worthy of consideration are those containing mononitronaphthalene, or naphthalene, and ammonium nitrate, but their behaviour is at present uncertain. Finally, attention is called to mixtures of ammonium copper nitrate and ammonium nitrate. The heat of formation of this salt N_2O_5CuO , $4 NH_3$ is for $(N_6 + H_{12} + O_8 + CuO)$ 164'1. The products of decomposition have not been studied, but the mode of disengaging most heat is as follows:—



disengaging 516 cals. per kilo. When exploded in the air white fumes of ammonium nitrate and of oxides of nitrogen are evolved; therefore products are uncertain. Its complete combustion by ammonium nitrate is represented by the following equation:—

$Cu(NO_3)_2, 4 NH_3 + NH_4NO_3 = 4 N_2 + 8 H_2O + CuO$, or proportions of 76 to 24 of nitrate, heat produced per kilo. = 655'5 cals., whilst the force = 6'090 kilos., and temperature of detonation 1,750°. This was therefore

considered as an interesting explosive in connexion with safety in fire-damp. In the open air or in tubes the detonation of the salt does not appear complete according to the above equations, either alone or when mixed with ammonium nitrate; in fact, is almost arrested in the open air when the nitrate present is double the copper salt. It is believed it would explode completely in a mine bore-hole; with regard to its safety the results are very satisfactory, even with mixtures containing only 25 per cent. of nitrate, but the mixture containing 80 per cent. of nitrate is safe in coal-gas, detonating at a temperature of 1,300°, with a force of 5,500 grms.

In conclusion they point out that safety mixtures of dynamite and ammonium nitrate should not contain less than 80 per cent. of the latter. The other mixtures must fulfil the conditions of having a temperature of detonation lower than 2,200°, of not yielding combustible gas after complete detonation, of having sufficient force to avoid use of larger quantities of the explosive, of being sufficiently explosive to minimise misfires, of being kept sufficiently long without undergoing change, and they must not be too expensive. Mixtures fulfilling these conditions more or less are those with ammonium nitrate, and (1.) A maximum of 75 per cent. of ammonium copper nitrate; (2.) 6 per cent. of naphthalene; (3.) 15 per cent. of octonitric gun-cotton; (4.) 10 per cent. of mononitro naphthalene; (5.) 10 per cent. of dinitrobenzene. They recommend trials in mines.

To avoid danger as much as possible, the mixtures should be well mixed, and the smallest proportion of the dangerous substance, consistent with efficiency, should be used.

As safety depends on the instantaneous admixture of the gas of the detonation with the surrounding atmosphere, it is therefore dangerous to blast with a large quantity of explosive in a confined space.—D. A. L.

Report on Further Experiments with Explosives at the Experimental Level of the König Colliery, near Neunkirchen (Saarbrücken), in Respect to their Behaviour with Fire-damp and Coal Dust. H. Lohmann. Zeits. f. Berg., Hütten-und Salinwesen, 1889, 83.

An explosive consisting of a mixture of dynamite with 40 per cent. of soda crystals gave very good results, both as regards safety from colliery explosions and the production of large coal. Samples of "carbonite" gave better results than before, and the cartridges were better made. Water cartridges—the explosives surrounded with water—gave good results as to safety.

"Ammonia dynamite" consists of 40 per cent. of ammonium carbonate, 10 per cent. of nitre, and 50 per cent. of a mixture of nitro-glycerol and kieselguhr, containing sufficient of the latter to make the mass plastic but not too soft. The introduction of ammonium carbonate is less advantageous than the oxalate. A good mixture is 45 per cent. of ammonium oxalate, 15 per cent. of nitre, and 40 per cent. of the kieselguhr dynamite. It seems possible that by some alteration in the composition of ordinary black powder it may be possible to use it in collieries with safety, ammonium oxalate being used in place of carbon.

"Securite" gave bad results as regards safety from explosion. The Rottweil powder works has consequently much altered and greatly improved this explosive.

"Roburite" was used with success in workings which were free from fire-damp. Analysis failed to show the presence of chlorine in the explosive obtained from Witten, although it was supposed that some of this element was present.

Experiments with Wolf's benzene safety lamp gave very good results.

As regards risk from explosion "ammonia dynamite" proved to be very safe; *Kieselguhr dynamite* and *gelatin dynamite* were bad and about equally so; "Roburite" is better than "gelatin dynamite," but not so good as "ammonia dynamite," although it is possible that this explosive may have been recently still more improved.

"Carbonite," the improved "securite," and "soda dynamite" afford great safety. "Gelatin dynamite No. 2" is as good as "No. 1," and Favier's explosive, one sample of which consisted of dinitrobenzene, mononitronaphthalene, ammonium nitrate and nitre, also gave very good results.

—A. W.

The Annual Report (Thirteenth) of Her Majesty's Inspector of Explosives for 1888.

THE 13th annual report on the working of the Act, signed by Colonel Majendie, H.M. Chief Inspector of Explosives, and his colleagues, Colonel Ford and Major Cundill, has just been issued. The total number of factories now under license is 112, with 353 magazines.

The factories and magazines are under the direct supervision of the inspectors, who report that their visits during the year have been sufficiently numerous to enable them "to speak with confidence and the greatest satisfaction of their general condition." In few instances indeed has there been any tendency towards retrogressions, "and there are now several private factories and magazines which we believe may challenge comparison with any similar establishment in other countries, whether public or private."

The number of deaths from accidents in the manufacture and storage is 6, this being the lowest number on record. Of these 6, three occurred in firework factories.

The four years preceding the passing of the Act show an average of 37 deaths, at which period less than half the present number of factories existed. Dr. Dupré, the chemical adviser to the department, reports a notable increase over the ordinary work of the laboratory, due to the increased importation of dynamite and to the introduction and gradual adoption of new explosives.

No less than 20 applications for a license to manufacture or import new explosives were made during the year. Of these, eight were reported on favourably, nine were rejected, and three were still under consideration at the time of the issue of the report.

It appears from Major Cundill's Dictionary of Explosives that out of a total of 350 suggestions for new explosives, 67 are chlorate mixtures. Of these 67, one only has been authorised. In spite of this fact inventors do not seem discouraged, as there were three chlorate mixtures submitted during last year, one under the name of "safety-powder." "This," says Dr Dupré, "so-called safety-powder is a mixture of chlorate of potassium and glycerin." The other mixture, called "Romit," is described as "another attempt to render chlorate of potassium available as a constituent of an explosive for general use, and, like most attempts, has ended in failure." The third, called "Howittite," has the objection of being not only sensitive to combined friction and percussion, but liable to spontaneous decomposition.

One out of three samples of "Carbonite" passed the necessarily severe tests satisfactorily; as also "Flameless Securite," which has the same composition as "Bellite" with the addition of oxalic acid or oxalates, "Fortis" a nitrate mixture, and others of, at present, little interest. "Bonolithe," a picrate mixture, was still under consideration at the time Dr. Dupré issued his report.

Local authorities appear in many instances to carry out their responsibilities in connexion with the Act in a very reprehensible manner. The report states, "We regret to have to say that, taken as a whole, the system is far below the standard which might reasonably be expected. In some places the work appears to be efficiently carried out by local authorities, while in others, as in some of the smaller boroughs and principal market towns, the work is almost, if not altogether, neglected." One effect is to place the law-abiding trader at a great disadvantage. On the other hand it is satisfactory to learn from the report that there are several important districts and towns in which an attentive and intelligent administration of the Act prevails. The high standard of purity for some time past maintained by "chemical explosives" has led to a relaxation of certain restrictions with regard to the storage of mixed explosives.

The report refers to the appointment by the War Office of a committee of chemists for the purpose of specially

investigating and dealing with chemical questions relating to explosives for use in naval and military services, and Dr. Dupré has been selected as one of the members of the new committee.

An amendment of the law in relation to petroleum has been promised for some time, and much of Colonel Majendie's time has been taken up with the preparation of the Bill.

The steadily progressive increase in the number of factories and magazines, accompanied by an actual decrease in the number of fatal accidents, is remarkable.—C. N. H.

PATENTS.

Safety-Fuse and Igniting Apparatus for setting Fire to Explosive Charges without Danger from the Presence of Fire-damp. H. Müller, Clermont, Belgium. Eng. Pat. 5061, April 5, 1888. 8d.

THE object of this invention is to produce a fuse which will not ignite fire-damp on combustion. This is effected by an envelope of wire, gauze, or similar material fixed on to the fuse in a special way. It is necessary to consult the drawings accompanying this specification in order to clearly understand it.—C. N. H.

Improvements in Fuses. C. A. McEvoy, Southwark. Eng. Pat. 5624, April 16, 1888. 8d.

THE object of this invention is to form a fuse that will be ignited by immersion in water. This is effected by means of sodium or potassium, or a mixture of both, suitably attached to the fuse.

Drawings accompany this specification.—C. N. H.

Improvements in Explosive Compounds. A. V. Newton, London. From A. Nobel, Paris, France. Eng. Pat. 6560. May 2, 1888. 6d.

THIS invention relates to the treatment of nitrated starch and nitrated dextrin for the production of explosive compounds to be used in place of gunpowder.

For this object nitrated starch or nitrated dextrin is incorporated with nitro-cellulose, and both dissolved in a suitable solvent such as acetone, &c. By means of such solvents, which are afterwards distilled off and recovered, a very perfect incorporation can be brought about.

Other explosive substances or oxidising agents, such as picroates, chlorates, nitrates, &c., may be incorporated with the aforesaid materials, the quantity of the solvent being so far increased as to allow of a complete and uniform distribution of the substance to be incorporated.—C. N. H.

XXIII.—ANALYTICAL CHEMISTRY.

Improvements in the Employment of Bunsen's Photometer. B. Nebel. Rep. d. Phys. 24, 724.

As light entering the eye laterally renders it less sensitive to slight differences of shade, the author has introduced a modification of Bunsen's photometer with a view to obviate this, for a description of which we must refer to the original article. For producing the grease spot, a perfectly-rounded brass disk, of 20 mm. diameter, and provided with a handle, is warmed, dipped into molten spermaceti, and after removing excess of the latter, the disk is placed on paper of .061 mm. thickness, which is stretched evenly on a flat board. The corners of the paper are best attached with little brass frames and some Canada-balsam. Since the visual power of the eyes usually differs, it is best to use only one eye for these determinations.—A. R.

Detection of Nitrates in Soils. Frank. Landw. Jahrb. 17, 723—724.

IN reply to Krenslor's suggestion that the blue colouration of diphenylamine produced by sand was due to the presence of manganic and ferric oxides (this Journal, 1889, 306), the author points out that his observations do not support this view, inasmuch as the iron-stained spots on the sand grains did not give the reaction, nor does impregnating the sand with ferric oxide impart to it the power of turning diphenylamine blue; moreover, by prolonged ignition of sand giving the reaction, it is possible to destroy its power to do so. Nevertheless, further investigation of the reaction in question has shown that it is probably neither due to nitrates nor any other plant nutrient.—D. A. L.

Detection of Nitrites in Water. F. Musset. Pharm. C. H. 1889, 195.

IN examining a drinking water for nitrites by means of zinc iodide, starch solution, and acetic acid, the author noticed that the liquid gradually darkened in colour, and after the lapse of 24 hours was quite a dark blue. The reaction is as a rule at an end after the lapse of a couple of hours. This water contained a large number of bacteria; it contained no iron; the sediment from the blue solution contained, amongst colourless forms, deep blue cylindrical forms of bacteria. The author concludes, therefore, that the bacteria are the cause of the colouration, and that these consequently have the property of liberating iodine from an acidified solution of zinc iodide and starch. After distillation no blue was obtained, so that only the distillate should be used.—T. L. B.

Characteristic Reaction of Copper-Salts. Denigès. Compt. Rend. 108, 568.

THIS reaction is based on the transformation of copper salts generally into cupric bromide by the action of potassium bromide. The cupric bromide, after drying over sulphuric acid, dissolves in an excess of the bromide with a red-violet colouration.—A. R.

Investigations on the Methods for the Valuation of Argol. P. Boessneck. Chem. Zeit. 13, 356—357.

THE author recommends the Goldenberg-Geromont method as the most reliable for the determination of the total tartaric acid in argol, and traces the high results (2—4 per cent. too high) obtained by both Lorcé's and Fresenius' modifications of Goldenberg's original method, either to alkali being retained by humus substances in the crude sample, or to the fact that the latter prevent the complete removal of the excess of acetic acid added in the precipitation of the acid potassium tartrate. (See this Journal 1888, 136, 239 and 349.) The analysis is carried out as follows:—Treat 10 grms. of the finely-powdered sample with 15 cc. of hydrochloric acid of sp. gr. 1.1, stir well, allow to stand, and make up to 203 cc. (3 cc. correspond to the volume occupied by the insoluble portion); filter the solution through a dry filter-paper, and heat 100 cc. of the filtrate in a flask. Then add potash till strongly alkaline, boil the solution, filter off the precipitate, and wash till free from alkali. The filtrate is treated with hydrochloric acid till only just alkaline, concentrated to 20 cc., allowed to cool, and warmed with 5—6 cc. of glacial acetic acid for 10 minutes on the water-bath. 100 cc. of absolute alcohol are next added and the whole allowed to stand for 2 hours before filtering; the precipitate is washed with alcohol until 20 cc. of the filtrate, diluted with an equal volume of water, are reddened by the addition of a drop of semi-normal alkali, after adding phenolphthaleïn. The titration is effected in the usual manner until the solution is almost neutral (this point being judged by means of litmus paper), and the final point tested in the boiling solution, using paper soaked in an ammoniacal solution of the artificial colour "azo-litminum," and then allowed to dry in the air. The paper thus prepared is of a pale pink colour, and turns blue on the addition of alkali. The determination of the quantity of acid potassium tartrate in argol in the

presence of calcium sulphate presents difficulties which the author suggests might be overcome by adding an excess of antimony oxide (Sb_2O_3), and then determining the amount of the latter, combined with the cream of tartar, after boiling and filtering, either gravimetrically or volumetrically. One molecule of cream of tartar takes up half a molecule of Sb_2O_3 . The results, however, appear dependent upon the degree of concentration of the solution, and also upon the quantity of the excess of antimony oxide added; this makes it necessary to work the method under constant conditions.

—C. A. K.

Volumetric Determination of Chromium in Chrome-iron Ore. C. Reinhardt. Chem. Zeit. 13, 430.*

THE finely powdered chrome ore (0.5 gm.) is fused for two hours with potassium bisulphate. The ore is completely decomposed by this means, which is not the case if soda be employed. The method is useful when a complete analysis of the chrome ore is required, since on treating the fused mass with water, insoluble basic chromium sulphate separates. If the chromium only is to be determined, J. B. Britton's method (Fresenius Quant. Analyse, p. 354) is more suitable; the chrome ore being fused with potassium chlorate and soda-lime yields the chromium as chromate. The solution of the melt after separating silicic acid is mixed with manganese sulphate, then with an excess of an acidified ferrous sulphate solution of known strength, and the latter titrated back with permanganate. The yellow colour produced by the latter is avoided by addition of phosphoric acid. No more permanganate should be added after the solution is coloured violet. Presence of manganese in the chrome-iron ore renders this method faulty, since when fused with chlorate, manganates or permanganates are formed.—A. R.

On the Determinations of Nickel as its Sulphide. A. Leerenier. Chem. Zeit. 13, 431 and 449.

COMPLETE precipitation of nickel sulphide with ammonium sulphide is only possible if the latter contain no polysulphides. As freshly-prepared ammonium sulphide rapidly turns yellow, it is difficult to have the reagent as pure as seems desirable for nickel determinations. By adding a certain quantity of sodium sulphite, however, the change into polysulphides is obviated. The author mixes one volume of ammonium sulphide with two volumes of a 10 per cent. sodium sulphite solution, and this solution is rendered colourless by heating on the water-bath. In a table which is appended, the author gives the results of experiments on this subject, which may be summed up as follows:—Precipitation of nickel by decolourised ammonium sulphide is only complete when the solution of the nickel salt does not contain less than 0.1 gm. of Ni for every 200 cc. of water. In very dilute solutions complete precipitation may be effected by adding a relatively small quantity of ammonium chloride, carbonate, or acetate. This is to prevent nickel sulphide remaining in solution in the colloid form. Presence of ammonia may entirely or partially prevent precipitation of nickel as sulphide; thus at a certain concentration colourless solutions may be obtained containing both a nickel salt and ammonium sulphide. It is therefore advisable to remove excess of ammonia by boiling and saturating the last traces with carbonic acid before adding ammonium sulphide. Regarding the cause of nickel sulphide being incompletely precipitated by ammonium sulphide containing polysulphides, the author believes this to be due to the formation of soluble ammonium sulpho-nickelate, and adduces the following facts in favour of this view. (1.) Ammonium sulphide which has been decolourised with mercury precipitates all nickel from solutions of any degree of dilution. (2.) Pure ammonium sulphhydrate (i.e., free from ammonia) which has been saturated with sulphur completely dissolves nickel sulphide. Moreover, a solution of the latter in ammonium polysulphides is not precipitated by boiling with sodium sulphite. Probably in this case the higher sulphide of nickel which is first formed, having been converted into an ammonium sulpho-nickelate decomposition by sodium sulphite, can no longer take place.—A. R.

On the Testing of Spent Substances from Gas Purification. C. Moldenhauer and W. Leybold. Jour. f. Gasbeleucht. 32, 155.

THE authors give a new method of determining the Prussian blue in the spent material. Formerly Knublauch's method was the most used, but the end of the titration was often uncertain. By the authors' process 50 grms. of the spent substance are placed in a flask with 100 cc. of a solution of 10 per cent. caustic soda and 2 per cent. sodium carbonate, heat is applied to hasten the decomposition, and the whole is then diluted to 1,030 cc. 100 cc. of the filtrate are evaporated down in a platinum or porcelain basin and treated with 25 cc. of dilute sulphuric acid (10 per cent.). After further evaporation the excess of acid is driven off and the organic matter destroyed by ignition. The yellow residue consists of ferric sulphate and sodium sulphate, which is dissolved in dilute sulphuric acid. The iron is reduced to the ferrous state by means of zinc and titrated with permanganate solution. From the iron thus found the amount of Prussian blue is calculated. A blank experiment should be made to ascertain the slight correction for impurities in the zinc. Concordant results were obtained by several chemists working independently.—G. H. B.

Colour Reactions of Certain Ethereal Oils. A. Ihl. Chem. Zeit. 13, 264.

Peppermint-oil mixed with alcohol and a little powdered sugar assumes a bluish-green colour when heated with dilute hydrochloric or sulphuric acid. Menthol which is contained in this oil does not give the reaction. Phloroglucinol is a very delicate reagent for these ethereal oils which contain eugenol. Thus, clove-oil which consists of eugenol and a sesqui-terpene $C_{15}H_{24}$ gives a bright red colour when treated with alcoholic phloroglucinol and concentrated hydrochloric acid. Resorcinol employed in the same manner causes a red-violet colouration and pyrogallol a violet one. Cinnamon-oil (cassia-oil) treated as above with phloroglucinol gives a deep red colour, and with resorcinol a cinnabar red. Pimento-oil is coloured pink by phloroglucinol, and dirty violet by resorcinol in alcoholic solutions and with addition of hydrochloric acid. The three last named ethereal oils, when mixed with alcoholic aniline sulphate and dilute hydrochloric acid, assume a yellow colour, especially on boiling. It is probable that this reaction is due to eugenol contained in these oils.—A. R.

Some Reactions of "Vanado-Sulphuric Acid" on Glucosides and Alkaloids. F. Kundrát. Chem. Zeit. 13, 265.

THE reagent was prepared by dissolving 0.1 gm. of ammonium vanadate in 10 cc. of conc. sulphuric acid.

Substance.	Gives with Vanado-Sulphuric Acid a Solution coloured
Aconitine	Light coffee-brown.
Atropine.....	Red, then yellowish-red, finally yellow.
Apomorphine.....	Dark violet-blue, rapidly changing to dirty-green, finally reddish to light brown.
Brucine.....	Intense blood-red, gradually changing to original colour of solution.
Cinchonine	Faint orange, gradually green.
Cocaine.....	Orange (foams on dissolving).
Codeme.....	Greenish-brown, gradually darker, finally brown.
Colchicine	Green, then brownish-green, finally coffee-brown.
Conine.....	Intense green, gradually becoming brown.
Digitaline.....	Intense brown with red shade, then quite brown.
Quinidine	Faint bluish-green.
Quinine.....	Slightly orange, then bluish-green, finally greenish-brown.

Substance.	Gives with Vanado-Sulphuric Acid a Solution coloured
Caffeine.....	No reaction.
Morphia.....	Brown.
Narceine.....	Brown, changing to dirty bluish-violet, then gradually reddish-brown.
Narcotine.....	Blood-red or purple.
Nicotine.....	Slightly darker, soon assumes same colour as original solution.
Papaverine.....	Violet with brown shade, gradually changing to bluish-green and then orange-green.
Picrotoxin.....	Hardly changed.
Pilocarpine.....	Light orange.
Piperine.....	Intense reddish-brown to black.
Physostigmine...	Greenish-yellow, then purple, finally yellowish-brown.
Salicylic acid.....	Brownish-green, becoming darker.
Antifebrine.....	Changes quickly from purple to brown.
Antipyrine.....	Intense greenish-blue, gradually bluer.
Kairine.....	Dirty pink, quickly changing to dirty light brown, and finally dirty brownish-green.
Santonine.....	No reaction.
Solanine.....	Coffee brown; after a short time the edge of the drop is coloured purple, towards the middle yellow, and in the middle dirty green. After two hours the drop changes to a gelatinous mass of an intense violet colour.
Strychnine.....	Bluish-violet, gradually changing to reddish-violet, purple, and brilliant red.
Veratrine.....	Brownish-red, gradually becoming a dark reddish-violet.

—A. R.

Examination of Creosote. W. Brandes. Arch. Pharm. 1889, 411.

THE German Pharmacopœia requires the sp. gr. 1.03 to 1.08 for creosote from beechwood tar. This is a mixture of guaiacol and cresol, the former of which has the sp. gr. 1.117, and the latter 1.088 at 15° C., from which it is evident that the specific gravity of good creosote must be higher than that given in the Pharmacopœia. A creosote which was free from phenol and cresol fulfilled the above requirements without containing any guaiacol cresol. It consisted chiefly of the homologues of cresol, viz.:—xylol and phlorol. The Pharmacopœia gives no reactions for determining guaiacol and cresol, but the property of their forming potassium salts, which are with difficulty soluble in alcohol, may be made use of for this purpose. The author states:—10 cc. of an alcoholic potash solution (1 part of KHO dissolved in 4 parts of 96 per cent. alcohol) shaken up with 1 part of creosote gives after some time a solid crystalline mass.—A. W.

Reactions for distinguishing Carbolic Acid and Resorcinol from Salicylic Acid. L. van Itallie. Apoth. Zeit. 4, 99.

By adding two drops of ferric chloride solution to 100 cc. of a 2 per cent. solution of phenol, resorcinol or a saturated solution of salicylic acid, a bluish-violet colour is produced. On now adding one drop of lactic acid the colour immediately changes to yellowish-green in the case of phenol or resorcinol, whilst with salicylic acid the original colour is maintained even if 10 drops of lactic acid be added.—A. R.

Quantitative Determination of Aniline and Monomethylaniline. F. Reverdin and C. de la Harpe. Chem. Zeit. 13, 387—388 and 407—408.

Two methods are at present in use for the determination of monomethylaniline. One depends on the rise of temperature, which is produced by adding acetic anhydride to the mixture under examination; the other (proposed by Nölting and Boas Boasson, Ber. 10, 795) consists in converting the monomethylaniline into methylphenylnitrosamine, $C_6H_5.N(NO).CH_3$. The former method can only be used for the examination of mixtures of mono- and dimethylaniline free from aniline; the latter, however, may be used in presence of aniline. At the same time the acetic anhydride method can only be used where small quantities of monomethylaniline are present; thus a mixture containing 2.82 per cent. showed a rise of 0.815° per 1 per cent., which coefficient used in the case of a mixture containing 9.36 per cent. of monomethylaniline gave a sufficiently satisfactory result, viz., 9.57 per cent.; but on raising the percentage to 29.55, an altogether unsatisfactory result was obtained, 37.42 per cent.

The other method is carried out in the following manner:—10 grms. of the mixture under examination are dissolved in 20 cc. of hydrochloric acid and 125 cc. of water, and a solution of 12.5 grms. of sodium nitrite is then gradually run in, the whole being well cooled. The methylphenylnitrosamine formed is then extracted with ether. Its weight multiplied by 0.786 gives the amount of monomethylaniline in the mixture.

The present authors, in order to obtain the nitrosamine pure, then distilled it with steam. They obtained it by this means as a light yellow oil, as it is usually described, but at + 2° C. it crystallised, forming masses of needles, the temperature at the same time rising to + 14° C. It melts at 12°—15°. After the distillation with steam there remained a yellow liquid, from which, on cooling, a quantity of yellow needles separated. These melted at 102°—103° C. and consisted in all probability of nitrophenylmethylnitrosamine, $C_6H_4(NO_2).N(NO).CH_3$, so that in the reaction nitroso-nitrosamine must have been formed by the excess of sodium nitrite, and then oxidised to nitronitrosamine. As this substance together with *p*-nitrodimethylaniline, $C_6H_4(NO_2).N(CH_3)_2$, was repeatedly obtained, the action of an excess of sodium nitrite was tried on pure monomethylaniline. No phenylmethylnitrosamine was obtained in this case, but a large quantity of nitronitrosamine. The formation of nitrophenylmethylnitrosamine, whose molecular weight is 181, while that of phenylmethylnitrosamine is only 136, is sufficient reason for considering the method inaccurate.

The authors attempted a separation by distilling salts of the bases with steam, but without success.

They obtained good results, however, by the following method:—

The aniline is determined by converting into diazobenzene and titrating with a solution of "R salt" (sodium salt of a β -naphtholdisulphonic acid). The monomethylaniline is determined by adding to the mixture a known quantity of acetic anhydride and titrating the excess of the latter with caustic soda solution.

When aniline or dimethylaniline are heated with acetic anhydride or glacial acetic acid secondary reactions occur, which would make this method of analysis inaccurate, so that whilst the reaction is in progress heat must not be applied. By boiling aniline for two hours with a considerable excess of acetic anhydride a much larger quantity of the latter is used up than is necessary for the formation of monoacetanilide; in all probability diacetanilide is formed in this case. Dimethylaniline heated for some time with a large excess of glacial acetic acid gives from 10—15 per cent. of tetramethyldiamidodiphenylmethane.

At ordinary temperatures excess of acetic anhydride quickly converts aniline and monomethylaniline quantitatively into monoacetanilide and methylacetanilide, whilst dimethylaniline remains for some considerable time unacted

upon, and even then the action is very slight. The analysis is carried out as follows:—

Determination of the Aniline.—Prepare a titrated solution of R salt, containing in 1 litre the equivalent of about 10 grms. of naphthol.

Dissolve 7–8 grms. of the mixture under examination in 28–30 cc. of hydrochloric acid and make up with water to 100 cc. Take 10 cc. of this solution, dilute with water and ice, and diazotise, using so much nitrite as would be used if aniline alone were present. Pour the product slowly into a measured quantity of the R salt solution, to which has been added excess of sodium carbonate. Salt out, filter, and ascertain excess of either by means of diazobenzene solution and R salt. A mixture containing 10.76 per cent. of aniline showed 10.24–10.40 per cent.

Determination of the Monomethylaniline.—Into a flask fitted with reflux condenser weigh 1–2 grms. of the mixture, add as quickly as possible a known weight of acetic anhydride, corresponding to about twice the weight of the mixture taken, and allow to stand for about half an hour; then add about 50 cc. of water and heat on a water-bath for three-quarters of an hour in order that the excess of acetic anhydride may be fully transformed. Cool, make up to a known volume, and titrate with caustic soda solution (phenolphthalein may be used as indicator). The amount of monomethylaniline may then be ascertained from the amount of acetic anhydride actually used, after deducting, of course, the amount necessary for the aniline—T. L. B.

Determination of the Free Alkali and Free Fatty Acid in Soap. E. Dieterich. Helffenberger Ann. 1888.

Dissolve one part of soap in 20–50 parts of water, and add so much sodium chloride that a little remains undissolved. Filter, and wash with a little saturated salt solution; dissolve the mass in water, and again salt out and filter as before. Combine the two filtrates and determine the free alkali by means of centinormal H_2SO_4 and phenolphthalein.

Dissolve the soap, salted out above, in 30 cc. of absolute alcohol by warming in a water-bath, add phenolphthalein and titrate with centinormal KOH. Calculate as oleic acid. As the alcohol frequently contains substances which decolourise phenolphthalein, it is necessary to determine separately the amount of centinormal KOH required to redden the phenolphthalein in 30 cc. alcohol, and to subtract this from the former determination.—T. L. B.

Method for Ascertaining the behaviour of Lubricating Oils at Low Temperatures. A. Hoffmeister. Mitth. d. Königl. techn. Versuchs. 1889, 21–27.

THE methods commonly used at the present time leave much to be desired, involving as they do errors objective and subjective. The following is the plan proposed to replace them:—About 4 cc. of the oil to be tested are introduced into a test tube and exposed to a constant predetermined temperature, a few degrees below zero, for one or two hours, at the end of which time it may be assumed to have acquired the greatest degree of consistency attainable at that temperature. Its precise condition can be judged by inclining the tube, probing it with a glass rod (cooled to the same extent) or by other suitable means. The tube containing the semi-congealed oil is then exposed in a similar way to a temperature a few degrees lower, and so on until solidification occurs. The constant, known, low temperatures are obtained by partly freezing solutions of various metallic salts in water, which are of such strengths that they are saturated at their freezing points. Such solutions when partially frozen remain constant in temperature until they have wholly solidified or wholly liquefied. Examples are given in the following table:—

Salt.	Parts per 100 of Water.	Freezing Point.
Potassium sulphate	10	- 1.9° C.
Sodium carbonate (crystallised)	20	- 2.0 ..
Potassium nitrate	13	- 2.85 ..
" chloride	30	- 10.9 ..
Ammonium	25	- 15.4 ..
" nitrate	45	- 16.75 ..
Sodium	50	- 17.75 ..
" chloride	33	- 21.30 ..
Barium	35.8	- 8.70 ..

If any particular degree not given in this table be adopted, help may be had in obtaining the conditions necessary for its attainment, by recourse to the device of mixing some other salt with one or other of those there recorded. For example, a solution of potassium nitrate freezing at -2.85° C. has its freezing point lowered 0.6° C. by the addition of 1 gm. per 100 of sodium chloride. This plan is not without objection, as the saline solution being no longer saturated in respect of one of its constituents, viz., the sodium chloride, does not deposit that body on being frozen, and therefore alters in degree of concentration, so that, while it liquefies, small variations in the temperature occur. However, by limiting the proportion of sodium chloride, and avoiding freezing too much of the saline liquid, this error becomes negligibly small.

Some mixtures giving temperatures approximating to those indicated by certain convenient round numbers are given in the following table:—

Freezing Point.	Substances used.	Parts per 100 of Water.
0° C.	Water .....	..
-2.85° approximating to 3° C.	Potassium nitrate ..	13
5° C.	Potassium nitrate ..	13
	Sodium chloride ...	3.3
- 8.7° approximating to 9° C.	Barium chloride ...	35.8
-15.4° .. 15° C.	Ammonium chloride ..	25

Solutions once made up can be kept and used repeatedly.
—B. B.

The Determination of the Solidifying Points of the Fatty Acids from Tallow, of Beef Tallow, and of Lard. Finkener. Mitth. Königl. techn. Versuchs. 1889, 27–41.

THE determination of the solidifying points of such liquids as water is easy, because if by sudden cooling the solidifying point be passed, the temperature of the mass rises again to the normal temperature when once solidification occurs. With fats and fatty acids, however, this rise is but gradual, and may not be discerned at all if the cooling agency be a powerful one, as the heat given out may be absorbed by it as fast as it is produced. Accuracy can be attained by using considerable quantities of the fat or fatty acid undergoing observation, and taking care that the cooling is very slow.

An elaborate series of experiments was made both in test tubes and flasks of various sizes, covered with wadding, buried in iron filings, or exposed freely to the air of the room (which was kept at different known temperatures), in order to determine the influence of such circumstances on the solidifying points of the substances mentioned in the heading; the results are recorded in voluminous tables quite unsuited for abstraction.

The conclusions arrived at were:—

(1.) An envelope of wadding raised the solidifying point of the fatty acids from tallow by about 0.3° C., when a

tube 18 mm. wide was used, and about 0.1°C . when one 45 mm. in diameter was employed.

(2.) The difference between the solidifying points determined in an 18 mm. tube and in a 45 mm. tube was about 0.7°C ., the wider tube giving the higher reading. The temperature remained constant at the solidifying point for 2 and 10 minutes respectively.

(3.) The substitution of a bulb of the same, or greater, diameter than the 45 mm. cylinder was without influence on the results.

The author recommends the use of a globular flask 45 mm. in diameter, carrying a thermometer of which the bulb is about the centre of the flask, surrounded with wadding, and allowed to cool in a room at the ordinary temperature. With this apparatus the thermometer remains stationary for 10 minutes at the solidifying point.

It was further found that considerable variations in the mode of saponification of the tallow used—such as differences in the quantities of potash, alcohol and water employed, time of heating, mode of freeing the fatty acids, &c.—did not affect the melting point of the fatty acids obtained. The method of Dalican, used in London and Paris for commercial purposes, is not satisfactory. It consists in melting the fatty acids in a test tube 18 mm. wide, placing it in another somewhat wider, leaving the thermometer at rest until the fatty acids begin to solidify at the edges, when it is moved round first to the right, then to the left, finally stood in the middle and its highest reading taken. It is difficult to decide when to begin this stirring, and solidification is inconveniently rapid.

Next, with regard to tallow it was found that the solidifying point rose with the quantity taken whether an envelope of wadding was used or not.

The following table gives some idea of the variations observed:—

Vessel used.	Solidifying Point.	
	Without Padding.	With Padding.
Test tube, 18 mm. wide ..	37.82°C .	41.23°C .
Flask, 50 mm. wide	41.15°C .	45.35°C .
" 80 " "	45.81°C .	46.50°C .
" 135 " "	47.90°C .	47.38°C .

In the case of lard the phenomenon was more complex. The solidifying point rose with the quantity taken, provided that no envelope was used. When it was used, and the quantity of lard was fairly large, the solidifying point actually fell below the value given by direct cooling in air, and a noticeable separation into a solid and a liquid portion took place. The author considers this separation to have an important bearing on the matter, since it renders possible the influence of one or both of the following two causes of error. *First*, the portion that solidifies first is free to sink to the bottom of the vessel, and being thus removed from the sphere of action, fails to promote the solidification of the remainder (as it otherwise would), and thereby to bring about the resulting rise of temperature. By artificial cooling of the lowest point of the flask (as by an ether spray) so as to solidify a portion of the mass, mixing this solidified portion with the remainder of the lard, and by finally letting the whole solidify spontaneously, it may be shown that the solidifying point thus obtained is about 0.4°C . higher than that got by allowing the flask to cool without any such treatment. *Secondly*, the central portion surrounding the thermometer bulb may lose heat, on account of the continued liquidity of the fat and resulting convection currents, which would not exist in a semi-solid medium. From these considerations it does not appear likely that any simple plan on the same lines as suffice for tallow can be formulated for the determination of the solidifying point of lard.—B. B.

On the Determination of Glycerol. T. Morawski.
Chem. Zeit. 13, 431.

50—60 grms. of lead oxide are weighed out into a large porcelain crucible, followed by about 2 grms. of the glycerin to be examined, enough alcohol having been added to facilitate the thorough mixture of glycerin and oxide. The contents of the crucible are first heated to 100° , then to 120° — 130° , until the weight becomes constant. The results differ by about 0.5 per cent. Tables are appended giving the figures obtained with different samples of glycerin examined by the author's method, comparing these numbers with those deduced from the sp. gr. tables of Leuz and others, and furthermore with the numbers found by combustion of the glycerin. Fairly close agreement with the latter proves the author's method to be satisfactory, and he claims that weighing as the lead compound is at present the most reliable and rapid method for the determination of actual glycerol in the commercial product.—A. R.

On the Estimation of Glycerol in Brandy Lyes.
H. G. von Törring. Landw. Versuchs. 36, 23.

ACCORDING to the author the various methods for the estimation of glycerol are subject to important sources of error, which are avoided in a new method depending on the following facts: (a.) A solution of glycerol may be evaporated, without losing a trace of glycerol, until the residue contains 50 per cent. of water. By mixing the residue with burnt gypsum most of the water is absorbed, and a mass obtained suitable for the extraction of the glycerol by a solvent. (b.) The glycerol can be completely separated from the non-volatile matters by distillation *in vacuo* at a temperature of 180° . (c.) The aqueous glycerol obtained by distillation is suitable for precipitation of the glycerol as benzoate. The method of procedure is to evaporate 30 cc. of the filtrate from the lyes on the water-bath to 5 cc. Then 15 grms. of burnt gypsum are mixed with the residue, and when the mass begins to set it is well powdered and exhausted for 6 hours with alcohol in an extraction apparatus. The alcoholic solution is treated with 10—20 cc. of water, and heated until all the alcohol is driven off, when the residue is distilled. The distillation apparatus consists of a retort resting in an air-bath, and a Liebig's condenser. The receiving flask has a neck connected with an air pump. The distillation is at first carried on at 150° — 170° without working the air pump, until all the water has passed over into the receiver. Then the pump is set to work, and the temperature raised to 190° — 210° . When all the glycerol has come over, about 3 to 4 cc. of water are added to the contents of the retort, and distilled at 150° — 170° , under ordinary pressure, in order to wash all the glycerol into the receiver. The yellowish distillate, amounting to 10 or 15 cc., is mixed in the receiver with 5 cc. of benzoyl chloride and 35 cc. of a 10 per cent. solution of caustic soda, with frequent cooling and shaking to consolidate the precipitated glycerol benzoate, which is finally collected on a weighed filter, washed with water, and dried for 2 to 3 hours at 100° .—G. H. B.

Examination of Malt Extract. E. Dieterich. Helfenberger Ann. 1888.

SOLID matter is determined in 2 grms.; the dried extract serves for determination of the ash, and this latter for determination of the phosphoric acid. Free acid is determined by titrating a solution of 10 grms. of extract in about 50 cc. of water with seminormal ammonia, using delicate litmus paper. In order to determine the albuminous substances, 2 grms. of extract are well dried, and the nitrogen determined by Kjeldahl's method and multiplied by 6.25.

Maltose.—A solution of 1 grm. of malt extract is made up to 100 cc. and the maltose determined gravimetrically and volumetrically by Fehling's solution. The result is only approximate owing to the presence of other substances, e.g., dextrin, which reduce Fehling's solution. The error due to the small quantity of dextrin in good malt extract is, however, not of much moment.

Dextrin.—To a solution of 5 grms. of extract in 25 cc. of water are added slowly 100 cc. of absolute alcohol, the whole being kept well stirred. This is allowed to stand for 12 hours and is then filtered; the residue is washed with alcohol, dissolved in 60 cc. of water, boiled, filtered, cooled, and made up to 100 cc.; 50 cc. of this are titrated with Fehling's solution. The remaining 50 cc. are heated for three hours on a water-bath with 0.5 cc. of hydrochloric acid, then neutralised carefully with caustic soda and titrated with Fehling's solution. The difference of the two titrations is calculated as dextrin.

Diastase.—Into a number of test-tubes are introduced 10 cc. of a 1 per cent. starch solution; to the first tube is then added 0.2 cc. of a 10 per cent. malt extract solution, to the second 0.3 cc. and so on. The tubes are then heated for three hours to 60° in a water-bath and are then tested for starch by adding a drop from each to an iodine solution. The percentage of diastase may be ascertained from the fact that one part of diastase decomposes 2,000 parts of starch.—T. L. B.

On Commercial Oleic Acid. Its Adulteration with Linseed Oil and Detection of the Lutter. Grauvall and Valser. J. Pharm. Chim. 1889, 232.

TEXTILE fabrics made from wool, which previous to spinning has been greased with olein, often show yellow streaks which cannot be removed by sulphurous acid. Moreover the thread is rough and sticky, there is a large quantity of waste, and the removal of the grease is attended with difficulties. The cause of this is sometimes the presence of mere traces of linseed oil in the olein. For the last few years fresh animal fat has generally been deprived of its more fluid constituents (margarin) at a gentle heat, and to the remaining mass, which consists chiefly of stearin and yields a hard cake of fatty acids on saponifying not readily pressed or purified, linseed oil is added. Now the latter contains solid fatty acids, which increases the yield of products for candle manufacture, but at the same time the oleic acid pressed out of this mixture contains linoleic acid which is easily oxidised and dried. Such olein is of a lighter colour than commercial oleic acid. Its sp. gr. is .912—.919, that of oleic acid being .905. By heating the impure product to 50°, it becomes more viscid on cooling, and, by repeatedly warming and cooling, the mass gradually assumes the consistency of butter. When 50 grms. of oleic acid are shaken with 450 cc. of 85 per cent. alcohol complete solution is effected; in presence of linoleic acid a lustrous precipitate is produced, which may be readily distinguished from a possible precipitate due to mineral oils, resin, fatty oils, or paraffin. After washing with alcohol and drying, the precipitate in the former case melts at about 47°. It dissolves readily in boiling spirit, separating again on cooling. The soap obtained by saponification dissolves in warm water, the solution becoming gelatinous on cooling. When 48 grms. of oleic acid containing linoleic acid are treated for one day with 4 grms. of Pontet's reagent, the acid remains quite fluid, the more fluid the greater the quantity of linoleic acid present. Pure oleic acid under similar conditions solidifies completely. A thin layer of oleic acid spread over a well polished lead sheet is almost unchanged after one day. In presence of linoleic acid it has a resinous appearance. On mixing a little of such impure oleic acid with an equal volume of caustic soda, an intense yellow colour is produced, whilst pure oleic acid is only coloured grey.—A. R.

Notes on Testing Commercial Olein. H. Hager. Pharm. C. H. N. F. 10, 130.

Good commercial olein is yellowish to brownish yellow, liquid at 20°, forming a buttery sediment at 15°, and solidifying to a buttery mass at 5°. It has a specific gravity of .912—.916 at 15°—20°, and is miscible in all proportions with alcohol of 85 per cent., and with petroleum spirit. It gives a firm gelatinous mass when shaken with

twice its volume of alcoholic ammonia (10 per cent.), but if mineral or resin oil be present in larger quantities the gelatinous mass does not form, and the neutral oil remains undissolved.—G. H. B.

Difference between the Extract from Tobacco Ribs and Tobacco Leaves. E. Geissler. Gartenflora, 37, 650—651.

The author has analysed two tobacco extracts with the following results per cent. : —

	Tobacco Extract 40° B.	
	Ribs.	Leaves.
Liquid	32.8	36.2
Mineral matter	22.1	15.5
(Containing potassium carbonate	7.73	9.50)
Organic matter	48.4	50.86
(Nicotine	1.86	8.1)

* Defective type in original.

The differences in mineral matter and nicotine are very great, therefore when purchasing tobacco extracts it is advisable to know if it is from ribs or leaves.—D. A. L.

PATENTS.

Improvements in Apparatus applicable for use as Retort Stands, Filtering Stands, or the like for Chemical, Pharmaceutical, and Household or other Purposes. F. D. Delf, Dewsbury. Eng. Pat. 6874, May 8, 1888. 8d.

The stand is formed of a stout iron ring, attached to three adjustable telescopic legs. The aperture of this ring can be reduced in size by a series of other rings differing in internal diameter. One side of this ring carries a short vertical tube having a sliding rod passing through it, capable of adjustment, and of sufficient length to reach the floor, and to project a considerable height above the ring. This rod carries several stout retort-rings, one of which can have its aperture reduced by a moveable rest projecting inward, and supported on a screwed pin or bar. By these arrangements, apparatus of various kinds and sizes can be supported for chemical and other operations. When not in use the whole stand can be quickly taken to pieces, so as to be packed into a small compass.—E. S.

Improvements in Apparatus for Testing and Detecting the Presence of Gases or Gaseous Mixtures. T. Shaw, Philadelphia, U.S.A. Eng. Pat. 18,105, Dec. 11, 1888. 11d.

This apparatus is designed to indicate the composition of gaseous mixtures (especially mine gases) by determining the proportion of atmospheric air or standard ignitable gas that must be added to bring the mixture to the explosive point. The apparatus consists essentially of two pumps, which drive the gases in any required proportions through a mixing arrangement to the gas tester. The pistons of both pumps are worked by one and the same beam, but by altering the position of one of them, the relation between the quantities of air and gas pumped may be altered at will. The mixture is exploded in the gas tester described in Eng. Pat. 3531 of 1887 (this Journal, 1887, 751). The proportion of carbonic acid is indicated by the effect produced by passing a known volume of the gas through a given quantity of lime water.—A. R. D.

New Books.

A TREATISE ON CHEMISTRY. By Sir H. E. Roscoe, F.R.S., and C. Schorlemmer, F.R.S. Volume III. The Chemistry of the Hydrocarbons and their Derivatives, or Organic Chemistry, Part V. London and New York: Macmillan and Co. 1889.

THIS, the fifth part of the above classic work on Organic Chemistry, contains a description of the Benzene Hydrocarbons and their Derivatives, with eight and more than eight atoms of carbon, and concludes with the Group of the Terpenes and Camphors, including India-rubber and Gutta-percha.

The following are the principal Groups treated of in detail in the text, which covers 485 pages:—The Styrolene, Cumene, Carbostyryl, Phenylpropionic, Cymene, Laurene, and Mellitene Groups; the compounds containing more than 12 atoms of carbons; Group of the Terpenes and Camphors; the Pinene Group; the Camphene, Limonene, Dipentene, Sylvestrene, Terpinolene, Terpinene, and Phellandrene Groups. In the chapter on the Polyterpenes about 14 pages are devoted to the subject of Caoutchouc and Gutta-percha.

The work concludes, as each volume of the English edition does, with an alphabetical index.

EXAMINATION OF WATER FOR SANITARY AND TECHNICAL PURPOSES. By HENRY LEFFMANN, M.D., Ph.D., and HENRY BEAM, M.A. Philadelphia (U.S.A.): P. Blackiston, Son, and Co., 1012, Walnut Street. 1889.

IN introducing their book to the public, the authors draw attention to the omission of certain processes hitherto considered stereotyped for all works dealing with water analysis. Among these is mentioned the use of soap solution for the determination of hardness, and the authors quote Hehner and Allen in support of their determination to be rid of the well-known Clark's process. On the whole it is clear that it has been the endeavour of the authors to set forth the most advanced analytical methods in the determination of the chemical and hygienic purity of water. The book is one of small 8vo. size, contains table of contents, 102 pages of subject-matter, and an alphabetical index. The text is embellished with some eight wood engravings, and inserted in the pages is a set of some five sheets of printed labels to fix on the bottles of solutions required in carrying out the methods described in the work. The matter is sub-divided as follows:—HISTORY OF NATURAL WATERS, ANALYTICAL OPERATIONS, in which considerable attention is given to the most recently developed methods for testing and determining the Nitrates and Nitrites in waters. INTERPRETATION OF RESULTS. The latter few pages of the book contain some valuable tables of data.

THE PRACTICAL OSTRICH FEATHER DYER. By ALEXANDER PAUL. Revised and corrected by Dr. M. FRANK. Published by Mrs. Dr. M. Frank, "Textile Colourist," 506, Arch Street, Philadelphia, U.S.A. 1888.

THIS work principally consists in an interesting collection of specimens of ostrich feathers dyed to a multitude of the various delicate shades, and carefully arranged in book-form, together with full text, giving all the practical details needed for dyeing such materials to sample, as exhibited in the pages. Besides for dyeing, methods and prescriptions are also given for the bleaching of ostrich feathers. The book contains thus 190 pages of matter, including those adorned with specimens. The size is small 8vo., and at the end of the work is a Table of Contents and also an Index to the Recipes.

YEAR-BOOK OF THE SCIENTIFIC AND LEARNED SOCIETIES OF GREAT BRITAIN AND IRELAND, comprising Lists of the Papers read during 1888 before Societies engaged in Fourteen Departments of Research, with the Names of their Authors. Compiled from Official Sources. Sixth Annual Issue. London: Charles Griffin & Company, Exeter Street, Strand. 1889.

EXERCISES IN THE PREPARATION OF ORGANIC COMPOUNDS. By Professor EMIL FISCHER. Translated, with permission of the author, from the second German edition, by ARCHIBALD KLING, F.I.C., Chief Assistant in the Chemical Laboratory of the Glasgow and West of Scotland Technical College, with a Preface by Professor W. DITTMAR, LL.D., F.R.S., &c. Glasgow: W. Hodge & Co. London: Williams and Norgate. 1889.

THIS little book is strongly bound in cloth-covered cardboard, and contains 72 pages of subject-matter, introductory Preface by Professor Dittmar, Author's Preface, Table of Contents, Method of Preparation of some 55 organic substances of leading theoretic interest for the laboratory student of Organic Chemistry, and an Alphabetical Index. The text is embellished with some 19 very well executed wood engravings representing the forms of apparatus recommended. The work is a faithful translation of the little treatise so well known in Germany as Fischer's "*Anleitung zur Darstellung organischer Präparate*."

Trade Report.

(From the Board of Trade Journal and other sources.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

FRANCE.

Modification of Import Duties on Salt.

The *Journal Officiel* for the 20th April last contains the text of a decree of the French President modifying the rates of Customs duty levied on the importation of salt into France, as follows:—

Sea, saline, and rock salt raw or refined, other than white, imported by land or sea: if of European origin, 2 frs. 40 cts. per 100 kilos.; if of non-European origin, imported direct from a non-European country, 2 frs. 40 cts. per 100 kilos.; imported from European entrepôts, 6 frs. per 100 kilos.

Sea, saline, and rock salt, raw or refined, other than white, imported from Senegal and its dependencies, free.

Sea, saline, and rock salt, refined, white, imported by land or sea: if of European origin, 3 frs. 30 cts. per 100 kilos.; if of non-European origin, imported direct from a non-European country, 3 frs. 30 cts. per 100 kilos.; imported from European entrepôts, 6 frs. 90 cts. per 100 kilos.

Sea, saline, and rock salt, refined, white, imported from Senegal and its dependencies, free.

ITALY.

Classification of Articles in Customs Tariff.

Note.—Lire = 20 s. d. Quintal = 220.4 lbs. avoirdupois.

The following decisions have recently been given by the Italian Customs authorities:—

Ichthyol (patent medicine).—Category 62. Duty, 120 lire per quintal.

Oleine perfumed with essence of myrbane.—Category 66A. Duty, 100 lire per quintal.

On the importation of sulfonal, the surtax of 108 frs. per quintal on the actual net weight (by making deduction of the weight of the immediate receptacles) for alcohol used in the manufacture of this article will be levied.

UNITED STATES.

Recent Customs Decisions.

Phenacetin, creosote, sulfonal, and hydroquinon, which preparations are composed of coal tar, wood tar, and other chemical ingredients, are held to be dutiable at the rate of 25 per cent. *ad valorem*, under the provision in Schedule A. (T. I., 92) for chemical compounds not specially enumerated or provided for.

A substance called white brass, in pigs, which is composed principally of tin, zinc, and lead, and is valued at from 105¢. to 120¢. per ton, is held to be dutiable at the rate of 45 per cent. *ad valorem* under the provision in Schedule C. (T. I., 216) for manufactures of tin, zinc, and other metals.

Elatarium, the expressed and inspissated juice of the elaterium fruit, is held not to be free as a crude drug, but dutiable as a medicinal juice under T. I., 93.

Angostura and aromatic bitters, which the appraiser reports to be proprietary preparations, made by private formulas, protected by trade marks, and not used as beverages, and which, as the labels indicate, "cure dyspepsia, diarrhoea, cholera," &c., are held to be dutiable at the rate of 50 per cent. *ad valorem*, under Schedule A. (T. I., 90) for "proprietary preparations."

Withdrawal of Alcohol from Bond for Scientific Purposes, and of Distilled Spirits for the use of the United States, free of Tax.

A circular, dated the 26th March last, has been issued by the Treasury Department of the United States containing full instructions as to the withdrawal of alcohol from bond for scientific purposes, and of distilled spirits for the use of the United States, free of tax.

CUSTOMS TARIFF OF MARTINIQUE.

Import duties in Martinique are collected under three heads:—
(1.) Customs duties on goods other than of French origin; (2.) Consumption duties on goods without distinction of origin; and
(3.) Maritime petrol duties (*octroi de mer*) on goods also of any origin. The only articles of chemical interest occur under the third head:—

Note.—Kilogramme = 2·204 lbs. avoirdupois. Metre = 3·28 feet.
Hectolitre = 22 imperial gallons. Franc = 9*s*.d.

3. *Octroi de mer* Duties on Articles of any Origin.

Articles.	Rates of Duty.
VEGETABLE ESSENCES.	
Pitch and tar	100 kilos. (gross) 0·50
Turpentine.....	" (net) 3·00
Fixed oils, pure:	
Olive, in baskets of 12½ litres	Basket 0·50
Do., in cases of 12 litres.....	Case 1·70
Do., in kegs	100 kilos. (net) 10·00
Do., in other receptacles.....	" " 6·00
Of oleaginous seeds (cotton-seed oil).....	" " 10·00
Other	" " 6·00
Essences of special descriptions used medicinally	5% <i>ad val.</i>
MEDICINAL PRODUCTS.	
Roots, herbs, leaves, flowers, barks, mosses, fruits, and seeds.....	5% <i>ad val.</i>
MINERALS.	
Cement of every kind (including hydraulic lime).....	100 kilos. (gross) 0·20
Coal tar.....	" " 0·50
Mineral oils (for lighting purposes).....	Litre 0·10
CHEMICAL PRODUCTS.	
Sea and rock salt	100 kilos. (gross) 0·10
Salts, oxides, and other products used as colours (dye prepared or not)	" (net) 1·50
Miscellaneous products used as manure ...	Free.
Acids, salts, and other articles not distinguished above	5% <i>ad val.</i>
COLOURS.	
Colours for boats, dried, liquid, or in paste (lamp-black included).....	100 kilos. (net) 1·50
Varnish of every kind ...	" " 15·00
Ink, for writing or printing	" " 12·50
MISCELLANEOUS ARTICLES.	
Perfumeries of all kinds	8% <i>ad val.</i>
Medicines compounded.....	5% <i>ad val.</i>
Soaps, not perfumed.....	100 kilos. (net) 2·50
Wax candles of every kind.....	" " 8·00
Candles, common.....	" " 1·00
Blacking.....	" " 10·00

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

THE MARGARINE TRADE IN SWEDEN.

In a despatch to the Foreign Office, dated the 11th May, Sir F. R. Plunkett, H.M. Minister at Stockholm, says:—

"The discussion of the proposed prohibition of margarine took place in both Chambers of the Riksdag this week, and has resulted in the complete triumph of the protectionist party.

"Both Chambers have agreed to request the Government—

"1st. To prohibit the manufacture in Sweden of margarine or oleomargarine.

"2nd. To prohibit the importation into Sweden of margarine or oleomargarine.

"3rd. To establish at the ports an effective Government control of all cream, milk, and butter imported into Sweden so as to ensure these articles not being below a certain standard.

"According to the forms of the Swedish Parliament, proposals for new legislation made by private members assume the shape of an 'humble request to His Majesty to order,' &c., &c.

"It therefore now remains for the Government to decide what action it will take on this proposal of the two Houses in regard to margarine."

THE NITRATE INDUSTRY IN CHILE IN 1888.

In a despatch to the Foreign Office, dated the 19th January, Mr. W. H. Newman says:—

"The feature of the last six months' West Coast business has been the sale to English joint stock companies of a large number of the nitrate-producing establishments. The handsome dividends earned and distributed by the earlier companies have largely contributed to the ease with which such enterprises have been transferred to English capitalists. At present it is impossible to say whether the prices obtained are within or beyond the value of the articles sold. In general there seems to be an impression that the sellers have gone out on the top of the tide. Most of the sales were made at a time when the price of nitrate was unusually high.

The history of the nitrate industry is one of vicissitudes. A period of inflation has always been followed by one of depression. At the same time the business of production has as a whole been a profitable one for those who have been able to hold on in bad times till the return of prosperity. It would be well for investors to recollect that the dividends paid by the earlier companies were earned during a period of prosperity, and also that a new "oficina" ought to pay best in its first years. Then the raw material lies close to the works, later on it has to be carted considerable distances; also that a nitrate field, however good, is at last exhausted. The great problem in this industry is the relation of supply and demand. For the last two or three years the latter has fully overtaken the former. But if all the companies lately formed are expected to return to their shareholders dividends such as have been paid by the earlier ones, it seems questionable whether the supply will not exceed the demand. This happened some few years ago, and a general crisis was only avoided by a strong combination among producers to limit the output. Should this again become necessary it is difficult to say whether the operation would be facilitated or not by the fact that a large proportion of the production is in the hands of English companies. In the event of the formation of a syndicate to control production there is another element of uncertainty which ought to be kept well before nitrate shareholders. The Chilean Government derives a very large portion of its revenue from the export duty on nitrate. It has lately committed itself to heavy expenses for the extension of railway communication throughout the country; also, for the construction of docks, shipping moles, prisons, and railway stations, besides ironclads and warlike stores. It cannot, therefore, allow a falling in the revenue from the nitrate business, and it is to be feared that any curtailment of production causing a loss of revenue would be met by a corresponding increase in duty on exports. This is all the more likely, as it is no secret that there is a considerable amount of jealousy felt and expressed at the fact that the profits on an article which is essentially a Chilean monopoly should go chiefly in the pockets of foreigners.

In a speech by the President of Chile, at the opening of an exhibition at Santiago, on the 25th of November last, his Excellency said:—"Why does the credit and the capital which are brought into play in all kinds of speculations in our great cities hold back and leave the foreigner to establish banks at Iquique, and abandon to strangers the exploiting of the nitrate works of Tarapaca, from which emanates the sap which gives life to the whole world, and to carry which fleets of merchant vessels never cease to arrive and depart? The foreigner explores these riches and takes the profit of its native wealth in order to give to other lands and unknown people the treasures of our soil, our own property, and the riches we require?"

As before stated, the production of nitrate is and always has been, taking over a series of years, a profitable business; but then no "oficina" as formerly worked, cost anything approaching to the prices lately paid by the joint stock companies, and the present excess of capital is likely to induce over-production in order to pay dividends, and this to an extent unknown to former producers, who were mostly limited by the extent of their means and the general consensus of opinion in a way which is not likely to be effective with public companies.

The total quantity of nitrate exported during the year 1888 amounted to 16,700,000 quintals, equal to 750,000 tons, of which 15,000,000 quintals were embarked for Europe and 1,700,000 quintals to the United States.

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ended 30th April.	
	1888.	1889.
	£	£
Metals.....	2,151,871	1,871,161
Chemicals, dyestuffs, and tanning substances	908,174	879,505
Oils.....	462,610	452,004
Raw materials for industries other than textile.....	2,325,282	2,887,633
Total value of all imports	32,008,603	37,225,549

SUMMARY OF EXPORTS.

	Month ended 30th April.	
	1888.	1889.
	£	£
Metals (other than machinery)	2,956,203	3,272,716
Chemicals and medicinal preparations	584,726	632,737
Miscellaneous articles.....	2,508,245	2,881,277
Total value of all exports.....	17,775,474	19,569,617

IMPORTS OF METALS.

	Month ended 30th April.	
	1888.	1889.
	£	£
Copper ore	84,095	74,847
„ regulus and precipitate.....	246,976	117,952
„ unwrought and part wrought	389,169	152,857
Iron ore.....	217,359	383,707
„ bars, bolts, and angles.....	11,701	41,578
„ steel (unwrought).....	14,926	2,194
Lead, pig and sheet	189,367	139,139
Pyrites, iron and copper	102,907	99,502
Quicksilver	57,329	99,128
Tin (ingot)	493,920	342,625
Zinc (crude in cakes).....	73,241	72,132
Other articles.....	240,881	315,500
Total value of metals.....	2,151,871	1,871,161

IMPORTS OF CHEMICALS.

	Month ended 30th April.	
	1888.	1889.
	£	£
Alkali	3,328	1,738
Bark (for tanners' or dyers' use)	6,615	13,738
Brimstone	9,398	8,063

IMPORTS OF CHEMICALS—continued.

	Month ended 30th April.	
	1888.	1889.
	£	£
Chemical manufactures and products unenumerated	115,466	133,615
Cochineal.....	2,397	4,105
Cutch and gaubier	56,947	76,350
Dyes (coal tar) :—		
Aniline	23,162	22,697
Alizarine	20,281	23,941
Other coal tar dyes	1,246	2,325
Madder, garancine, and munjeet	1,100	1,308
Nitrate of soda.....	203,878	182,231
Saltpetre	18,415	27,335
Valonia.....	47,711	79,093
Other articles.....	174,148	192,965
Total value of chemicals	908,174	879,505

IMPORTS OF OILS.

	Month ended 30th April.	
	1888.	1889.
	£	£
Cocount	15,516	13,363
Olive	53,873	116,590
Palm	80,569	67,021
Petroleum	193,305	121,088
Seed of all kinds	46,403	32,393
Train, blubber, and sperm.....	8,647	15,837
Turpentine	6,729	29,082
Other oils.....	57,568	56,630
Total value of oils.....	462,610	452,004

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES.

	Month ended 30th April.	
	1888.	1889.
	£	£
Bark, Peruvian	40,832	59,711
Bristles.....	36,205	35,352
Caoutchouc	199,213	145,595
Gum arabic.....	17,616	15,921
„ lac seed shell and dye	22,673	60,589
Gutta-percha	7,897	46,185
Hides, dry	181,376	209,529
„ wet.....	65,810	93,583
Ivory.....	59,347	84,849
Manures, guano.....	22,514	21,611
„ bones.....	50,000	24,270

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES—continued.

	Month ended 30th April.	
	1888.	1889.
	£	£
Paraffine.....	50,579	24,402
Rags, linen and cotton	34,135	19,056
Esparto fibres.....	96,267	84,055
Pulp of wood	50,871	51,460
Rosin.....	21,108	35,460
Tallow and stearin.....	89,381	153,639
Tar.....	1,942	1,593
Wood and timber, hewn.....	204,292	353,866
" " dressed.....	329,165	500,677
" " staves.....	32,598	41,005
" " mahogany.....	46,802	51,450
Other articles.....	661,819	751,275
Total value of raw materials for } non-textile industries.....}	2,325,282	2,887,683

Besides the above, drugs to the value of 60,987*l.* were imported during the month, as against 80,948*l.* in 1888.

EXPORTS OF METALS.

	Month ended 30th April.	
	1888.	1889.
	£	£
Brass	26,812	35,000
Copper, unwrought	154,261	85,048
" wrought	38,227	43,887
" mixed or yellow metal	22,753	41,771
Hardware and cutlery	215,008	272,729
Iron and steel	2,144,073	2,458,413
Lead	68,300	43,455
Plate and plated wares.....	26,982	36,962
Telegraphic wires and apparatus	27,012	13,062
Tin	55,342	44,854
Zinc	6,980	8,101
Other articles.....	139,463	186,455
Total	2,956,203	3,272,716

EXPORTS OF CHEMICALS.

	Month ended 30th April.	
	1888.	1889.
	£	£
Alkali	150,215	135,076
Bleaching materials.....	50,178	41,756
Manures (chemical)	122,170	133,394
Medicines	76,956	77,572
Other articles.....	175,207	245,029
Total	544,726	632,737

EXPORTS OF MISCELLANEOUS ARTICLES.*

	Month ended 30th April.	
	1888.	1889.
	£	£
Caoutchouc manufactures.....	90,177	93,374
Gunpowder.....	24,145	32,412
Candles.....	18,700	18,138
Cement.....	91,205	129,720
Earthenware and porcelain	147,310	181,620
Stoneware and pottery.....	5,852	16,606
Leather, unwrought	120,741	165,873
Seed oil.....	143,635	133,261
Oil cloth.....	62,100	71,242
Painters' colours and materials.....	123,678	127,156
Paper of all kinds	137,398	139,618
Rags for paper making.....	31,551	50,322
Soap	38,709	48,884
Total exports of miscellaneous } articles.....}	2,508,245	2,884,277

* Only articles of chemical interest are given here, and consequently the items and total do not agree.

STATISTICS.

FIFTY YEARS OF FRENCH FOREIGN TRADE.

Some very interesting statistics regarding the foreign trade of France for the decade between 1877 and 1886, as compared with the five decades preceding, have recently been published. These show that the total trade of the country has increased sixfold during the last half century, the period of by far the greatest expansion being that of the reign of Napoleon III., when a liberal commercial policy prevailed. During the last 10 years French exports have been almost stagnant, the increase between the decade ending in 1886 and its predecessor having been only 24 per cent., as compared with 63 per cent. for the decades 1857-66 and 1867-76. Fifty years ago the principal countries sending goods to France, in order of their importance, were:—United States, Italy, Belgium, United Kingdom, Germany, Russia; now they are:—United Kingdom, Belgium, United States, Germany, Italy, Spain. Fifty years ago the countries to which France sent most goods, in the same order, were:—United Kingdom, United States, Germany, Spain, Italy, Belgium; now they are:—United Kingdom, Belgium, Germany, United States, Switzerland, Italy. The average exports of articles of pharmaceutical interest from France, in millions of francs, have been as follows:—

	Chemicals.	Dye-wood Extracts.	Fixed Oils.	Prepared Medicines.	Common Soap.	Perfumery.
1837-45	7.9	1.1	3.2	3.2	2.3	8.0
1877-86	56.6	17.6	23.0	11.7	8.5	8.2
	1837-46.	1847-56.	1857-66.	1867-76.	1877-86.	
Million francs.,	8.0	10.5	14.2	12.7	8.2	

—Chemist and Druggist.

A CENTURY OF AMERICAN TRADE.

The United States Bureau of Statistics has recently published some figures showing the progress of the United States trade between 1789, the first year of the constitutional government of the Republic, and 1888, the year which completes the first century of its existence as an organised State. The imports in 1789 were declared at a value of 23,000,000 dols.; in 1888, at 753,500,000 dols.; and the exports have grown during the same period from 20,000,000 dols. to 723,500,000 dols. A hundred years ago commercial statistics were not, of course, kept with the same care and detail as at present, but the following figures will convey some idea of the growth of some of the exports of the country of interest to the drug trade. They refer to the exports for the entire year 1789, and those of the ten first months of 1888, the complete figures of the latter year not being in our possession at present:—

—	Potash.	Candles.	Spermaceti.	Whale Oil.	Ginseng.
	Dols.	Dols.	Dols.	Dols.	Dols.
1789	661,634	45,113	79,542	124,08	47,924
1888	891,918	1,654,864	322,637	1,528,376	299,569

—	Medicines.	Soap.	Seeds and Roots.	Perfumery.	Lard.
	Dols.	Dols.	Dols.	Dols.	Dols.
1789	1,733	3,967	2,689	73,579	31,175
1888	1,373,723	17,718,127	118,832	9,728,314	876,671

No sufficient statistics of imports were kept a century ago to admit of comparison.—*Chemist and Druggist.*

MISCELLANEOUS TRADE NOTICES.

AMERICA'S OIL SUPPLY.

See Board of Trade Journal for May, pp. 542.

THE PRODUCTION OF SISAL HEMP.

See Board of Trade Journal for May, p. 544.

THE TRADE OF CHILI IN 1888.

See Board of Trade Journal for May, p. 550.

DISTILLATION OF MINERAL OIL FROM PEAT IN BRAZIL.

The *Bulletin de Musée Commercial* for the 20th April last, with respect to the distillation of mineral oils from peat in Brazil, says:—

"Under the heading of 'Brazilian petroleum,' the *Comercio* of Amazonas gives interesting details respecting the distillation of peat, which is carried on by a large firm at Marahu. Up to the present, there have been worked 10 beds of an area of 82 hectares 360 metres square. The value of the beds may be gathered from the fact that solid peat is met with up to a depth of 150 feet, without any signs announcing the end of the bed being found.

"The firm employs at the present time 300 workmen, and 33 boilers, with washers, stills, refrigerators, steam saw mill, foundry, forges, &c. The workshop, fitted with the latest improvements, can produce 3,000 cases per month. The paraffin will be used for candles; plant is being set down which will produce 80 tons monthly. Besides, from the raw material itself, a lubricating oil for all kinds of machinery is extracted.

"The concessionaires have constructed a large quay, 14 feet deep, where two ships of 900 tons have already been berthed to be unloaded."

A NEW TEXTILE.

M. Vicente Solis Leon says, in the *Revista de Merida*, that a new textile plant has just lately been attracting some attention in Yucatan. The natives recognise it under the name of *atuc*. The *atuc* shoots on the hillocks, and in the waste grounds at Yucatan which are called *cuyos*. The owner of the Xanchann hacienda has sent several pounds of *atuc* fibre to a New York firm, which immediately gave an order for 2,000 bales, offering the price of 15 cents per pound. The fibre, it appears, can be substituted for flax, or be mixed with linen yarn for the manufacture of fine tissues.

The *atuc* grows like the henequen (sisal hemp). In growing, it successively loses its lower leaves, and forms a trunk which grows to a height of four metres and sends out branches, which give to the plant the appearance of a tree. It produces, till its decay, several thousands of fibrous leaves averaging 62 centimetres in length.

THE EXPORT TRADE OF THE CONGO.

The following particulars of the export trade of the Congo during the year 1888 are extracted from the *Bulletin Officiel de l'Etat Indépendant du Congo* for the month of April last:—

Special Exports.

The total value of the special exports, being those from the Independent State of the Congo, during 1888, was 2,609,900 francs. The principal articles exported, together with their values, were as follows:—Ground nuts, 2,928 francs; caoutchouc, 280,929 francs; copal, 7,006 francs; palm oil, 463,125 francs; ivory, 1,096,240 francs; palm nuts, 754,791 francs.

General Exports.

The total value of the general exports, which include those from the Congo Free State together with the French and Portuguese possessions in the Congo, was 7,332,348 francs. The proportion taken by the different European countries was as follows:—

Netherlands, 4,343,177 francs; England, 337,927 francs; Portugal, 563,350 francs; Germany, 312,003 francs; Belgium, 249,844 francs; and France, 23,181 francs.

INDIAN TRADE WITH RUSSIA.

The following notice appeared in the *Englishman's Overland Mail* (Calcutta) for the 27th March last:—

"One of the consequences of the imports to India of Russian petroleum would seem to have taken the form of an extension of the direct trade with Russia in indigo. In this, as in many other departments of commerce, England is to a great extent losing its place as a distributing centre. Thus, last year Russia took 1,623 cwt. of Indian indigo, valued at over five lakhs of rupees. The figures for the previous 12 months were 46 cwt., of the value of nearly one and a quarter lakhs. The direct trade that is springing up between India and the European continent is one of the most noticeable features of the commercial situation of India."

THE CINCHONA TRADE OF BENGAL.

The *Times* of India for the 29th March last, reviewing the administration report of Bengal for 1887-88, says:—

The cinchona trade continued favourable, and the policy of replacing the red bark or cinchona febrifuge-yielding plant by the *calisaya ledgeriana* and hybrid varieties which yield quinine, was steadily pursued. The year was marked by the discovery of a process for the manufacture of sulphate of quinine, which it is expected will be indistinguishable from the best brands of European manufacture. In other respects also the manufactures, mines, and other industries of the Presidency show a general improvement all round.

THE MINERAL RESOURCES OF BRITISH COLUMBIA.

See Board of Trade Journal for May, p. 553.

MINERAL EXPORTS FROM VICTORIA DURING 1888.

The *Cape Argus* (weekly edition) for the 27th March last states that the quantity of uncoined gold exported from Victoria during 1888 was 60,632 oz.; antimony, 7 tons; arsenic, 99 cwt.; coal, 325 tons; copper, 700 cwt.; pig iron, 35 tons; lead ore, 3 tons; quicksilver, 13,510 lb.; silver, 26,034 oz.; amalgam (gold and silver), 6,258 oz.; sulphur, 1,297 cwt.; tin ore, 12 tons; tin sand, 160 cwt.; and ores, mineral clays, &c., unenumerated, 287 tons.

ALCOHOL FROM BANANAS AND TAMARINDS IN NEW CALEDONIA.

Efforts have been made at Koc to distil alcohol and wine from bananas, which grow well in New Caledonia. These have not resulted in anything of importance. The banana wine was a passable cider, and the brandy had no particular quality to recommend it. On the contrary, the tamarind tree has produced an excellent brandy, manufactured in the following way:—The fruit, picked a little before it was ripe, was crushed in water, and the whole allowed to ferment. From 13-50 kilos, of fruit eight litres of brandy at 55°, of good quality, were produced. A very remarkable fact is the absence in the tamarind of the essential oils, which pollute almost all fruit or grain alcohols below a certain degree. Besides alcohol, there can be extracted from the fruit of the tamarind a certain quantity of tartaric acid. Agave fibre is another vegetable product, which was introduced several years ago, and which is beginning to be of value in New Caledonia. In short, the colony is one which, with care, cannot merely be made to produce corn and wine for its own consumption, but may become a centre of commercial activity from which agricultural and horticultural products may be exported to other countries.

DR. DECHAMBRE'S ENCYCLOPEDIA COMPLETE.

At the Academy of Sciences' sitting of May 13, Dr. Verneuil announced the completion of the *Dictionnaire Encyclopédique des Sciences Médicales*, formerly edited by Dr. Dechambre, who died in January 1886. This immense work, treating not only of medicine but also of pharmacy and allied sciences, consists of 100 volumes

octavo, and is considered the most complete of its kind. Dr. Verneuil remarked, while paying a tribute to the memory of his late fellow academician, that the *Encyclopædia* had almost as many subscribers abroad as at home, Great Britain and the United States having taken a considerable number of copies. — *Chemist and Druggist*.

THE ANTIQUITY OF BRONZE.

According to an analysis made by Professor Berthelot, the sceptre of Pepi I., an Egyptian king of the sixth dynasty, consists of almost pure copper. The sceptre in question belongs to the British Museum, and as a special favour to Minister Waddington, the Museum authorities consented to give a portion of the precious object to be submitted to Professor Berthelot for analysis. Some filings from the inside—the sceptre is hollow—weighing less than $\frac{1}{2}$ gram, or exactly 0.0248 gram, were detached for examination. The Professor has found them to consist of a reddish metal, slightly oxidized, and a quantitative analysis, correct within one-tenth of a milligramme, has proved the substance to be pure copper, without any admixture of tin, and doubtful traces of lead. His conclusions are that, since archaeologists agree in placing Pepi's reign at about 1400 years before the Christian era, the introduction of bronze, both in the old world and in America, occurred very nearly at the same period, and at an epoch not much farther back than fifty or sixty centuries from the present time. — *Chemist and Druggist*.

THE TRANSVAAL GOLD FIELDS.

In the course of an article on these gold fields, the special correspondent of the *Engineering and Mining Journal* states that these fields are very severely handicapped by want of transport facilities. It not only takes months to get a waggon from Ladysmith, the terminus of the Natal railway, to Barberton, but the cost of freight is 10s. to 30s. per cwt. There is not a railroad in the country, nor any reasonable prospect of one.

There is no timber for mining purposes in the Barberton district, and none for fuel for motive power. There is, however, abundance of splendid coal in the country, but it is 50 miles off at least, and on the "High Veldt," so that for metallurgical purposes and steam raising its cost would be prohibitory. When the railroad is made it will pass on its way to Johannesburg right through these coal fields; at present companies are forced to place their mills on banks of streams and use water power to run them. This may entail transport from the mine by means of oxen—a slow and unreliable method. Steam tramways are about to be tried in one or two cases, but the correspondent thinks that electric propulsion must eventually come. For labour the mines are dependent on the natives, who are unskilled and unreliable, but make on the whole good rough workmen. Mining is primitive, and many properties have been opened by means of adits, but work cannot be long continued by this means. The milling of the auriferous ores is bad in all cases, and only such free gold as is caught on copper plates is saved. The pyrites, which generally is extraordinarily rich, is only partially, if at all, saved by blankets, the balance being irrecoverably lost. This pyrites is sometimes ground with mercury in pans, which only yields a portion of the gold contents. Chlorination can only be adopted when the fuel question is satisfactorily settled. Ore concentrators are not yet in use.

The Transvaal Gold Law is very vexatious in petty taxes, which aggregate into a large percentage of the gold produced, the worst feature in these laws being the fact that there is no absolute security of title.

The Transvaal Government has given concessions or monopolies for the sole rights to manufacture certain articles and use certain processes, such as the manufacture of iron, of sporting and blasting powder (which is so bad that it is useless), of dynamite and nitro-glycerine compounds (which has been nullified by permission to import some thousand cases, which will last for some years); to the Newberry Vautin Company for the exclusive right to employ chlorine or bromine to extract gold from its ores; and, lastly, the sole right to electrically transmit power.

In conclusion, the correspondent gives details of the cost of mining, and as to how the mines are floated. He protests against the ridiculously exorbitant prices paid for mere mining properties. At the same time the future, he thinks, is hopeful, and he expects to see the gold production from now known properties eventually rise to 50,000 oz. per month.

THE GOLD PRODUCTION OF THE TRANSVAAL.

A. Götz. *Chem. Zeit.* 13, 297, 313, 314.

The production of gold is rapidly increasing, as is shown by the following figures representing the value of the exports from the English colonial harbours, Delagoa Bay not included:—

	£
1871 to 1880.....	324,666
1881.....	17,952
1882.....	22,049
1883.....	30,157
1884.....	39,095
1885.....	68,563
1886.....	131,769
1887.....	235,487
1888.....	880,461
Total.....	1,534,773

Most of the gold from South Africa comes from the Transvaal districts; Witwatersrand, 35 miles south of the capital of Pretoria; De Kaap, 250 miles east of Pretoria; Zoutpansberg, 160 miles north

of ditto; Pilgrim's Rest and Lydenburg, 180 and 218 miles north-east of ditto; Komati, 220 miles east; Potoschefstrom, 50 miles; and Klerksdorp, 100 miles south-west of Pretoria.

The auriferous deposits of the two last districts and of Witwatersrand are conglomerate, stratified with sandstone, and are probably Devonian in age. In other districts the deposits are chiefly quartz. There are also relatively small quantities of alluvial near Barberton, in the Witwatersrand, and elsewhere. Of the districts mentioned, the gold output has been almost wholly from the Witwatersrand and the De Kaap. The production of the former in 1888 was, for the first half year, 89,514 oz., and for the second, 141,142 oz. The value of the same averaged about 3*l.* 19*s.* 6*d.* per oz. The conglomerate reefs have been traced for 45 miles; 120 companies are at work, with capital to the value of 1,000,000*l.* The outputs of the chief mines have been as follows:—

	oz.
Robinson Co., from Feb. to end of Nov. 1888....	19,680
Crown Reef, to end of Nov. 1888.....	13,246
Salisbury, from Sept. 1887 to end of Nov. 1888....	10,248
Wemmer, to the end of Nov. 1888.....	13,394
Jubilee, " " ".....	6,782
Worcester, " " ".....	1,330
Royal, " " ".....	4,692
Grahamstown, to Oct. 1888.....	3,323
Pearl, Pretoria, from Mar. to Nov. 1888.....	4,715
Wolluter, from Aug. 1887 to Aug. 1888.....	3,351
Langlaate Estate, from Jan. to Nov. 1888.....	9,044
City and Suburban, from Aug. 1887 to end of Oct. 1888.....	4,985
Heriot, from Feb. to end of Nov. 1888.....	4,517

The deposits in the Barberton districts are difficult to mine owing to want of water. The following are the productions of the chief mines in this district:—

	Oz.
Sheba Gold Mining Company.....	31,500
Republie do.....	2,274
Consort do.....	3,863
Barberton do.....	1,900
Central do.....	830
Oriental do.....	815
Moodies do, from August, 1885 to March 1888.....	22,977

The gold from this district is worth about 3*l.* 17*s.* per oz. The most important mine is the Sheba, the monthly productions of which are given from October 1887 to June 1888, the average per month in 1888 being a little under 2,000 oz.—A. W.

NOTES FROM THE CAUCASUS.

Chem. Zeit. 13, 357.

The yield of naphtha from the neighbourhood of Novorossiysk for the past year amounted to 1,200,000 pounds. There are 70 borings, belonging chiefly to the "Standard" Company, of which 14 have been bored during the past year. Only 15 per cent. of these are exhausted. Their depth varies from 25 to 100 fads, the deeper borings yielding a lighter oil than the shallower ones. The price for naphtha residues, sold on the spot, has risen to 25 copecks per pound. In the Batumi district, near Sapsa, the borings are being continued, but they are not likely to yield the quantities of oil got from the Baku region. Manganese is exported in small quantity from Tschiatour, but the cost of transport to the station Kuribiy is so great that most of the workings are abandoned. Coal from Tkibuli has made its first appearance on the market. This district is situated 40 km. north of the town Kutais, with which it is connected by a railway line. The deposits of coal are about 300 ft. above the village; they are exposed to the surface, and contain a thickness of about 8 fads of pure coal, which is very resinous, yields a large percentage of ash, but contains little carbon. A German company which proposes to make use of this coal to work up the manganese ores of the Tschiatour district for export, is expected to begin work soon. Fireproof materials, hitherto imported from England, are now made in Baku, from material found in the neighbourhood.—C. A. K.

INDUSTRIAL APPLICATIONS OF COTTON-SEED OIL.

R. Grimshaw. *J. Franklin Institute*, 1889, 191—203.

The crude oil expressed from decorticated and crushed upland cotton-seed is dark brownish-green, odourless, and having a specific gravity of .9224; refined, by treatment with alkalis, it becomes clear yellow, while unchanged in density; "boils" at 600° F., solidifies at 50° F. for summer-pressed and at 32° F. for winter-pressed oil. Oil made in Great Britain from Egyptian or Indian seed is not so clear as the American product. About 800,000 tons of cotton-seed are crushed yearly, yielding 28,000,000 gallons of oil, worth about 30 cents per gallon when refined. Of this quantity, nine-tenths are used as food, e.g., in "refined lard," salad and cooking oil; the remainder goes for soap-making, for use as an illuminant and for many minor purposes. Standing between the drying and non-drying oils, it can be employed neither as a lubricant nor as a vehicle for paint.

Forty years ago it began to be used to soften lard intended for sale in very cold climates, after which it was used in the manufacture of facitious lard for temperate climates, beef-fat being added to harden the product; and the same method is practised extensively to-day. It is claimed that such "lard" is preferable to real lard from the hog, as it is less liable to contamination from the fat from portions of the animal that cannot be considered legitimate sources of lard, and from animals more or less diseased.

The United States exported 321,523,746 lb. of "lard," valued at 22,763,921 dollars in 1887.

The cotton-seed meal left after the expression of the oil forms a good cattle food, causing the production of more and better milk and meat, and richer manure; this is attributed to the quantity of albuminoids and fat it contains. An analysis of the decorticated meal is given, together with many others of various American feeding stuffs, in the form of a table quoted from Stewart's "*Feeding Animals*." According to this it has the composition:—Water, 8.33; ash, 7.25; albuminoids, 35.75; carbohydrates (including fibre), 22.25; fat, 11.65 parts per cent. respectively, while its feeding value per ton of 2,000 lb. is 15 dollars as against 12.40 dollars for meadow hay, 24 dollars for dry brewers' grains, and 35 dollars for linseed cake. The ashes of the cotton-seed hulls are used as a fertiliser, and it is stated that 1 ton of them is equal to 4½ tons of hard wood ashes and to 15 tons of leached hard wood ashes. The hulls are also freed from their fibre, which is used in paper-making, and then form an excellent cattle food. A table is given in the form of a genealogical tree showing the yield of these and other products from 1 ton (2,000 lb.) of cotton seed. The two chief items are crude oil 280 lb., and hulls 891 lb.—B. B.

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

6391. W. Hucks. Method for separating solids from liquids. Complete Specification. April 15.
 6770. H. Finch and J. Mackenzie. Metallic hampers or skips for carboys and other articles. April 23.
 6861. J. Price. Apparatus for expelling liquid from and compressing semi-fluid or plastic substances. April 24.
 6938. J. C. Fellner and C. Ziegler. Travelling platforms, beds, or trucks for kilns or ovens for drying, burning, baking, and similar operations. Complete Specification. April 25.
 6955. G. E. Dorman. Pumps for producing high vacuums. April 26.
 6989. E. Edwards.—From G. Lange and L. Rohrmann, Prussia. Apparatus for treating gases by liquids. April 26.
 7015. J. Dixon and E. W. Walker. Jacketed pans for melting wax and other substances. April 26.
 7035. H. B. Fletcher. Apparatus and appliances for melting metals and other fusible substances by means of water-gas or other gaseous fuel. April 27.
 7087. J. Hill. Presses for compressing semi-fluids into solids. April 29.
 7110. J. Jackson. Apparatus for lifting malt and other liquors—partly applicable to other purposes. April 29.
 7111. H. Walker. Pyrometers. April 29.
 7119. C. Salomon. Drying, desiccating, and roasting apparatus. Complete Specification. April 29.
 7203. H. Roeske. Improvements in filters. April 30.
 7343. J. Foster. Vacuum distilling and evaporating apparatus. May 2.
 7516. W. W. Tyfe. Filters. May 1.
 7548. C. Salomon. An improved process for drying, desiccating, and roasting. Complete Specification. May 6.

COMPLETE SPECIFICATIONS ACCEPTED.*

1888.

7667. B. Finch. Liquid fuel furnace bars. May 8.
 9667. J. G. Lorraine. Method and apparatus for filtering fluids. May 1.
 10,069. W. Ackroyd and T. H. Ackroyd. Apparatus for consuming smoke and economising fuel. May 15.

13,263. O. Murray.—From W. Lorenz. Method and apparatus for working pressure pumps. May 1.

17,809. W. R. Watson and R. A. Robertson. Apparatus for evaporating, concentrating, and distilling liquids. May 15.

18,138. J. Walworth. Furnace for production of hot air. May 15.

18,383. W. R. Watson and R. A. Robertson. Apparatus for evaporating, concentrating, and distilling liquids. May 15.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

6397. B. H. Thwaite. Improvements in the use of atomised solid fuel for generating heat by its combustion, and in apparatus therefor. April 15.
 6432. F. Sanders. Improvements in retorts for producing gas. April 15.
 6567. W. Deighton. Improvements in gas-producer apparatus and appliances connected therewith, for the manufacture of water-gas and other gases. April 17.
 6659. J. von Langer and L. Cooper. Improvements in or connected with the manufacture of water gas. April 18.
 6683. H. Aitken. Improvements in treating bituminous, carbonaceous, or combustible substances to obtain gas and other products, and in the treatment of gases such as result therefrom. April 18.
 6747. W. Bliss, E. Bradbury, and A. H. Gibson. Improvements in and connected with burning gas tar or other liquid fuel in steam boiler and other furnaces. April 20.
 6805. L. Paget and C. J. Kintner. Improvements in the manufacture of hoods or mantles for burners used in incandescent gas lighting. Complete Specification. April 23.
 6833. B. H. Thwaite. Improvements in methods of generating water gas and other like combustible gases for heating, lighting, and motor purposes, and in apparatus therefor. April 24.
 6840. J. P. Cornett. A process connected with the cleansing of the waste fluid from coal-washing machines and the recovery of products therefrom. April 24.
 6854. H. W. Leonard. Improvements in means for feeding fluid fuel to furnaces, particularly applicable to the furnaces of brick kilns. Complete Specification. April 24.
 6917. J. N. Flesch. Method of rendering petroleum less explosive and improving its illuminating power. April 25.
 6920. C. Kreissig and O. Seim. Method of producing an increased light effect of gas, paraffin, and other flames. Complete Specification. April 25.
 6937. C. J. Langley. Improvements in artificial fuel. April 25.
 7044. A. Harkness and W. T. Harkness. An improved method of and apparatus for causing complete combustion of fuel in furnaces for heating purposes, and also effecting the abatement of smoke nuisance. April 27.
 7054. T. Walrond-Smith. Improvements in the manufacture of water-gas, and apparatus for that purpose. April 27.
 7092. J. Byrom. Improvements in gas-lighting. April 29.
 7152. H. J. Allison.—From A. G. N. Vermilya, United States. Improved process and apparatus for generating heat. Complete Specification. April 30.
 7159. J. F. Halligan. An improved apparatus for carburetting gas. April 30.
 7222. O. Peischer. Improved means of utilising waste heat in fires. May 1.
 7227. J. Elliott. Improvements in charging machines for gas retorts. May 1.
 7231. J. E. Winspear and R. Waugh. An improved time-recording candle. May 1.
 7252. J. von Langer and L. Cooper. Improvements in or connected with the manufacture of "water," "Siemens," "producer," or other such gases, and in apparatus connected therewith. May 1.
 7256. W. Hubbard. Improvements in the manufacture of coal briquettes or compressed fuel. May 1.
 7424. A. M. Chambers and T. Smith. Improvements in coke ovens, and in methods of and apparatus for collecting and utilising the products of combustion from such coke ovens. May 3.
 7551. H. J. Newcome. Condensing and purifying and abating smoke from ordinary fires. Complete Specification. May 6.
 7559. J. T. Ellis. Improvements in apparatus for condensing smoke in the furnaces of steam and other boilers. Complete Specification. May 6.

7532. W. E. Gedga.—From P. J. Leteneur. Improvements in making artificial fuel. May 6.

7541. W. Walker.—From C. H. Seymour. Improvements in the manufacture of gas, and apparatus therefor. May 7.

7544. J. T. Key. Improvements in the manufacture of gas. May 7.

7553. C. Dubois. Obtaining useful products from refuse or residues of gas purifying, and apparatus therefor. Complete Specification. May 7.

7559. J. Quaglis. Improved process and furnace for the preparation of calcin (crude gas) according to Leutgen's method, by the combined use of water, coal-gas, wood-gas, oil-gas, or natural gases and generator gas. May 7.

7741. G. W. Hart. A process and apparatus for manufacturing hydrocarbon gas. May 9.

7781. A. M. Hay. Improvements in the process and apparatus for producing oil-water gas. May 9.

7792. J. Broad and G. C. Fowler. Improvements in night and other similar lights.

7795. G. A. Cannot and L. N. Frère. Improved compound adapted to absorb petroleum or other combustible liquids and wastes for the production of artificial fuel. May 9.

7812. G. Rose, A. Baird, and M. B. Baird. Improvements in the method of and apparatus for the manufacture of water-gas. May 10.

7843. T. Ellis. A fire-light. May 10.

7847. R. T. Baxter. Improvements in the manufacture of water-gas. May 10.

7854. C. P. Armstrong.—From G. Jaumez, France. An improved apparatus for manufacturing carburetted air gas. May 10.

7876. E. Patterson. Improvements in oxidising coal gas for illuminating purposes when burned by the ordinary burner. May 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

6432. B. H. Thwaite. Gaseous fuel-producing apparatus. May 1.

9266. G. A. Page and R. Fallnicht. Improved firelighter—"artificial resinous pine." May 1.

11,677. G. Frank. Manufacture of compressed artificial fuel. May 15.

12,377. G. Frank. Artificial fuel. May 8.

15,799. W. Eacrett. An indestructible firelighter.

1889.

2914. J. D. Averell. Apparatus and process for manufacturing gas. May 15.

5132. T. H. Gray. Treatment of mineral oils. May 1.

5134. G. H. Turnbull. Trays or grids of gas-purifying apparatus. May 8.

5181. W. M. Cash. Apparatus for manufacture of illuminating and heating gases. May 15.

5389. A. J. Boulé.—From H. G. Weber. Manufacture of artificial fuel. May 8.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

6683. H. Aitken. See Class II.

6726. N. McFarlane Henderson. Improvements in and connected with retorts for the destructive distillation of shale or other oil-yielding minerals. April 20.

6993. O. C. Hagemann. Improvements in nitrifying phenols and other similar bodies. April 26.

7634. J. Armour and H. Armour. Improvements in and connected with retorts for distilling shale or other oil-yielding minerals. May 7.

COMPLETE SPECIFICATION ACCEPTED.

1888.

7334. F. Lennard. Distillation of tar, &c., and apparatus therefor. May 15.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

6434. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brünig, Germany. Production of an imide compound of fluoresceine chloride and of colouring matters therefrom. April 15.

6435. O. Imray.—From the above. Production of colouring matters. April 15.

6488. J. Dawson. Process for the separation of thioparalulidines (thiodines) by treatment with sulphocarbon. April 16.

6761. M. Honig. A process and apparatus for obtaining pure indosin from commercial indigo, and from by-products or raw materials containing indigo. April 20.

6777. J. E. Bedford. Improvements in the manufacture of colouring matters. April 23.

6778. J. E. Bedford. Improved apparatus for the production of colouring matters. April 23.

6791. P. Mounet. The preparation of thiophthaleines and the new colouring matters which are derived therefrom. April 23.

7057. S. Pitt.—From L. Casella and Co., Germany. The manufacture of oxyethers of alpha-naphthylamine, and their sulpho-acids and dyestuffs derived therefrom. April 27.

7314. B. Willeox.—From The Farbenfabriken vorm. F. Bayer and Co., Germany. The manufacture of diamidodiphenylene oxide, and of direct-acting dyestuffs therefrom. May 2.

7559. C. D. Abel.—From The Actien-Gesellschaft für Anilinfabrikation, Germany. Manufacture of green and violet colouring matters. May 6.

7587. A. Bang.—From Messrs. Dahl and Co., Prussia. The production of azo-colouring matters from diamidodibenzylbenzidine and diamidodibenzyltoluidine. Complete Specification. May 7.

7588. A. Bang.—From Messrs. Dahl and Co., Prussia. The production of paranitrobenzylsulpho acid, and also azo-colouring matters from the amidobenzylsulpho acid corresponding to this nitric acid. May 7.

7802. B. Willeox.—From The Farbenfabriken vorm. F. Bayer and Co., Germany. The manufacture of azo dyes and of materials therefor. May 9.

7857. O. Imray.—From The Faberwerke vorm. Meister, Lucius, and Brünig, Germany. Manufacture of a new colouring matter of the induline series. May 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

9600. C. D. Abel.—From The Farbwerke vorm. Meister, Lucius, and Brünig. Colouring matters. May 15.

16,133. H. H. Leigh.—From R. G. Williams. New colouring matters. May 1.

1889.

16. A. Deminger. Preparation of nitro and amido phenols from the corresponding amides. May 15.

4904. S. Meyer. Manufacture of para-dioxybenzol in yellow staple crystals. May 1.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

6793. The Société Simonis and Chapuis. A new or improved machine for drying and carbonising wool and other textile matters in combination with an elevator and a purifying and cleaning apparatus. Complete Specification. April 23.

6827. H. Ledger. See Class VI.

6836. S. Cooper and T. Cooper, jun. Improved apparatus to be employed in the manufacture of wood wool. Complete Specification. April 24.

6890. R. Hardman. Improvements in dressing yarn for weaving, and in apparatus employed therefor. April 25.

7058. B. W. Weatherdon.—From T. A. Compere. *See* Class IX.

7090. C. Dreyfus and J. Robinson. Improvements in and relating to the manufacture of india-rubber or waterproof textile fibres and fabrics. April 29.

7315. J. T. Pearson. Improved means of and apparatus for humidifying fibrous substances. Complete Specification. May 2.

7715. C. H. Bine and J. H. Noad. A process for waterproofing and preserving textures and other materials. May 8.

7877. B. Ellinger. Improvements in the manufacture of coloured cotton weft pile fabrics. May 11.

COMPLETE SPECIFICATION ACCEPTED.

1888.

9429. S. Mason, jun. Apparatus for drying and ageing spun cotton, &c. May 15.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

6827. H. Ledger. Improvements in the process of obtaining, treating, and bleaching of fibres and fibrous materials from plants and textile fabrics, and materials of vegetable origin, and the recovery of waste products therefrom. April 24.

6876. V. D'Aoust. Improvements in apparatus for dyeing wool on bobbins and textile fabrics in the like form. April 24.

7100. F. B. Gonty. Improvements in apparatus for the use of dyers, bleachers, and others for boiling, dyeing, fastening, and finishing colours upon textile materials. April 29.

COMPLETE SPECIFICATION ACCEPTED.

1888.

6570. E. Brasier. Apparatus for washing, discharging, bleaching, softening, &c. fibres and textiles. May 8.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

6453. W. Schlenning. *See* Class IX.

6443. E. Anec. Improvements in the manufacture of soda alum. Complete Specification. April 15.

6191. C. O. Andreac.—From A. Seyferth, Germany. Process for the purpose of cleansing crystals soluble in water from adhering mother-lye. April 16.

6668. M. Netto. Improvements in the manufacture of artificial cryolite. April 18.

6674. W. R. Hodgkinson. A process for the continuous formation of ammonia or ammonia compounds from nitrogen gas. April 18.

6710. W. P. Thompson.—From J. A. Bradburn, United States. Improvements in the process of manufacturing caustic soda or caustic potash. Complete Specification. April 20.

6968. J. Hargreaves, T. Robinson, and J. Hargreaves. Improvements in the treatment of black ash and alkali waste, to obtain sulphuretted hydrogen, sulphur, and cement, and in apparatus employed therein. April 25.

7129. A. B. Cunningham. Improvements relating to the recovery of soda from slags containing the same. April 29.

7250. E. W. Parnell. Improvements in the manufacture of hypsulphite of calcium from Leblanc alkali waste. May 1.

7374. S. W. Wilkinson. Improvements in apparatus employed in evaporating brine. May 3.

7407. J. Greenwood. Improvements in the manufacture or production of metallic sodium and of chlorine. May 3.

7491. J. R. Wylde, M. J. Hammill, and H. Auer. Improvements in the manufacture of the carbonates and hydrates of potash or soda. May 4.

7654. P. J. Davies. Improvements in sulphate of ammonia plant. May 7.

7664. H. H. Lake.—From L. Bemelmans, Belgium. Improvements relating to the production of alkaline sulphides and chloride of sulphur, and to apparatus therefor. May 7.

7690. E. W. Parnell. Improvements in obtaining ammonium sulphide from ammonium chloride and Leblanc alkali waste, and in apparatus therefor. May 8.

7716. C. F. Hine and J. H. Noad. A process for producing euprammonia. May 8.

7733. The Alkaline Reduction Syndicate, Lim., and A. B. Cunningham. Improvements relating to the recovery of soda from slags containing the same. May 8.

7901. G. Veitch. Improvements in the concentration of sulphuric acid, and in the apparatus employed therefor. May 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

7285. P. A. Mallet and T. A. Pagniez. Distilling, purifying, and concentrating ammoniacal and other liquids. May 1.

9166. H. Snilliot and H. Raymond. Production of iodine and iodine compounds. April 24.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

6393. P. Simon. Improvements in the manufacture of plate glass. Complete Specification. April 15.

6446. J. E. Mathewson.—From B. C. Tilghman, United States. Improvements relating to the ornamentation of glass, and in apparatus to be used therefor. April 15.

6565. A. Rimmer and J. H. Thomas. A manufacture being mainly a substitute for glass, and improvements connected with the making of the same. April 17.

6825. T. W. Bennett. Improvements in and relating to the manufacture of certain classes of pottery ware. April 18.

7245. W. H. Hollingshead and H. Griffiths. Improvements in and relating to decorative pottery-ware. May 1.

7387. G. Fahn. The improvement of all fire-clay goods by adding sugar to the compound known as silica and alumina. May 3.

7761. O. P. Erard and B. J. Round. An improved process for depositing metal on glass. May 9.

COMPLETE SPECIFICATION ACCEPTED.

1888.

7183. W. T. Turner. Means for "towing" or "scouring" ceramic productions in the clay or biscuit state. May 8.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

6124. J. Mobbs and H. A. Mobbs. An improved material for paving roads, and for such like purposes. April 16.

6133. W. Schlenning. Application of the residues of soda manufacture for building purposes. April 15.

6536. H. Wright de Lespaze and W. H. Shafto. Improvements in the manufacture of plaster and the like substances. April 16.

6584. G. R. King. Compounds to restrain the setting of plaster and the like. Complete Specification. April 17.

6874. J. N. Tata and J. Lyon. Improvements in the manufacture or production of mosaics for floors, staircases, walls, ceilings, and other like purposes. April 24.

7058. R. W. Weatherdon.—From T. A. Compere, Italy. An improved combination and mode of treating hemp, flax, jute, and other fibres, and employing the same for roofing tiles, buildings, and other purposes. April 27.

7162. W. Adamson. An improved combination curbing. April 30.

7943. S. Hindley and G. R. McKenzie. Improvements in the manufacture of cement for joining wood, stone, and other materials. May 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

8485. R. Mannesmann. Fireproof columns. May 15.

9605. P. M. Justice.—From A. Gravelin. Plastic compounds. May 15.

1889.

3872. L. J. Cadwell. Pavements and blocks therefor. May 15.

4509. W. Davidson. Kilns for drying granular substances. May 1.

4806. Sir E. J. Harland, Bart. Manufacture of elastic tiles. May 8.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

6430. C. Wells. Improvements in the manufacture of tin-plates. April 15.

6460. J. A. Conrad. Improvements in or relating to the treatment of auriferous alluvium. April 15.

6521. G. A. Jarvis and W. P. Thompson. Improvements in or relating to the manufacture of sodium or (with certain precautions) other metals. April 16.

6594. H. F. Taylor. Improvements in apparatus for coating with tin, lead, or other metals or alloys. April 17.

6684. H. Aitken. Improvements in connection with blast furnaces or other large furnaces or fires for utilising the otherwise waste heat thereof in the obtaining of products from sea water or brine. April 18.

6708. G. A. Jarvis and W. P. Thompson. Improvements in or relating to the manufacture of aluminium, alloys of aluminium, and of other metals. April 20.

6882. F. Knowles.—From T. C. Sanderson, Portugal. Improvements in effecting the separation of gold from antimony. April 24.

6925. A. H. Holdich. An improved form of stopper or valve for controlling the flow of steel from the ladle or reservoir used at steel works. April 25.

7013. L. P. Devancelle. Improvements in the manufacture of aluminium and alloys thereof. April 26.

7035. H. B. Fletcher. See Class I.

7047. W. F. Jackson and W. Galbraith. Improvements in the manufacture of steel. April 27.

7066. W. H. Rickard and T. J. Rickard. Improvements in apparatus or machinery for coating steel, iron, or other plates with tin, lead, or other metals or their alloys. April 27.

7132. L. Imperatori. Manufacture of compressed compound blocks of substances containing iron and of carbonaceous matter, and the use of such blocks in the production of cast steel and ingot iron. Complete Specification. April 29.

7181. E. Walsh, jun. Improved method of and apparatus for condensing zinc vapours and collecting the metallic zinc therefrom. Complete Specification. April 30.

7271. C. Netto. Improvements in and relating to apparatus for condensing sodium and other vapours. May 1.

7311. R. Heathfield. Improvements in apparatus or machinery used in coating metal sheets with metal or alloys. May 2.

7353. N. Lébedeff. Improvements in and means or apparatus for the extraction of metals from metallic ores in matters containing metals. May 2.

7407. J. Greenwood. See Class VII.

7443. J. McCann. Improved blast furnace blocks and tuyeres. May 4.

7459. J. Clark. Improvements in the process of obtaining aluminium and alloys of aluminium with other metals. May 4.

7468. C. F. Barker. Improvements in the amalgamation of the precious metals, and in the means or apparatus employed therein. May 4.

7514. C. Netto. Improvements in the manufacture of sodium and potassium, and in apparatus therefor. May 4.

7666. G. Bamberg. Reducing aluminium by the action of molten metals, particularly iron, zinc, copper, and lead, on chloride of aluminium or double chloride of aluminium and sodium. May 8.

7667. G. Bamberg. Reducing aluminium by the action of zinc vapour on chloride of aluminium or double chloride of aluminium and sodium. May 8.

7778. F. F. Jones. Improvements in the process of and apparatus for reducing aluminium, its alloys, and other metals from their ores. May 9.

7832. F. Merricks and G. A. Nussbaum. Improvements relating to apparatus for the separation or extraction of metals from their ores by amalgamation. May 10.

7886. W. Potter. Improvements in the hardening of steel. May 11.

7887. C. Lingard. Method of casting steel articles in sand moulds to harden in water after annealing. May 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

7408. A. J. Boulton.—From G. Manet and C. Manet. Electrical cartridges for firing the charges of blast holes. May 1.

8042. G. Siddell. Appliances for rotating ingots or large forgings while under forging press or steam hammer. May 8.

8423. G. Siddell. Apparatus for turning ingots, &c. while under the action of the steam hammer or forging press. May 1.

8439. W. Eyre. Forged hollow weldless shells. May 15.

8743. L. Q. Brin. Plating metals with aluminium, and producing alloys thereof. May 15.

8783. R. Evans. Apparatus for consolidating quantities of scrap metal. May 1.

8961. W. H. Beck.—From A. Lévy. Process for depositing metals from their salts. May 8.

9392. A. Wilson and S. Ontes. Apparatus for manipulating arm or plates and other large ingots in forging presses. May 8.

9886. C. A. Burghardt. Reduction of zinc oxides. May 15.

10182. S. Alley and J. A. MacLellan. Apparatus for making moulds for casting. May 15.

12298. W. P. Thompson.—From A. Rovello. Obtaining copper and other metals from solutions of the salts of same, and apparatus therefor. May 15.

18842. L. Burdon. Ingots for making seamless plated wire. May 1.

1889.

1418. G. Kruss. Decomposing commercial nickel and its salts, and galvanically coating objects with pure nickel. May 8.

2031. S. McColley Godfrey and J. B. Allen. Impregnating metals and making alloys. May 15.

2279. A. J. Boulton.—From O. Hofmann and P. Linke. Metal alloy for moulders' tools. May 8.

4428. N. C. Cookson. Coating iron with antimony. May 1.

4556. C. Jones. Treatment of steel. May 15.

5639. F. Knaffé. Process and apparatus for manufacture of steel ingots and castings. May 8.

5667. J. H. Darby. Manufacture of ingot iron or steel, and production of highly phosphoric slag. May 8.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

6745. M. Kiliani. Improvements in the method of and means for electrolysis of substances in a state of fusion. April 29.

6848. H. W. Boulbee. Improvements in the treatment of galvanised sheets of metal, and in apparatus therefor. April 24.

6865. G. E. Heyl. Improvements in secondary batteries. Complete Specification. April 24.

6942. J. Zacharias and F. Marx. Improvements in electrical accumulators or storage batteries. April 25.

7002. T. H. Hicks. Improvements in electric secondary or storage batteries. Complete Specification. April 26.

7005. A. Schanschoeff. Improvements in galvanic batteries. April 26.

7215. C. B. Askew and J. K. Pampelly. Improvements in secondary batteries. April 30.

7356. C. Maltby-Newton. Improvements in galvanic or primary batteries. Complete Specification. May 3.

7428. C. Pollak. Improvements relating to electric accumulators or secondary batteries, and to the manufacture of plates or electrodes therefor. May 3.

7568. G. H. Jones. Improvements relating to electric batteries. May 6.

7597. C. H. Mehner. Dry galvanic cells. Complete Specification. May 7.

7619. W. J. Starkey Barber-Starkey. Improvements in and connected with electric batteries. May 7.

7628. Mix and Genest, Limited. Improvements in primary and secondary elements. Complete Specification. May 7.

7647. S. S. Wheeler. Improvements in electric motors and dynamo-electric machines. Complete Specification. May 7.

7719. P. Schoop. Improvements in electric or galvanic elements or cells. May 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

6893. E. C. Walker. Electro-magnetic and magneto-electric generators. May 15.

6907. M. Immisch. Storage batteries. April 17.

8905. H. Lahousse and Co. and C. Collé. Electric batteries. April 24.

9854. L. Bristol. Secondary batteries. May 8.

9910. G. Kapp. Continuous current dynamo-electric machines. May 15.

18,494. J. L. Roberts and H. L. Brevoort. Galvanic batteries. May 15.

1889.

1418. G. Kruss. See Class X.

5176. E. A. Sperry. Improvements in electrical installations. May 15.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

6601. J. H. Casey. An improved compound for cleaning paint, veneer, varnish, and the like. April 17.

6877. L. Gismondi. New or improved apparatus for extracting oils from seeds or the like. April 24.

7098. F. Crossley. Improvements in washing or cleansing compounds. April 29.

7554. A. J. Boulton.—From J. Lafage, France. Improved process for extracting the oil from the livers of cod and other fish. May 6.

7617. W. Smith. An improved soap. May 7.

7618. W. Smith. An improved salve or pomade. May 7.

7834. W. Johnstone. Improvements in the manufacture of soap. May 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

6949. W. A. Mitchell and O. C. Hagemann.—Partly from M. von Schmidt. Purification of oils and fats, and obtaining of useful products therefrom. May 8.

8366. J. Jeys. Manufacture of soap. April 24.

9477. W. T. Hicks and J. Elliott. Lubricating composition. May 1.

1889.

5028. J. Annull. Lubricating compound. May 1.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

6581. G. Hand Smith. Improvements in the treatment of gum copals, gum resins, and other gums for the manufacture of varnishes and other solutions for coating surfaces and for other uses. Complete Specification. April 17.

6589. J. J. Hummel. New or improved red dye or pigment, and process for making and applying the same. April 17.

6815. R. W. E. MacIvor, F. A. Darlington, G. Paul, and J. Allan. Improvements in the production of white lead or carbonate of lead. April 23.

7051. A. Washington. An improved paint. April 27.

7154. J. Thom. Improvements in making white lead. April 30.

7156. J. Macfarlane. Improvements in obtaining yellow pigments. April 30.

7379. W. Smartt. Improvements in the production of vulcanised india-rubber and analogous materials for use as boot and shoe soles, tyres, and other purposes. Complete Specification. May 3.

7542. E. N. Norminton. The manufacture of copal oil varnish to dry without the aid of any metallic driers of any kind. May 10.

7881. N. B. Denny. Preserving and preventing the fouling by marine growths of submerged wood or iron, to be named "the zoeus anti-fouling paint." May 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1889.

4637. R. Seabrook. Anti-fouling compounds for coating vessels. May 1.

5703. M. Gauzl and J. Mössner. Solution for rendering cloth, felt, paper, &c. waterproof. May 15.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATION.

6703. A. F. S. Grant and W. Francis. Tanning. April 20.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

10,482. J. Rivage and J. B. Matrod. An improvement in tanning. May 8.

1889.

2771. W. Gridley and F. B. Pike. Manufacture or treatment of gelatinous substances. May 1.

XVI.—SUGARS, STARCHES, GUMS, ETC.

APPLICATIONS.

7131. H. A. Hughes. The manufacture of sugar liquor from sugar cane by diffusion. Complete Specification. April 29.

7517. G. Adant. Improvements relating to apparatus for the manufacture of sugar. May 4.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

9183. G. Fletcher.—Partly from C. A. Matthey. Apparatus for use in boiling and evaporating sugar and other liquids. May 1.

1889.

76. O. Lenz. Manufacturing colourless maltose syrup. May 15.

4741. H. Barker. Manufacture of gluten and starch. May 8.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

6918. C. R. Bonne. Improvements in the manufacture of "German yeast." April 25.

7049. W. W. Mutter and W. Dawson. Improvements in or relating to distillers' safes. April 27.

7110. J. Jackson. See Class I.

7338. C. R. Evans and T. Green. Tomato wine. May 2.

7598. W. G. Hicks. The use of pure oxygen gas for assisting the fermentation of beer or other fermentable liquids. May 7.

7909. A. Perry. Improvements in the treatment or preparation of rice and other grain or cereals for brewing and other purposes, and in means or apparatus employed therein. May 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

2735. W. S. Squire. Apparatus for purifying crude spirit. May 1.

6026. W. Hucks. Treatment of brewers' or distillers' worts. April 3.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

6436. G. Bischof. Improvements in apparatus for sterilising water and rendering it suitable for drinking and other uses. April 15.

6943. F. J. Chevet. Improvements in the manufacture of desiccated soup, and in packing the same. April 25.

6884. A. Vászrhelyi and J. Jámor. Improvements in the method of preserving milk. April 26.

7320. G. Dixon. Improvements in or relating to preserving food and other organic matters. May 2.

B.—SANITARY CHEMISTRY.

6522. J. S. Rigby and J. Rigby Wyld. Improvements in pressing or filtering and separating from each other the solid and liquid constituents of mud and other semi-fluid mixtures. April 16.

6528. H. H. Lake.—From J. Hirshfeld, United States. Improvements relating to the treatment of feculent matter, and to apparatus therefor. April 16.

6576. J. P. Cornett. An improved process connected with the treatment of sewage and the utilisation of products therefrom. April 17.

6994. C. H. Harsey (for The Barry Patent Manure Co., Ltd.). Improvements in the clarification or purification of sewage and other foul waters of analogous nature. April 26.

7385. J. Bentley and T. Thorp. Improvements in the disposal of sewage and ashpit refuse. May 3.

7630. J. Davis. Improvements in and relating to means for purifying water. Complete Specification. May 7.

7699. G. A. H. Gabel. An improved process for the extraction of ammoniacal nitrogen from sewage. May 8.

C.—DISINFECTANTS.

6411. F. W. A. Hille. Improvements in disinfectants, their manufacture, and their use. April 15.

6772. T. Hambly. Manufacturing fumigating tobacco paper. April 23.

7824. G. H. Jones. An improved disinfectant and antiseptic. May 10.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1888.

7475. E. J. T. Digby. A new alimentary compound and means of producing same. May 15.

15,813. R. S. Baxter and G. D. Macdonald. Manufacture of seed cake or cattle food from cotton seed. May 8.

B.—SANITARY CHEMISTRY.

1888.

6405. F. R. Lipscombe. Apparatus for precipitating organic or inorganic matter in solution or suspension, and for purifying the liquid afterwards and treating the precipitate. May 8.

9091. J. A. Muller. Prevention of fermentation or decomposition of animal or vegetable substances, and apparatus therefor. April 24.

15,321. H. Wollheim. Clarifying, purifying, disinfecting, and utilising sewage and foul or waste waters. May 1.

C.—DISINFECTANTS.

1888.

16,242. H. Wollheim. Reagent for disinfecting, preservative, or remedial purposes. May 1.

XIX.—PAPER, PASTEBOARD, Etc.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

8840. A. Boake and F. G. A. Roberts. Discharging excess of bleaching agent from paper pulp after bleaching. April 24.

8981. C. D. Aria. Treatment of paper, paper pulp, cardboard, &c. to render same impervious to acids, water, air, mineral oils, gases &c. April 24.

9106. J. H. Annandale. Preparing pulp for paper making machines, and apparatus therefor. May 8.

9321. L. G. Danielson. Improved paper, and manufacturing a paper sized on one side and unsized on the other, or more impregnated with size or glue on one side than the other. May 15.

18,753. L. Piette. Method of sorting disintegrated wood for the manufacture of cellulose, and apparatus therefor. May 15.

1889.

5247. F. Weyland. Apparatus for drying cardboard or paper. May 1.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

6494. O. J. Steinhart. Improvements in the manufacture of ethyl mercaptane. April 16.

7391. J. F. von Mering. A process for the production of a substance to be called "chloroformamide" or "chloralamide." May 3.

7530. G. Bamberg. Utilising sulphocyanide of iron as a medicinal drug in lieu of the usual ferruginous tonics; also the use of any alkaline sulphocyanide as a medicinal drug. May 6.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.*APPLICATION.*

7747. W. F. Greene. Rendering cardboard, paper, or the like impervious to the action of photographic chemicals, and therefore suitable for photographic purposes. May 9.

XXII.—EXPLOSIVES, MATCHES, ETC.*APPLICATIONS.*

6399. C. O. Lundholm and J. Sayers. Improvements in the manufacture of explosives. April 15.

6427. W. R. Hodgkinson. Improvements in explosive compositions or combinations of matters for use as blasting agents. April 15.

6459. H. E. Michelsen. An improved combined match and fusee. April 15.

6530. A. Melville, J. B. Chalmers, and G. J. Marples. Improvements in or connected with explosives. April 16.

6531. A. Melville, J. B. Chalmers, and G. J. Marples. Improvements in or connected with explosives. April 16.

6532. A. Melville, J. B. Chalmers, and G. J. Marples. Improvements in or connected with explosives. April 16.

6595. L. Cobbaert. A machine for the continuous manufacture of matches. April 17.

7004. T. Nordenfelt. Improvements in percussion fuses. April 26.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

6805. G. J. Mayer. Manufacture of quick match and other fireworks, and apparatus for covering same. April 17.

8503. E. Ducretet. Magneto-electric fuses. May 8.

9164. T. G. Hart. Explosives for use in firearms. May 15.

13,656. C. F. Hengst. Smokeless safety gunpowder. May 1.

13,912. R. Bateman. Railway fog signals. May 1.

1889.

4812. R. H. Earle. Marine distress signals or bombs. May 1.

5720. W. Kennish. Means for igniting the charge in explosive projectiles. May 15.

THE JOURNAL OF THE Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 6.—VOL. VIII.]

JUNE 29, 1889.

[Non-Members 30/- per annum; Members
21/- per Set of extra or back numbers;
Single Copies (Members only) 2/6.

The Society of Chemical Industry.

Past Presidents:

Sir H. E. Roscoe, M.P., LL.D., V.P.R.S.	1881—1882.
Sir Frederick Abel, C.B., D.C.L., F.R.S.	1882—1883.
Walter Weldon, F.R.S.	1883—1884.
W. H. Perkin, Ph.D., F.R.S.	1884—1885.
E. K. Muspratt 1885—1886.	
David Howard 1886—1887.	
Prof. James Dewar, F.R.S. 1887—1888.	

COUNCIL FOR YEAR ENDING JULY, 1889.

President: Ludwig Mond.

Vice-Presidents:

<i>Sir I. Lowthian Bell, F.R.S.</i>	<i>David Howard.</i>
R. Forbes Carpenter.	<i>Ivan Levington.</i>
Prof. F. Clowes, D.Sc.	<i>E. K. Muspratt.</i>
Sir J. Neilson Cuthbertson.	<i>Dr. W. H. Perkin, F.R.S.</i>
Prof. James Dewar, F.R.S.	<i>Sir H. E. Roscoe, M.P., F.R.S.</i>
Dr. John Evans, F.R.S.	<i>Prof. W. A. Tilden, F.R.S.</i>

Ordinary Members of Council:

Alexander M. Chance,	<i>F. J. Rowan.</i>
James Duncan.	<i>Dr. Edward Schunck, F.R.S.</i>
A. E. Fletcher.	<i>E. C. C. Stanford.</i>
S. H. Johnson.	<i>J. C. Stevenson, M.P.</i>
B. E. R. Newlands.	<i>T. W. Stuart.</i>
B. S. Proctor.	<i>Thos. Tyrer.</i>

With the Chairmen and Secretaries of Sections.

Honorary Treasurer:

E. Rider Cook, East London Soapworks, Bow, E.

Honorary Foreign Secretary:

Dr. Ferdinand Hurter.

General Secretary: Charles G. Cresswell.

Offices:

Palace Chambers, 9, Bridge Street, Westminster, S.W.

THE JOURNAL.

Publication Committee:

The President.

Sir F. A. Abel, F.R.S.	Prof. A. K. Huntington.
A. H. Allen.	F. Hurter, Ph.D.
G. H. Bailey, D.Sc., Ph.D.	F. Jones, F.R.S.E.
Joseph Bernays, M.I.C.E.	Ivan Levington.
H. Brunner.	Prof. R. Meldola, F.R.S.
W. Lant Carpenter.	E. K. Muspratt.
Prof. Frank Clowes, D.Sc.	C. O'Sullivan, F.R.S.
W. Y. Dent.	John Pattinson.
Prof. Jas. Dewar, F.R.S.	W. H. Perkin, Ph.D., F.R.S.
John Heron.	Sir H. E. Roscoe, M.P., F.R.S.
D. B. Hewitt, M.D.	John Spiller.
David Howard.	A. Norman Tate.
Prof. J. J. Hummel.	Thomas Tyrer.

Editor:

Watson Smith, The Owens College, Manchester.

ASSISTED BY THE FOLLOWING STAFF OF

Abstractors:

T. L. Bailey, Ph.D.	F. S. Kipping, D.Sc.
G. H. Beckett.	Chas. A. Kohn, Ph.D.
D. Bendix.	F. W. T. Krohn.
E. Bentz.	T. A. Lawson, Ph.D.
E. E. Berry.	J. Walter Leather, Ph.D.
E. J. Bevan.	A. Liebmann, Ph.D.
Bertram Blount.	D. A. Louis.
Arthur G. Bloxam.	W. Maenab.
C. H. Bothamley.	J. M. H. Munro, D.Sc.
E. G. Clayton.	H. S. Pattinson, Ph.D.
Julius B. Cohen, Ph.D.	H. T. Penternmann.
C. F. Cross.	S. G. Rawson, B.Sc.
A. R. Davis.	A. Rée, Ph.D.
W. W. Haldane Gee, B.Sc.	F. W. Renaut.
C. Napier Hake.	Edward Simpson.
S. Hamburger, Ph.D.	A. J. Smith, B.Sc.
Oswald Hamilton.	Oscar J. Steinhardt, Ph.D.
John Heron.	A. L. Stern, B.Sc.
Bertram Hunt.	A. Studer, Ph.D.
C. C. Hutchinson.	Bertram Thomas.
D. E. Jones, B.Sc.	Eustace Thomas.
W. E. Kay.	V. H. Veley, M.A.
A. J. King, B.Sc.	R. Lloyd Whiteley.
	A. Wingham.

NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list, will retire from their respective offices at the forthcoming Annual General Meeting.

Sir Isaac Lowthian Bell, Bart., F.R.S., has been nominated to the office of President; and Mr. Ludwig Mond has been nominated Vice-President under Rule 11.

Dr. W. H. Perkin, F.R.S., has been nominated a Vice-President under Rule 24; Mr. James Duncan, Mr. S. H. Johnson, Dr. Hugo Müller, F.R.S., and Dr. Edward Schunck, F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. L. Archbutt, Mr. John Brock, and Mr. John Spiller have been nominated Ordinary Members of Council under Rule 17, in the place of Mr. James Duncan, Mr. S. H. Johnson, and Dr. Edward Schunck, F.R.S., nominated Vice-Presidents.

The Treasurer and Foreign Secretary have been nominated for re-election.

ANNUAL GENERAL MEETING.

Notice is hereby given that the next Annual General Meeting will be held in London on Wednesday, Thursday, and Friday the 10th, 11th, and 12th of July next.

The following is a synopsis of the arrangements:—

Wednesday, July 10th.

Annual Meeting, Royal Institution	-	-	11.0 a.m.
Doulton's Art Pottery, Lambeth	-	-	2.0 p.m.
Lambeth Palace	-	-	3.0 p.m.
Reception	-	-	9.0 p.m.

Thurs-day, July 11th.

River Excursion (Old Swan Wharf)	-	10.0 a.m.
Saccharine Works, Hammersmith	-	11.30 a.m.
Kew Gardens	-	3.0 p.m.
Dinner at "Star and Garter," Richmond	-	6.30 p.m.

Friday, July 12th.

Truman, Hanbury's Brewery	-	11.0 a.m.
Cowan's Sugar Refinery, Barnes	-	11.30 a.m.
A.B.C. Sewage Works, Kingston	-	11.30 a.m.
Brush Electric Light Co., Lambeth	-	2.15 p.m.
Brin's Oxygen Co., Westminster	-	3.0 p.m.
Groth's Electric Tannery, Bermondsey	-	3.0 p.m.

Further details will be sent to each member with the Ballot List by post.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Post Office Orders in payment of subscriptions should in all instances be made payable at the General Post Office, London.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January 1883, and January, February, and April 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once, stating price required, with Mr. Cresswell. The stock of all other numbers is at present sufficient for the Council's requirements.

LIST OF MEMBERS ELECTED, 21st JUNE, 1889.

- Burgess, Geo., Marsh Alkali Works, Widnes, chemist.
 Cadett, Jas., Ashted, Surrey, chemist.
 Corrie, David, c/o Nobel's Explosives Co., Ltd., Polmont Station, N.B., chemist.
 Davies, G. W., 8, Spring Hill, Stockport, teacher of chemistry.
 Dewey, Fred. P., c/o Smithsonian Institution, Washington, D.C., U.S.A., Curator, Metallurgical Department, U.S. National Museum.
 Evans, P. Norman, Ph.D., 28, Great Ormond Street, W.C., consulting chemist.
 Fenwick, Jas., Tharsis Mines, Huclva, Spain, analytical chemist.
 Glatz, Jos., Riverside Chemical Works, 485—493, Kent Avenue, Brooklyn, N.Y., chemical manufacturer.
 Hartley, R. Kent, Springwood House, Chadderton, near Oldham, chemical manufacturer.
 Pullman, John, Grove End, Chiswick, W., leather merchant.
 Rogers, Jno. Martin, 20, Frances Street, Truro, Cornwall, mining engineer.
 Schroeter, Hermann M., 1517, Montgomery Avenue, Philadelphia, Pa., U.S.A., chemist.
 Schweich, Emile, Winton Park, Northwich, Cheshire, chemist.
 Stern, Arthur L., c/o Messrs. Bass & Co., Burton-on-Trent, chemical assistant.

Woolford, Jas., Lempdes, Haute Loire, France, miner and metallurgist.

Yates, H. Noble, c/o Cowles Electric Smelting and Aluminium Co., Lockport, N.Y., U.S.A., chemist.

CHANGES OF ADDRESS.

- Cameron, R., 1/o Kelvinside; Wellpark House, Bathgate, N.B.
 Craw, Jno., 1/o Meadowbank; North Greenhill Cottage, Paisley, N.B.
 Dreaper, W. P., 1/o Clapham; Silk Crape Works, Ponders End, N.
 French, Andrew, 1/o Glasgow; Willowbank, Larbert, N.B.
 Gadd, W. L., 1/o Wath; Beech Villa, Swinton, Rotherham.
 Harrison, C., 1/o Hull; 34, Talbot Place, Sheffield.
 King, C. M., 1/o Highgate; Quinta do Caima, Estarreja Porto, Portugal.
 Lodge, A. S., 1/o Prestwich; Newchurch, near Manchester.
 Lucas, R., 1/o Kilburn; Mainzerstrasse 8, Wiesbaden, Germany.
 Lundberg, Alf., 1/o Northfleet; Ströms Bruk, Hudiksvall, Sweden.
 McCowan, Wm., 1/o Glasgow; Mount Osborne, Barnsley, Yorks.
 McEwen, T. G., 1/o Commercial Road; 73, The Grove, Stratford, E.
 McKenzie, T. E., 1/o Huclva; 10, Willowbank Crescent, Glasgow.
 Markel, Dr. Karl E., 1/o Northwich; Kirby House, Kirby Bedon, Norwich.
 Markham, A. D., 1/o London; 2, London Road, Enfield, N.
 Oddy, R. W., 1/o Molesworth Street; 60, Waterhouse, Toad Lane, Rochdale.
 O'Neill, Chas., 1/o Denmark Road; 11, Carter Street, Greenheys, Manchester.
 Parnell, E. W., 1/o Widnes; Dee Hills, Chester.
 Purser, E. T., 1/o Dublin; Dry Creek Valley, Healdsburg, Cal., U.S.A.
 Shadwell, J. E. L., 1/o Christchurch; Meadowbank, Melksham, Wilts.
 Smith, A. J., 1/o Plumstead; 58, Park Road, Greenheys, Manchester.
 Smith, Dr. J. H., 1/o Gateshead; Hottingen, Zurich, Switzerland.
 Smith, Thos., 1/o Edinburgh; 20, Crichton Road, Craigmore, Bute, N.B.
 Spoor, J. L., 1/o Tynemouth; Stone Court Cement Works, Greenhithe, Kent.
 Stanley, C. L., 1/o Wath; Oakwood Hall, Rotherham, Yorks.
 Taylor, H. E., 1/o Brand Street; 68, Ashburnham Grove, Greenwich, S.E.
 Turney, Sir John; Journals to "Springfield," Alexandra Park, Nottingham.
 Wates, E. A.; Journals to c/o Hyderabad (Deccan) Co., Secunderabad, Deccan, India.
 Whalley, L. J. de, 1/o Leytonstone; 27, Ormiston Road, Westcombe Park, S.E.
 Young, Jno. (Hanley); Journals to Gas Works, Etruria, near Stoke-on-Trent.

CHANGES OF ADDRESS REQUIRED.

- Bell, G., 1/o 17, Greenway Road, Runcorn.
 Porter, Herbert, 1/o Lime Tree Terrace, Stowmarket.

Deaths.

- Dale, John, Cornbrook, Manchester.
 Gunter, Evan, Nobel's Explosives Co., Ltd., Stevenston, Ayrshire.
 Percy, Dr. John, F.R.S., 1, Gloucester Crescent, Hyde Park, W., June 19th.
 Price, D. S., 26, Great George Street, Westminster, S.W.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	R. Messel.
H. E. Armstrong.	B. E. R. Newlands.
W. Lunt Carpenter.	B. Redwood.
W. Crowder.	T. Royle.
W. J. Dibdin.	John Spiller.
C. Graham.	Wm. Thorp.
S. Hall.	C. R. Alder Wright.
C. C. Hutchinson.	

Hon. Local Sec. and Treasurer:

Thos. Tyrer, Garden Wharf, Battersea, S.W.

SESSION 1888-89.

July. — Annual General Meeting.

Meeting held Monday, June 3rd, 1889.

PROFESSOR JAS. DEWAR, F.R.S., IN THE CHAIR.

ON THE PURIFICATION OF ALCOHOL BY MEANS OF HYDROCARBONS.

BY W. S. SQUIRE, PH.D.

THE purification of commercial alcohol by some ready and inexpensive method is a matter of great importance. The voluminous report of M. Claude, presented in 1887 to the French Senate, accompanied by an exhaustive atlas of the quantity and kind of spirit consumed in different departments of France, demonstrated the great evils which result from the consumption of impure alcohol. Legislation based on this report was contemplated with a view to compel the purification of spirit going into consumption, but useful legislation of any kind is not likely to occur amid the frequent wreck of ministries, and the constant struggle of adventurers for place and power.

The German Government has also had this question under consideration, and it is probable that legislation in this direction will be attempted ere long. But apart from legislation there is a large actual demand for pure spirit for the manufacture of liquours and the common sorts of brandy, for medicinal purposes, and for the fortification of wines.

In Germany, where the spirit industry has attained such development as to be of national importance, the spirit as it comes from the distilleries is very impure. The distilleries are very numerous, and for the most part very small. Indeed, in many cases a distillery is part of the regular plant of a farm, the farm labourers being employed during the winter in the distillery working up the potatoes and other matters into spirit, the whole of the residual products going back to the land, either directly as manure, or indirectly as food for the cattle. This arrangement is very wisely encouraged by the Government, which favours the farmer in the matter of duty, provided nothing leaves the land, except the carbon, hydrogen, and oxygen in the alcohol, which, strictly speaking, were never in the land at all, but have been derived from the air.

It will be readily understood that small distilleries of this kind, at work only half the year, are unprovided with the apparatus necessary for producing a pure spirit. The stills are of comparatively simple construction, and, indeed, very little attempt is made to remove any impurity, except water. This of course is removed, so far as it can be easily removed, in order to keep the cost of packages and carriage as low as possible.

The spirit in this impure state comes into the market like peas, or beans, or other agricultural produce, a few casks at a time, and is bought by the rectifiers, who have usually large establishments, and work on a considerable scale.

The German rectifier commences his operations by diluting the raw spirit with water until the mixture contains from 40 to 50 per cent. of absolute alcohol. This dilution greatly facilitates the removal of the fusel oil. The dilute alcohol is then filtered through wood charcoal. Lime-tree charcoal is preferred, but the charcoal of other light and soft woods is occasionally employed. The apparatus used for this purpose is shown in Fig. 1. The plant consists of a number (usually six or eight) of wrought-iron cylinders about 3 or 4 metres high, and about 80 centimetres in diameter. These cylinders are filled with wood charcoal in small pieces, and are connected together by means of pipes and cocks to enable the requisite operations to be carried on.

The dilute crude spirit is contained in a tank above the apparatus (not shown in the drawing), and the purified spirit is received in a tank, at a lower level but above the apparatus, shown on the right hand. The cock A being open, but the cocks B, C, and D closed, as are also the cocks A², the spirit coming down the supply pipe enters the first cylinder, which it ultimately fills. The cocks E and F being closed the spirit passes down the outlet pipe, and the cock B² being open while the cocks A², C², and D² are closed, the spirit enters the second cylinder, and the same thing happens to all the succeeding cylinders. In the case of the eighth cylinder the cock E⁸ is open, and the spirit having no other outlet, for the cock B is closed, makes its way into the tank intended to receive the purified spirit.

The charcoal in No. 1 cylinder, being in contact with the most impure spirit, becomes first charged with impurities, and this cylinder must be emptied and recharged. In order to do this, the cocks A and B² are closed and the cock A² is opened. This has the effect of cutting out the first cylinder. The cock D is then opened, and the fluid contents of the first cylinder run off to be pumped back to the crude spirit tank above. While this is going on the cock G, which is intended to admit air while the cylinder is being emptied or to allow to pass out when it is being filled, must be open. The cocks G and D are then closed, and the cock C, which admits steam from the steam pipe, and the cock F, which puts the cylinder in communication with a pipe leading to a condenser, are opened. In this way any residual spirit remaining in the charcoal is given off and recovered. Lastly, the manhole is removed, the charcoal taken out, and a fresh charge introduced through the upper manhole. No. 1 cylinder is then thrown into circuit by closing E⁸ and opening B and E, No. 1 cylinder then becoming the last one. No. 2 is then thrown out of circuit in like manner, and recharged, and so on. Usually seven cylinders are at work while one is being recharged. This apparatus, although largely used, is not, so far as I am aware, figured and described in any work on spirit manufacture. It might be imagined that the vapours driven out of the cylinders by the current of steam, and condensed in the condensers, would contain a considerable quantity of fusel oil. This, however, is by no means the case; the condensed liquid has a nasty smell, it is true, but not such as would be due to a large amount of fusel oil.

Stammer in his large work, "Die Branntweinbrennerei," refers to this fact, and on that account dismisses the charcoal process as being of little use in removing fusel oil; but professors, when they write on technical subjects, are very apt to jump to conclusions on insufficient evidence, and there is one fact of which Stammer must have been aware which does not at all square with his theory. If the fusel oil and other impurities absorbed by the charcoal were

driven off in a current of steam it follows that the steam would revivify the charcoal, and there would be no necessity for recharging the cylinders with fresh charcoal. That, however, is not the case, it is necessary from time to time to remove the charcoal and heat it to redness in closed vessels. Moreover we know that charcoal possesses the property of absorbing certain gases, for instance, sulphurous acid and ammonia, in considerable quantity. Now these gases are nothing more than liquids at temperatures much above their boiling points. It does not, therefore, at all follow that fusel oil, absorbed by charcoal at the ordinary temperature, will be driven off when the temperature reaches the boiling point of the absorbed liquid.

As a matter of fact, the charcoal purifies the spirit very considerably, and manufacturers would not go on using the process if it were found in practice that the spirit came out of the cylinders pretty much as it went in. The purification is, however, not complete. When the purified spirit is rectified in a Savalle rectifier—the apparatus generally employed—an impure spirit, usually about 3 or 4 per cent. of the whole, and containing aldehyde and certain ethers with low boiling points, comes over first. This is followed by a very pure spirit, usually about 10 per cent., used chiefly for fortifying wines. Then comes the ordinary rectified spirit, and lastly an impure spirit containing impurities with high boiling points. The heads and tails of the distillation, as they are called, are usually mixed together and sold at a cheap rate, as they obviously contain impurities which the charcoal process is unable to remove.

It has long been known that oils and fats possess the power of absorbing the more or less volatile bodies which we know as odours; the odours of flowers for example. Some of these odours are very delicate; for instance, those of the violet and tuberose, which cannot be extracted from the flowers without serious injury by the ordinary process of distillation. Perfume manufacturers take advantage of this property of oily bodies to extract the odours without the use of heat. The flowers, and layers of pure grease (a mixture of lard and suet) spread on glass, are piled up in frames, and after standing some time, the odours of the flowers are absorbed by the fat, and may be extracted again from the fats by strong alcohol. This process is called "Entourage," and is largely practised in the South of France.

The same general idea has been applied to the purification of alcohol. The first person who experimented in this direction appears to have been Parsons, of New York City, who in 1869 took out a patent for purifying alcohol by means of paraffin. His process consisted in mixing strong alcohol—90 per cent. at least—with paraffin, and heating the mixture by means of a steam coil with continual agitation. He then introduced warm water so as to bring the mixture down to about 50 per cent. of alcohol, and allowed the whole to cool with continual agitation. The paraffin which separated in flakes was then filtered off from the purified spirit. He states that if the spirit is of less strength than 90 per cent. the purification is less perfect. In the following year he took out a patent for purifying spirit by causing its vapour to traverse a layer of melted paraffin, and he also claimed the use of mineral oils. So far as I am aware nothing came of these proposals, and we shall see later on that nothing was likely to come of 90 per cent. alcohol and hot melted paraffin through which the vapour of alcohol was caused to bubble.

In 1880 a patent was taken out by Simon Roessler, of Troppau, Austria, through Messrs. Haseltine, Lake, and Co., patent agents of London, for purifying alcohol, fatty matters, and wax, and for regenerating the materials employed; but whether the object was to purify the alcohol by means of the fatty matters, or the fatty matters by means of the alcohol, I defy anybody to make out. Apparently the inventor wants to do both at once.

In 1884 the subject was taken up by a Danish chemist named Bang, who became associated with M. Ruffin, of Paris. He recognised at once that the alcohol must be treated in a dilute condition. Fusel oil is but little soluble in dilute spirit, but very soluble in strong spirit; indeed,

strong spirit actually extracts fusel oil from a mixture of hydrocarbons and fusel oil, while the hydrocarbons extract the fusel oil from dilute spirit. It is a question of relative solubility. I cannot very well show you the fusel oil leaving the dilute spirit and passing to the hydrocarbons, but I can show you something of the same sort which will illustrate my meaning. If I add a dilute solution of chromic acid to a very dilute solution of peroxide of hydrogen I develop, as you see, the magnificent blue colour of perchromic acid. This substance is, as you see, soluble in water, but it is much more soluble in ether. I will add a little ether and shake up the bottle, when the layer of ether floating on the top will become intensely blue, and the water below remains almost colourless. This is what happens when hydrocarbon oils are brought into intimate contact with dilute alcohol containing fusel oils, and other substances more soluble in the hydrocarbon oil than they are in the dilute alcohol.

In Bang's first patent of 1884 he proposed to use as a purifying agent the more volatile portions of petroleum, generally known as essence of petroleum. The apparatus he constructed for the purpose is shown in Fig. 2. The dilute spirit to be purified is contained in a cylindrical vessel A, and the hydrocarbon is pumped in through the perforated pipe *t*. The small bubbles of hydrocarbon rise through the dilute spirit, abstracting the fusel oil, and collect in the glass globe *a*. From this it is conducted into the cylinder B furnished with baffle plates *c c*. This cylinder is filled with water which abstracts any alcohol which may have been mechanically carried over in the hydrocarbon. From B it is conducted to a similar cylinder C filled with chloride of calcium to abstract any water it may have taken up. From C it passes into D, filled with strong sulphuric acid, the object of which is to remove the fusel oil and other impurities by the formation of sulpho-compounds. Finally the hydrocarbon is passed through the cylinder E, filled with pieces of marble in order to remove the sulphuric acid which may be mechanically mixed with the oil.

The hydrocarbon thus regenerated is returned by the pump P to the cylinder containing the alcohol to be purified. I may remark, in passing, that if alcohol is mechanically carried over into B, and water into C, so will solution of chloride of calcium be carried over into the sulphuric acid in D, and that will make a nice mess. And, further, that greasy lumps of marble are not precisely the best means for removing concentrated sulphuric acid.

The use of volatile hydrocarbons being open to many objections, Bang and Ruffin, in 1886, substituted hydrocarbons with a higher boiling point, and devised the apparatus shown in Figs. 3 and 4. A series of cylinders, V, V¹, V², are fitted with baffle plates as at V, or filled in the middle with sponge or porous material, to facilitate the contact of the two liquids. These cylinders are filled (says the patentee; I suppose he means partially filled) with the hydrocarbon oil, and the dilute spirit is let in from the cistern A. It sinks through the hydrocarbon in V, and then passes through the outlet pipe to the top of V¹, when it again falls through the hydrocarbon, passing to V², and so on, being finally delivered at the outlet E. As the hydrocarbon in V becomes charged with impurities, it is necessary from time to time to remove it, and substitute for it that contained in V¹, which is less impure; this in its turn being replaced by that in V², which is almost pure. This is accomplished by shutting the cocks B and E, and opening the cocks C and F. The hydrocarbon then runs in the opposite direction from V² to V, and escapes at C. The hydrocarbon is afterwards regenerated by means of sulphuric acid, which takes up the fusel oils by formation of the sulpho-compounds.

A modification of the apparatus is shown in Fig. 4, which consists of a column divided into compartments by means of perforated diaphragms, and filled with porous material. The lower end of this column communicates with the hydrocarbon cistern C, while the alcohol to be purified is let in from the cistern A. The discharge pipes C and E communicate respectively with the top and the bottom of the column. There is also a pipe K communicating with the column at two different levels. The column is first filled with water up to the level of the first diaphragm O O. The

CHARCOAL PROCESS

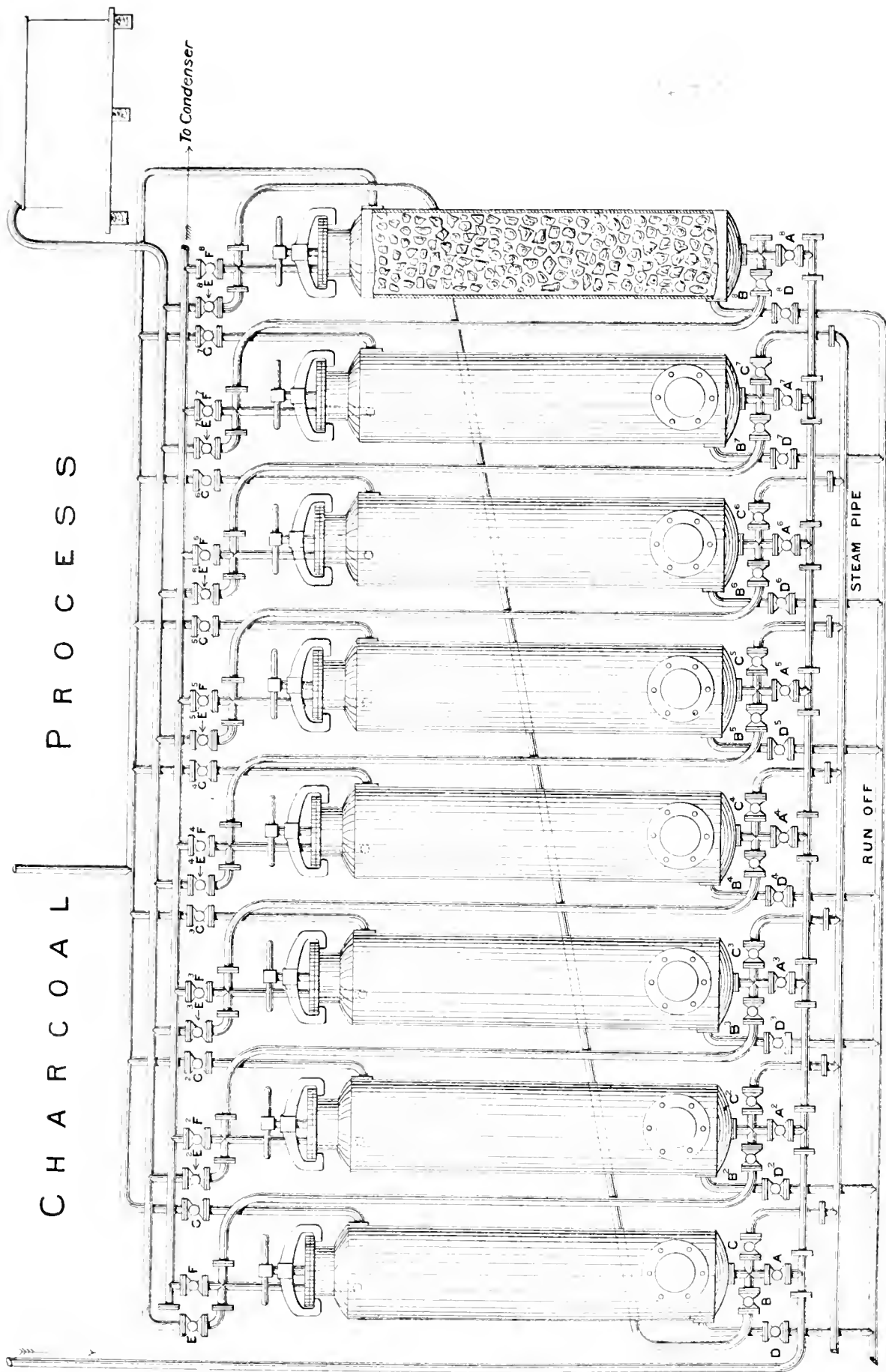


Fig 1.



BANG AND RUFFIN 1884.

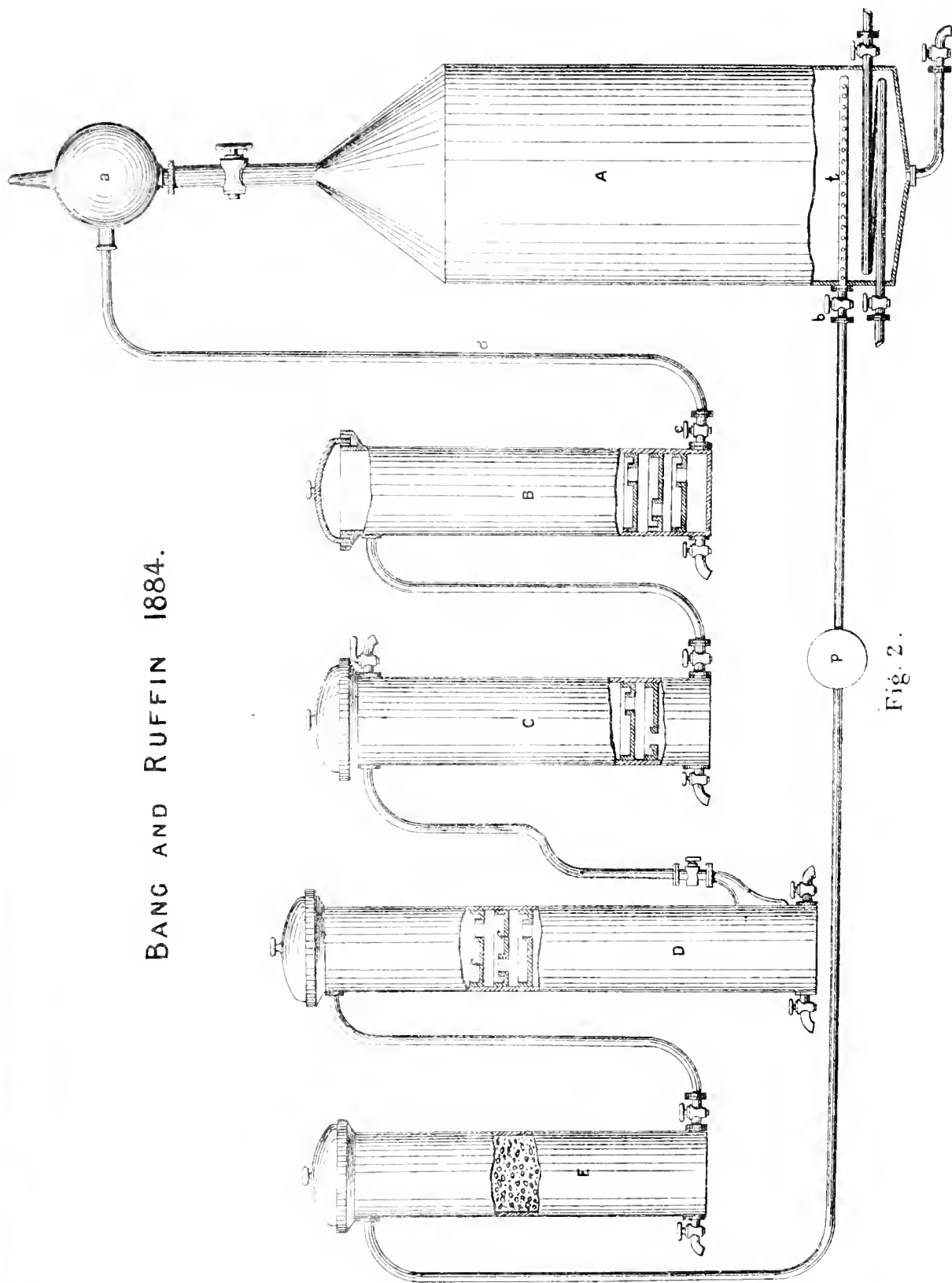
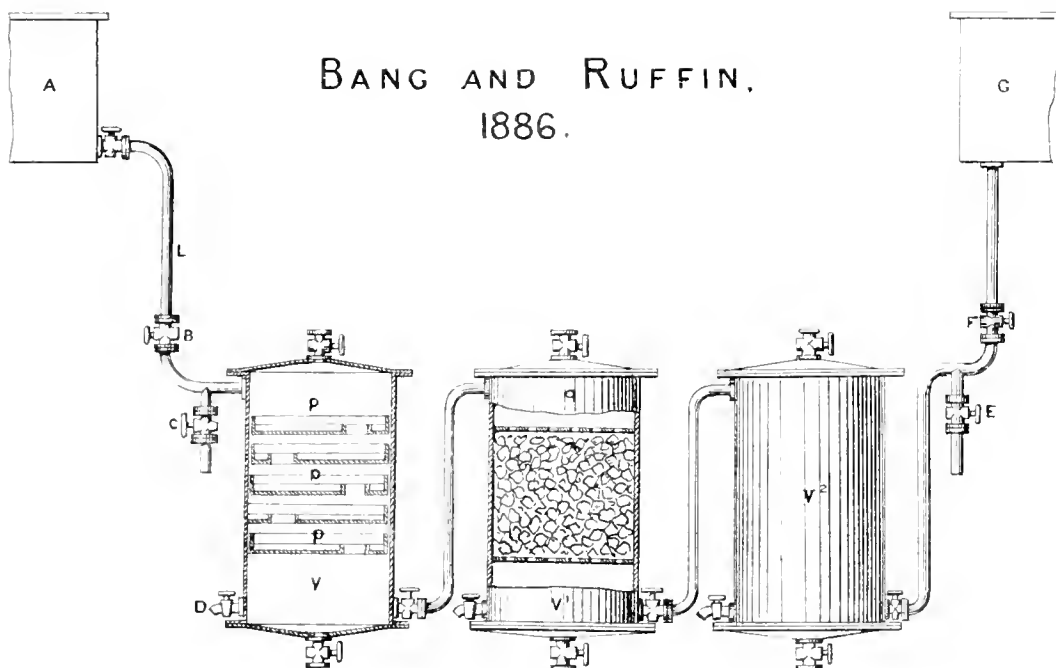
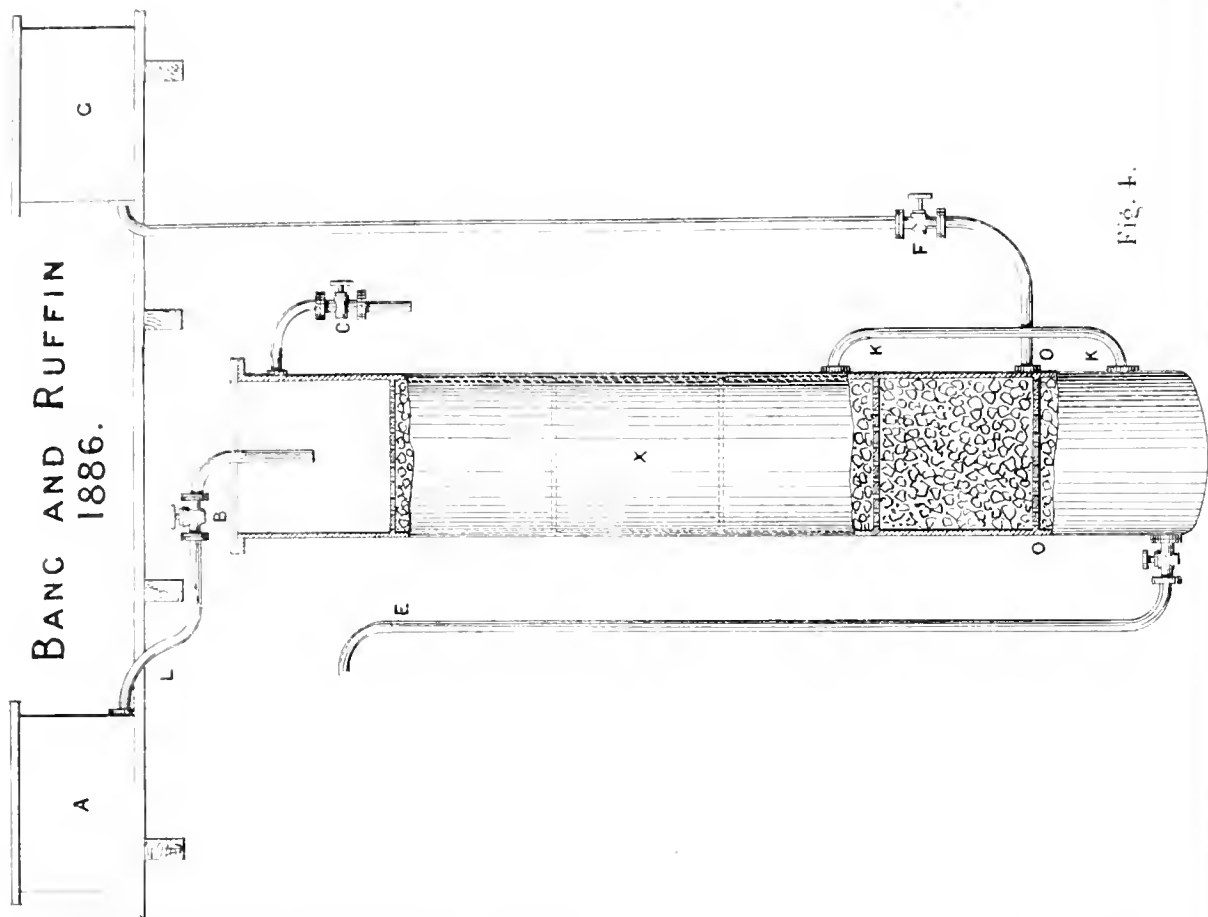


Fig. 2.





BANG AND RUFFIN, 1887.

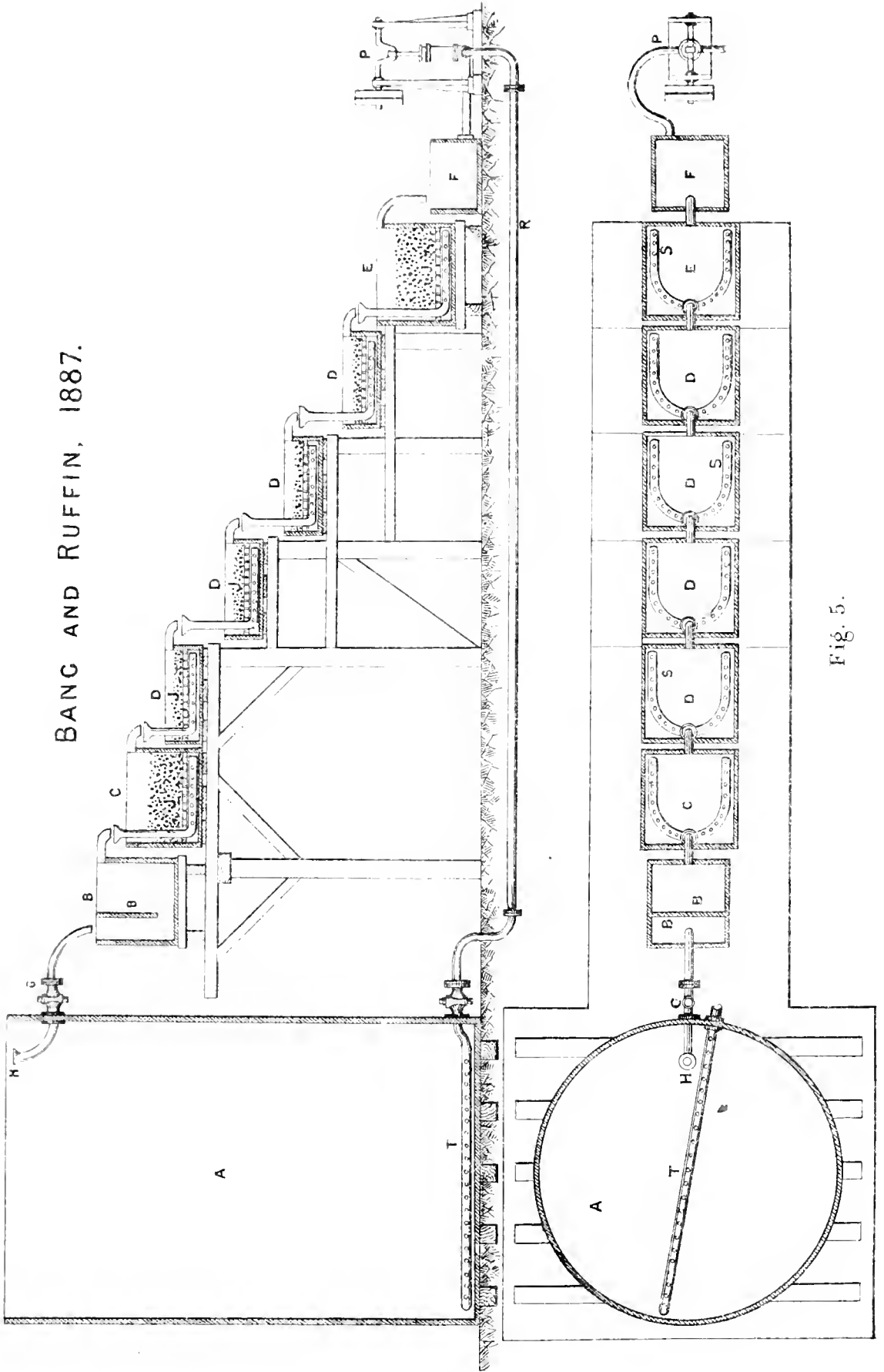


Fig. 5.

BOWICK, - 1887.

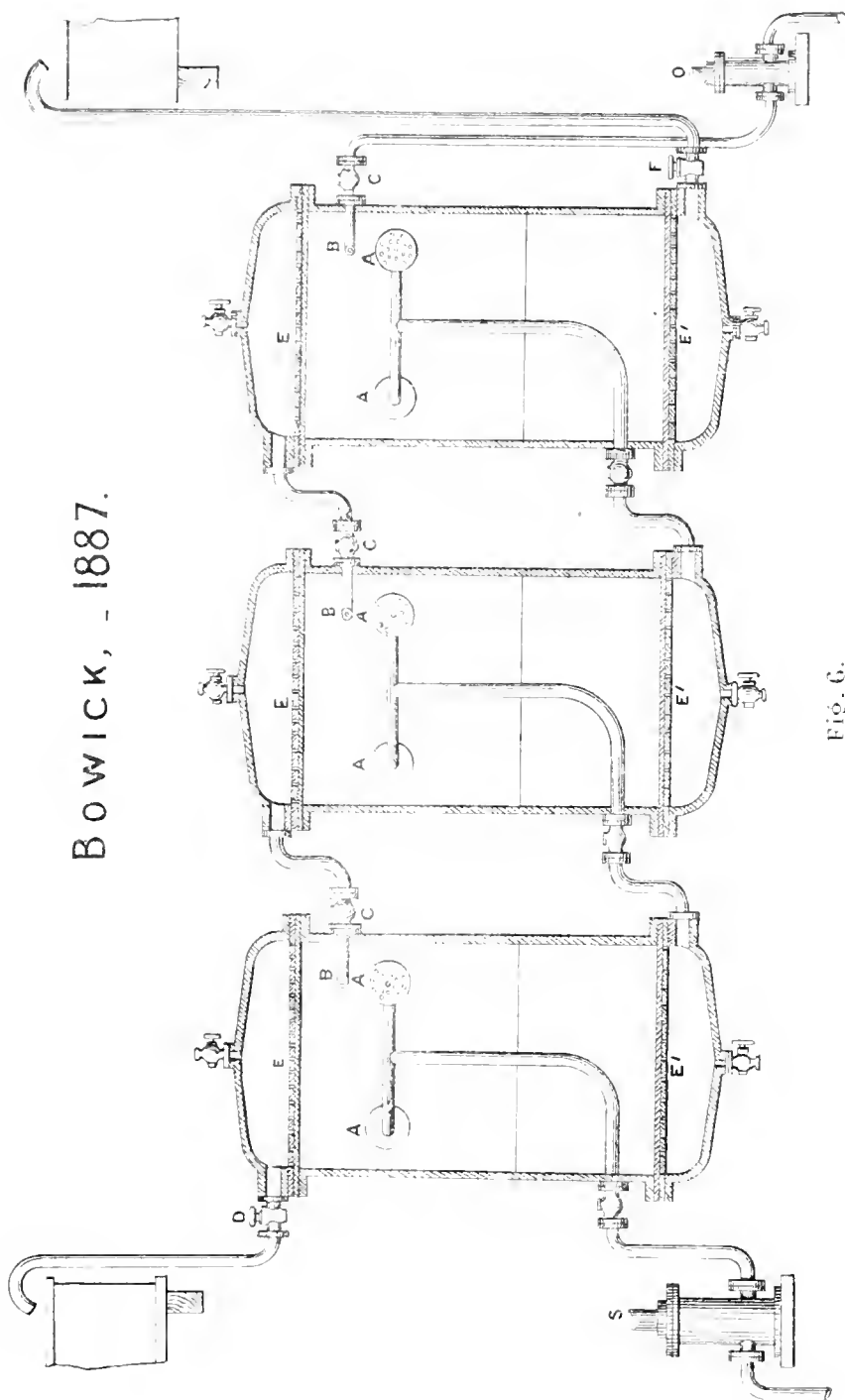


Fig. 6.

hydrocarbon is then run in till it overflows at C. The dilute alcohol is now admitted by opening the cock B, and descends by gravity through the oil, driving the water before it, and making its exit at E. The hydrocarbon is renewed by stopping the flow of alcohol, and letting in the oil from G.

These apparatus, apparently methodical in their action, are open to a good many objections. Constructed as they are the alcohol will be very prone to go down all in one place, and this will in no wise be prevented by the perforated diaphragms so liberally introduced. I have often been struck by the unreasoning way in which perforated diaphragms are introduced into chemical plant. A whole chapter might be written on the use and abuse of perforated diaphragms. Let us suppose a fluid arriving through an inch pipe and assume the perforations to be an eighth of an inch in diameter; then 64 holes will equal the area of the pipe (the friction when thin plates are employed may be neglected), but instead of 64 holes there are usually about 610. Even if the pipe runs full bore the liquid will run through a comparatively small number of holes just where the liquid falls, but the pipe rarely runs full bore. There is usually a cock introduced to "regulate the flow," so that as a distributor the perforated plate goes for nothing. A perforated diaphragm should be so constructed that it opposes such a resistance to the flow of the liquid that the whole of the liquid cannot get through the holes until a certain head accumulates, and in virtue of the pressure of this the flow through the holes is accelerated until an equilibrium is established, and only in such a case will every hole deliver the same quantity, and act as a distributor. It is obvious, too, that the oil will be mechanically carried along with the spirit when the spirit flow is on, and the spirit will be mechanically carried along by the oil when the oil flow is on, and, further, that the impure oil hanging about the porous substance will not be carried on by the general flow of the oil, so that the apparatus is by no means so methodical as it looks.

That the apparatus was open to some such objections as I have named seems probable, for in the following year, 1887, Bang and Ruffin took out another patent for an apparatus shown in Fig. 5, which is, I believe, the apparatus now used by their company at their works near Paris. In this apparatus all attempt at methodical treatment is abandoned. The dilute alcohol to be treated is put into a large vat A, and the hydrocarbon oil is pumped in by the pump P through the perforated pipe T, thus reverting practically to the original arrangement. The bubbles of oil rise by gravity to the top of the vat, and the oil which collects runs off through the parachute pipe H. The oil passes next to the vessel B, where "the oil descending on one side of the partition and ascending on the other deposits in B some of the heavier impurities carried over by it," whatever that sentence may mean. From B it overflows into C, ascending in streams through a perforated pipe and a perforated floor, through water, to remove any alcohol mechanically carried over, and then through D, D, D, D, provided also with perforated pipes and perforated floors, and filled with pieces of glass, where it is treated with strong sulphuric acid. Then on to E, where it encounters a solution of soda (the marble business, I presume, not being found to answer), and finally into the reservoir F, from which it is pumped back to the vat A. During the operation the sulphuric acid is moved upwards successively from the lower to the upper vessels D, but it has to be bucketed up in jugs, an operation which is neither neat nor handy. I should mention that the dilute spirit in A is made alkaline in order to resinify any aldehyde that may be present.

One of the chief objections to this process is that it is very slow. Something like 48 hours at least is required for the purification of the alcohol. At the beginning the oil is largely contaminated with fusel oil, but as the operation goes on it takes out less and less, and yet has to go through the same process of regeneration. It is like washing out completely a voluminous precipitate, and then having to boil down all the endless wash waters. Every chemist knows what a ghastly operation this is. I say nothing of the bucketing up of the sulphuric acid, but after what I have said about perforated false bottoms, it may be doubted

whether the distribution in the vessels D, D, D, D, is very effective.

In 1887 Bowick attempted to meet these difficulties by the construction of an apparatus which should be perfectly methodical in its action, and yet free from the objections to Bang and Ruffin's, 1886. His apparatus is based on the principle that if we take a fairly intimate mixture of dilute alcohol (or water) and hydrocarbon oil, and pour it on a filter wetted with oil, it is only the oil which passes through, leaving the dilute alcohol behind, while if the mixture is poured on to a filter previously wetted with dilute alcohol (or water) only the dilute alcohol will pass through, leaving the oil behind.

The arrangement is shown *diagrammatically* in Fig. 6. It consists of a series of cylinders, all precisely similar, connected together as shown. Each is provided at the top and at the bottom with a filter E, E'. These are supported by perforated metal plates, not for the purpose of distribution, but simply as supports. These vessels are filled about one-third with water or purified dilute alcohol (this wets the lower filter), and are then filled up with the hydrocarbon oil (this greases the top filter). The outlet cock D for the oil being closed, and the outlet cock F for the spirit being open, the dilute spirit is pumped in, by means of the pump S, through the roses A, placed horizontally, so as to give a rotary motion to the contents of the cylinder. Under these circumstances a species of emulsion is formed, which, being somewhat heavier than the oil, slowly descends until it reaches the bottom filter, where it is separated into the dilute alcohol, which passes through, and the oil, which rises to rejoin the layer of oil above. The same process takes place in each successive cylinder, and thus the spirit, coming in contact with oil always purer and purer, issues in a constant stream at F, deprived of all those impurities which the oil is capable of absorbing. As in Bang and Ruffin's 1886 proposal, it is necessary occasionally to displace the oil in the opposite direction. To do this the spirit pump is stopped, and the oil pump O set to work, the cock F being closed and the cock D open. The upper filters then come into play, and prevent any of the dilute alcohol being carried over mechanically by the oil. In order to make sure that the two liquids shall only travel in the prescribed direction, back-pressure valves, C, C', C'', are introduced. The oil is regenerated by simply blowing through it a current of steam, which carries off the whole of the fusel oil. This can be condensed and collected. As there is a strong demand for fusel oil at a price higher than the price of spirit, this is a decided advantage over the destruction of the fusel oil by means of sulphuric acid.

The oil employed is one which boils at or about the boiling point of mercury, so that there is no danger of any being vaporised with the spirit. It is perfectly destitute of taste or smell. It dissolves fusel oil with the greatest ease, and is, therefore, well fitted for its removal; and I believe that this process is a good one for the removal of fusel oil.

The advantage of Bowick's apparatus is that it permits a far greater subdivision of the oil, and therefore more intimate contact without any danger of the oil being mechanically carried along in the stream of spirit, or the spirit in that of the oil. It is, moreover, perfectly methodical and continuous in its action, and in consequence, the oil is always charged to the fullest extent with impurities, and there is no oil weak in impurities to treat, as in the latest Bang and Ruffin. Even with the Bowick apparatus it is not advisable to go too far in the subdivision. If the particles of oil are more minute than the pores of the paper they will go through; just as milk does. But if the pressure and the size of the openings in the roses are properly adjusted, very great subdivision may be attained, with complete separation by the filters.

Whatever apparatus is used, the result in the end must be the same. If you go on treating dilute spirit with hydrocarbon oil long enough, you will end by removing all that the hydrocarbons will remove. It is simply a question of employing an apparatus which will do it, most economically and in the shortest time.

As to the efficiency of the hydrocarbon process, it is clear that if the impurities are more soluble in the hydrocarbon

than in the dilute spirit, they will be removed. If more soluble in the spirit than in the oil they will not be.

Now, aldehyde is not an unfrequent constituent of crude spirit. All the patentees claim more or less that the hydrocarbon process gets out the aldehyde. But aldehyde is perfectly insoluble in the hydrocarbon oil, while it is soluble in all proportions in water and alcohol. Therefore the hydrocarbon process cannot remove it. Bang and Rutlin make their dilute spirit alkaline in order to resinify the aldehyde, but the resinification is accompanied by the formation of some volatile body of very pungent smell, so that the remedy is as bad as the disease.

As the alcohol is employed in a dilute form, it is necessary in any case to pass it through a rectifying still in order to remove the water. As the aldehyde is very volatile it comes over first, and that will be the best way of getting rid of it.

Speaking generally, I think the hydrocarbon process is a distinct advance on the charcoal process. It removes the fusel oil most effectually. Owing to the presence of aldehyde, and some very volatile ethers possibly, not removed by the hydrocarbon, there will still be some "heads" to reject, but spirit purified by the hydrocarbon process is almost entirely free from tails. Whether it will be possible to devise any process which shall be capable of removing every possible impurity from commercial alcohol without the aid of the rectifying still, I may be permitted to doubt.

DISCUSSION.

Mr. B. E. R. NEWLANDS said that he had devoted considerable time and attention to the two processes described by Dr. Squire. He had had an opportunity of seeing the Bowick process at work at Vauxhall, and he had recently spent a week at Paris in examining the Bang and Rutlin process. The Bowick process was being worked on only a small scale; but by the Bang and Rutlin method some 10,000 litres of alcohol were being treated daily, and the process worked well. He had taken samples at various stages of the process, and having examined them carefully had come to the conclusion that the Bang and Rutlin process produced alcohol quite equal to the best charcoal spirit. It was true that petroleum had little or no solvent action on aldehyde; but by boiling the alcohol and passing the vapours through a condenser surrounded by water at such a temperature that while the alcohol was condensed the aldehyde passed over, the head of the impurities was caught before commencing the petroleum treatment. A full consideration of the matter had convinced him that petroleum by itself would be of but little use. It must be worked concurrently with some other process, as at Paris, for removing the aldehyde and ethers, and at present he knew of no method other than distillation suitable for that purpose. If, however, the Excise authorities in this country would allow petroleum to be employed on a commercial scale in the distillery these processes might probably have a future before them, seeing that for purifying certain kinds of spirit, such as those produced from beet molasses, they would appear to be specially suitable. However, until the Excise authorities allowed greater freedom of action it would, he feared, be impossible to carry out any petroleum process in England in a distillery. In the meantime, so far as this country was concerned, the processes would have to remain in their present experimental position.

Glasgow and Scottish Section.

Chairman: R. R. Tatlock.

Hon. Vice-Chairmen: { E. C. C. Stanford.
Sir J. Neilson Cuthbertson.

Committee:

J. Addie.	R. Irvine.
G. Bellby.	T. P. Miller.
W. Boyd.	E. J. Mills.
A. Crum Brown.	J. M. Milne.
J. Christie.	T. L. Patterson.
W. S. Curphey.	J. Pattison.
W. Dittmar.	D. R. Stewart.
D. B. Dott.	A. Whitelaw.

Hon. Treasurer: W. J. Chrystal.

Hon. Local Secretary:

G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The last Meeting of the Session was held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, 4th June 1889.

MR. E. C. C. STANFORD IN THE CHAIR.

REFRACTORY GOLD ORES.

BY J. HOLMS POLLOCK, B.Sc., UNIVERSITY OF GLASGOW.

In dealing with gold quartz the first point of interest is the character of the quartz, as this has a very important bearing on the best manner of treatment. Quartz can be more or less divided into three groups according to its behaviour on treatment, viz., free-milling; float, fine, or rusty; and refractory quartz. In free-milling quartz the gold exists in a coarse granular condition scattered throughout the body of the quartz, which generally consists of pretty pure silica with little oxide of iron or sulphides, though the presence of these in moderate quantity is not necessarily detrimental so long as the gold is in a coarse or granular state. With these the miner has no difficulty, all he has to do is to crush and amalgamate in the ordinary manner with the stamp battery, and collect the gold by riffles and amalgamated copper plates, a very large proportion of the gold present being readily secured. This is the good old style of quartz that used to be obtained plentifully in Victoria and California. Of this class of ore I have few specimens, as it is of little interest to me; for when people can treat their ores without difficulty, they do not take the trouble to send samples to be tested by new processes. However, I have here a specimen from Queensland in which you will see the little specks of gold without difficulty.

In rusty, float-, or fine-gold quartzes, though there is not much pyrites or other sulphides present, there is much loss in working, for the gold is in a finely divided state and disseminated through the quartz. When these ores are subjected to the ordinary process of crushing and amalgamation, the loss of gold is very great indeed, the fine gold being carried away by the water along with the quartz, and going over in the tailings. In some cases, when the gold is very fine, much of it does not even remain in the tailings, but passes away in the sludges, and is irreparably lost. From investigation, I am inclined to think that these ores were originally of the refractory type, the iron being in the form of sulphide, with the gold, as it were, alloyed with it,

or perhaps the gold itself existing as sulphide, and that subsequently by percolation of water the pyrites was weathered and converted into hydrated oxide of iron, leaving the gold in an excessively fine state of division throughout this oxide. If you crush these quartzes, and attempt to concentrate them by washing, you find that the iron oxide, because of its softness, crushes very finely, and then the water carries this fine oxide over; if the oxide is allowed to deposit and then assayed, it gives more gold than the heavy portions remaining behind. Then again, these quartzes are usually vesicular, and often contain ferrous oxide, and lastly the veins composed of them usually pass into pyrites quartz at greater depth, all which points to the supposition that they were formerly of the refractory type. Of course no exact line can be drawn between these float or rusty ores and the free-milling or coarse gold quartzes, for the float gold quartzes usually contain a considerable proportion of the gold coarse enough to be saved by the ordinary methods; and as miners never like to talk of the gold they *do not get*, they very much prefer to call these "too free-milling" ores if they can get any profitable return. The importance of this may be judged when I say that in the Transvaal, where almost all the ores at present worked are of this type, the gold lost is usually as much as that saved, and large quantities of valuable tailings have now accumulated. At the Sheba Mine, the tailings assay about $2\frac{1}{2}$ oz. of gold per ton, while at the Wemmer and Jumper Mines there are tailings assaying respectively 3 oz. and 4 oz. per ton, while of tailings of about 1 oz. there is any quantity. In New Zealand the state of affairs is even worse, or better for those who can extract the gold. There the loss owing to float or fine gold is so great that in many cases rich ores will not pay the working. I know of one ore which assayed 5 oz. per ton, but when treated in London by amalgamation, it only yielded 1 oz., and I may add that in this case the gold was so excessively fine that little of it remained in the tailings, the bulk of it going off in the sludges, and being thus irreparably lost; but when this sample was treated by hydraulic chlorination it yielded $4\frac{3}{4}$ oz. of gold per ton. Another point of interest in New Zealand ores, more particularly in the Auckland district, is that they often contain a large proportion of silver as well as gold, which makes the working of these ores exceptionally profitable. It is quite possible that the excessively "floaty" character of the gold may in no small degree be caused by this silver, for, as is well known, silver is very difficult to concentrate, and were the gold associated with it, one could easily understand how it might be carried away, besides which the sulphide or chloride of silver would envelop the gold, and prevent its amalgamation. In the United States of America, British Columbia, and elsewhere, there is also much loss owing to fine gold.

Next we have the truly refractory quartz, which is quartz associated with much iron pyrites or other sulphides, but usually with iron or arsenical pyrites. Many of these cannot be worked at all by amalgamation, for not only does amalgamation fail to extract the gold, but the mercury is itself fouled and carried away. These refractory ores are often solid pyrites, and contain no amalgamable gold whatever; at other times they contain a certain proportion of the gold in a coarse and amalgamable form, and I have found this to be most frequently the case when they are not solid pyrites, but quartzes with a considerable proportion of pyrites present. I have seldom found ores of this class to contain much float or fine gold, and this has a very important bearing on their economical working, for these ores, which are an admixture of quartz and pyrites, can be crushed and concentrated before treatment with little or no loss, practically the whole of the gold, both coarse and that contained in the pyrites, being found in the concentrates. In this way the cost of working is greatly reduced, for in place of having to chlorinate the whole bulk of the stone, you have only to treat the concentrates obtained. It is ore of this class which is to be found in Wales, and owing to the cheapness of operating in this way, comparatively poor ores may, in my opinion, be made to yield a handsome profit. I have here a specimen of rock impregnated with pyrites, which assays only 3 dwt. of gold per ton, but by crushing and concentrating by jigging, 10 tons of ore yield

1 ton of concentrates, assaying $1\frac{1}{2}$ oz. of gold per ton, besides copper and silver, and if desired, by finer crushing and more careful concentration, 30 tons of stone may be made to yield 1 ton of concentrates, assaying about 3 oz. of gold per ton, besides copper and silver, and these concentrates may then readily be worked by hydraulic chlorination, which secures practically the whole of the gold, silver, and copper present. With this system of treatment I shall not be surprised if Wales becomes a very profitable field for gold-mining enterprise, and certainly the discovery of gold in Wales offers great facilities for thoroughly testing new methods of treating refractory ores.

In Queensland there are large quantities of rich auriferous pyrites which also contain considerable quantities of copper easily extracted along with the gold. I have here two specimens, the one from Ravenswood Mine containing 2 oz. gold, 2 oz. 5 dwt. silver per ton, and 4 per cent. copper; the other, from Bethanga Mine, containing 2 oz. 14 dwt. gold, 1 oz. 10 dwt. silver per ton, and 3.1 per cent. copper. In the Transvaal, as I have already explained, the ores at present worked are for the most part of the float gold character, but there also vast quantities of auriferous iron and arsenical pyrites which have not as yet been touched, except in a few cases, for the very good reason that the gold cannot be extracted by amalgamation, and mines of this class which have been opened up have in almost every case been subsequently abandoned, though I know of one that is still lingering in a precarious condition. There they have arsenical pyrites assaying about 2 oz. of gold per ton, but they cannot get enough out to make it pay, extracting as they do only about 6 or 7 dwt.

To treat ores by hydraulic chlorination the ore is first crushed to about the fineness of fine sand, that is, to a fineness which would pass through wire gauze of about 25 mesh to the linear inch, and it is very desirable in crushing the quartz to use machinery which will produce as little fine dust as possible, otherwise the filter is apt to get choked in the subsequent operations. After crushing, the ore is when necessary roasted, the object of which is to remove the sulphur and convert the iron into anhydrous ferric oxide, in which state it is not acted on by chlorine, and to leave the ore in a porous or sponge-like condition. With float gold quartzes it is often quite unnecessary to roast. I have here a number that will chlorinate just as well without roasting, viz., Sheba tailings, Reliance reef quartz, Dutch Guiana quartz, and concentrated river sand from Assam. On the other hand it is often desirable to roast float gold ores though they may contain no pyrites, for if the iron oxide be hydrated the chlorine acts on it, and either you must add more chlorine or roast, whichever is the most economical under the circumstances. With pyrites ores roasting is at all times absolutely indispensable, and I venture to assert that there is no other chemical process that could successfully deal with these ores without roasting. When copper, lead, zinc, &c., are present in the pyrites, a small proportion of salt is added in the roasting so as to chlorinate these metals in the furnace, and thus prevent them consuming chlorine in the subsequent operation, for though anhydrous ferric oxide is not affected by chlorine the oxides of these metals are readily dissolved. For the purpose of roasting any suitable furnace may be used, provided always that the ore is kept well mixed and the heat is regular and does not rise much above a dull red. Perhaps the revolving furnace is the best for economical working, but those used by the Tharsis Copper Company for calcining copper ores are perfectly suitable.

After the ore is properly roasted it is allowed to cool, or partially cool, and placed in revolving cylinders in charges of about $1\frac{1}{2}$ tons at a time with about 1 per cent. of bleaching powder, and $1\frac{1}{2}$ per cent. of bisulphate of soda, these being added the one before the other and after the ore to prevent the liberation of chlorine before revolving the cylinder. As soon as the ore and reagents are placed in the cylinder the cover is screwed over the charging aperture and the valve on the hydraulic supply pipe opened, when water rushes in from the accumulator or pump, the air escaping from the cylinder by a valve placed on the top for that purpose. When the cylinder is full the air escape is closed and the cylinder revolved, the accumulator or pump exerting a

steady pressure throughout the whole operation. The hydraulic pipe does not interfere with the rotation of the cylinder as it passes through the centre of rotation, to one end of which it is connected by a packing box that keeps the pipe perfectly tight, but leaves the cylinder free to revolve. Inside the hydraulic supply pipe and immediately beyond the packing box is placed an automatic rubber valve which is made like a cone slit at the top and placed pointing into the cylinder; through this the water can enter freely, but it prevents ore and solution from finding its way out of the cylinder into the pipe. The object of removing the air from the cylinder is that any air present acts detrimentally in absorbing part of the chlorine, and this chlorine not being in solution is utterly valueless for the purpose of chlorinating gold. It is quite a mistake to think that by pumping more air into the cylinder the amount of this useless excess of chlorine would be in any way diminished, for, as is well known, by Dalton's law one gas is a vacuum to every other gas. If you have a given volume of air with a quantity of chlorine diffused through it, you might pump in more air until you burst the containing vessel, but you would never liquefy a single drop of that useless chlorine or drive it into solution, for though the liquefying point of chlorine is about 60 lb. per square inch, it must be remembered that that only means that chlorine liquefies when the pressure of its own vapour is 60 lb. and not when other gases with which it happens to be mixed are at 60 lb. By use of hydraulic pressure the whole of the chlorine present is retained in solution, and the high pressure rapidly forces this strong chlorinating liquid into the pores of the ore. When the chlorination is completed the hydraulic pressure is shut off, the excess of chlorine blown out, and the ore and solution discharged on a suitable filter, the liquid being rapidly filtered through and delivered into tanks by means similar to those practised for many years in most gold and silver works in America, and fully described in Egleston's book on gold and many earlier publications; or if preferred the filtration may be accelerated by means of a vacuum pump, as is done in many alkali works in this country (first patented by Spencer in U.S.A., 4th June 1867). For practical working, however, I prefer the American plan of using a steam ejector. The gold is then precipitated in the tanks in which the solution is collected, by means of ferrous sulphate or other suitable precipitant. After settling for 12 hours the clear liquor is run off through charcoal filters, which serve to arrest any gold that has not completely settled; then more liquors can be run into the tanks, and these in their turn precipitated on the top of the last, and so on until sufficient precipitate has accumulated, when it is collected, dried, and fused. In like manner the charcoal filters are occasionally cleaned out, the charcoal being burned and the contained gold collected.

When ores contain copper, silver, lead, zinc, or lime; or if you have complex ores partly float and partly coarse gold, or partly pyrites gold and partly coarse gold, various modifications are introduced for the most economical treatment of these, but time will not permit my entering into detail. I may add that recently I have made a number of improvements in the process which greatly add to the ease in working, and which make our machinery cheaper, lighter, and if possible more simple, and I have now made the process applicable to the few ores with which I had formerly some difficulty. Needless to relate these improvements are or will be secured by patents.

I think I am within the mark in stating that at the present moment I can treat almost any ore in existence at a cost of about 6s. 6d. per ton in Glasgow, guaranteeing an extraction of 95 per cent. of the gold present.

DISCUSSION.

MR. ELLIS said he would like to ask Mr. Pollok how much chlorine there was in the liquor after it came away from the cylinder; what amount of sulphate of iron was used for precipitation, and what quantity of ore was put into the cylinder?

MR. ROTTENBURG asked what was the proportion of liquid to ore in the cylinder; what time the filtration took; what weight of ore had been practically treated; and what would be the cost of roasting the ore in the Transvaal?

MR. RÖDGER said that Mr. Pollok had stated that 6s. 6d. per ton of ore was the total cost of treatment. That, he presumed, referred to quartz ores only, for it would be impossible to roast refractory ores for that sum.

MR. PLAYFAIR said the ores that derived their value from the gold were mostly free-milling ores, and there was no difficulty in treating these, but it was different with the refractory ores, because they sometimes contained a larger value of silver than gold. He would like Mr. Pollok to have gone further into that matter in his paper. Would Mr. Pollok say if he had ever tried manganese ores?

THE CHAIRMAN said that the next generation would probably see a large development in wet processes, not only for gold, but other precious metals. He could not understand how it was possible to extract the gold from the ore properly by amalgamation.

MR. POLLOK, in reply to Mr. Ellis, said that roughly speaking there was about half the chlorine left in the liquor after it came from the cylinder, that about 1 per cent. of sulphate of iron was used for precipitation, and that about $1\frac{1}{4}$ tons of ore were put into the cylinder at a time. In reply to Mr. Rottenburg he stated that there were about equal volumes of liquid and of solid in the cylinder. The total amount of liquor used for each charge, including washing, was about 40 cubic feet, and the volume of loose ore thrown into the cylinder was 25 to 30 cubic feet. The time for filtration, if the ore was not too finely crushed, was about half an hour. About $1\frac{1}{2}$ cwt. had been practically treated, and of a heavy ore about 2 cwt. at a single charge. The cost of treating the ore in the Transvaal he thought would be from 20s. to 24s. per ton.

As to the charge of 6s. 6d. per ton for treatment in Glasgow, one point had to be taken into consideration in that connexion. There the sulphur could be sold, but abroad the sulphur could be burnt off in the open air without any serious trouble from the authorities, and accordingly they were roasted in open hearths at a very low cost. Replying to Mr. Playfair, he said he had used the usual processes for the extraction of silver, and had not had an opportunity of trying manganese ores. He had not found it to be the case that refractory ores generally contained more value in silver than in gold.

A SHORT ACCOUNT OF THE OPIUM INDUSTRY IN THE N.W. PROVINCES AND OUDH.

BY T. A. WEIR, M.B.

AT the request of the Secretary I have compiled, for the information of the Section, the following notes, the greater part of the material of which already exists on record, for the most part, however, in the official publications of the Governments of Bengal and of India, which are not perhaps within reach of many in this country.

The opium poppy is a native of Asia Minor, but having been so long and generally cultivated in Europe and parts of Asia, it is now naturalised less or more in many different countries. The precise date of its introduction to India is unknown, but it can be traced as far back as the 16th century, during the latter half of which the produce of the opium monopoly in the sarkars of Allahabad and in Ghazipur was 1,000 chests, according to the A'in Akhbar of Abul Fazl. It had attained considerable importance by 1786, at which time Lord Cornwallis wrote a minute respecting the best method of deriving a revenue from opium. It has now been long extensively cultivated in the Upper Gangetic plain, in Behar, Bundelkhand, and Malwa. "The area under poppy cultivation in the N.W. Provinces and Oudh is scattered over 38 of the 49 revenue districts in these provinces, and occupies more than $\frac{1}{4}$ million acres, and necessitates the employment of no less than 2 $\frac{1}{2}$ millions persons in the fields." For the Chinese market the opium

of the Behar and Benares agencies is commercially the best, as being the most approved by the Chinese, although *officially* it is inferior to the Smyrna drug.

The cultivation of opium in India in British territory is a Government monopoly, existing for the benefit of the Imperial revenue. The Opium Department is for convenience administered, under the Lieutenant-Governor of Bengal, by the Board of Revenue of the Lower Provinces. Subordinate to the Board are the two opium agents, each of whom is in charge of one of the two opium agencies. One of these is the Behar agency, with its headquarters at Patna, and situated entirely in the Lower Provinces. The other is the Benares opium agency, situated in the N.W. Provinces and Oudh, and having its headquarters at Ghazipur, on the Ganges, about 40 miles from Benares. In each agency there are under the agent two sets of officials, the district officers concerned with the production of the raw material, and the factory staff occupied in its manufacture.

The system of cultivation at present in force in British territory is briefly as follows:—No poppy is allowed to be grown save with the permission of Government. Government grants this permission to suitable cultivators on condition that only a certain definitely agreed-on area of land shall be sown by each with poppy, and that the entire produce shall be made over at the proper time to the agents of Government in exchange for its value in cash calculated at the rate (at present) of Rs. 5 per ser of 70³ consistence. (70³ consistence opium is opium of which 100 grms., when dried at 100° C., yield 70 grms. residue. Opium of this consistence is called standard opium.) Permits or licenses to grow poppy are issued in the period from August to October, at which time the district officers meet the would-be cultivators or their agents and settle more or less directly with each the area he is to be allowed to cultivate. The experience of many seasons, as recorded in the books of his office for each locality, enables a district officer to estimate very closely the average quantity of standard opium that the particular area licensed to any cultivator is likely to produce. In this way the district officer is able to keep within the limits of the quantity his district has been called on to supply, which quantity in turn is based on the indent sent down by Government to the agent, and by him apportioned among the districts under his charge. At the time of settlement the district officer makes to the cultivator a cash advance of a certain percentage of the value of the out-turn of standard opium that the area he has undertaken to cultivate is estimated to produce. For such advances, and for similar advances towards the purchase of bullocks, the sinking of wells, &c., and aggregating over 200 lakhs of rupees (nominal two million pounds sterling) per annum, no interest is charged by Government, the cultivator enjoying the use of the money free. The advances are in due course recovered in the shape mainly of produce, the balances being paid up in cash, and outstanding of any size are little known.

Having settled with the district officer, and been licensed to sow a certain area, the cultivator returns home and prepares his land, and makes other necessary arrangements, and in due course, about November, he commences to sow his seed. During the growth of the plant, the industrious cultivator takes care to attend to its proper tillage, watering it at the proper times, and keeping the ground free from weeds.

During this season the district officer with his staff goes on tour throughout the area under his charge—which may measure many hundred square miles—in order to measure the ground cultivated by each licensee for the purpose of seeing that he has sown up to his engagements (on which his advances were calculated), and not in excess of his engagements (as this would throw out the arrangements for complying exactly with the indent sent down by Government); to see that the cultivation is being carried on in a proper manner (the plant being watered as required, and the soil kept clear of weeds), and that no other crops are being simultaneously cultivated in the poppy field; to give, if necessary, a further cash advance on account of the value of the estimated out-turn; to see that no illicit poppy cultivation is being practised (which would lead to

smuggling, and to the defrauding of the Excise revenue); and to report, periodically, to the agent on the general prospects of the crop.

About the beginning of February the plants begin to flower. At this time is begun in certain districts the preparation of "leaf." "Leaf" is the technical name for the material used at the factory to form the shell of the opium cake in course of provision for the China market. About the close of the third day of the flower's expansion the petals are in such a stage of maturity that they are ready to drop off the top of the seed-vessel at a touch; at this stage the cultivators go through the fields in the afternoon, and collect the petals or carry them home. In the evening, after she has basked her husband's hammock, the cultivator's wife takes two or three handfuls of the petals and throws them on the top of the hot griddle-iron, and as the gummy juice of the petals exudes by the heat, she presses the petals down by a damp cloth which she skilfully manipulates, until what with the steam from the cloth, and the gum in the leaves, the petals become agglutinated, and ultimately take the pancake-like form of the so-called "leaf." The leaves are carefully dried, and are in due course brought by the cultivator to the district officer, who receives them on behalf of Government, and pays for them according to their quality, at from Rs. 10 to 5 a per maund (of 82½ lb.), and forwards them to the factory at the headquarters of the agency for disposal.

The annual consumption of "leaf" in the preparation of the shells of the provision of opium for the China market is very large—amounting to from 16 to 20,000 maunds—representing the petals of over 5,000 million flowers according to Scott's calculations.

In the course of from 7 to 10 days from the fall of the flower leaves, the capsules are sufficiently mature for the extraction of the drug, becoming plump and firm, and coated with a fine whitish bloom.

The incisions are now commenced, and are carried on regularly every third day, and according to the condition of the plant, and the time of the collection, the number of lancings required to extract all the juice varies from one to five or six, and perhaps seven in isolated cases. The lancing is carried on in the afternoon, and consists of three or four vertical incisions performed at one operation by three or four primitive lancets tied together with cotton thread. The juice exudes slowly, and is milky white at first, the outer part of the tear gradually changing to a pinky salmon colour. Next morning the tears that have exuded are scraped off by an iron trowel-shaped scraper and put into a metal dish, from which at the cultivator's house they are transferred to unglazed earthen vessels set afloat to allow excess of watery matter and pasewa to drain off. The aggregate of the drug belonging to a cultivator is kept in a shady place in his house, and carefully treated so as not to injure the grain, but to allow the consistence to rise evenly until it has reached the desired degree. The opium is then brought to the district officer at the appointed time and place, and he receives it over by weight on behalf of Government, and transmits it to the factory in jars containing one maund (82½ lb.) each, paying to the cultivator a further advance on its value according to his estimate of its assay. The annual amount of opium delivered in the two agencies amounts to perhaps 107,000 maunds at 70³ (equal to about 3,900 tons, and for which the cultivator would receive Rs. 2,14,00,000, nominally 2½ million pounds sterling).

After the collection of the opium has ceased the plants are allowed to remain standing in the fields till the capsules are quite ripe; these are then collected, and the plant leaves when dry are, in certain districts, gathered and sent into the factory under the name of *trash*, to be used as dunnage in packing the provision opium for China. Trash is paid for in the Benares agency at about 10 annas per maund. The annual out-turn of trash in the two agencies is more than 28,000 maunds.

The opium on arrival at the factory is, after weighing, examined jar by jar by the opium examiner, who certifies to its quality and purity. It then has its consistence determined for each jar by assay on the steam table, and

according to its consistence it is stored away in one or other of the extensive ranging store vats in the malkhana or storehouse, some of which hold 3,000 maunds. The final payments to the cultivators are made according to the value of the opium as determined by its consistence on assay at the factory.

When a sufficient quantity of suitable opium has been received into the factory, the manufacture of the provision of opium for the China market is commenced. The provision is caked at the consistence of 70°, to this end quantities of opium of consistencies above and below 70° are alligated or mixed together in certain proportions so that the mean consistence of the mixture may fall within the limits allowed. Before issue from the caking vats the opium in them is assayed for consistence to ensure that it does not fall below the caking standard laid down by Government.

For each "cake" there are served out the equivalent of a certain weight of standard opium for the central mass, together with a certain measure of "*lewa*," the equivalent of a fixed weight of standard opium. *Lewa* is a paste made of opium broken up in water, and is of 52·5° consistence. For each cake is also issued a certain weight of leaf, which is previously damped to make it flexible and non-friable.

In a hemispherical brass cup of about 6 in. diameter, the cakemaker pastes layer after layer of pieces of leaf which he gums together with *lewa* until the thickness of the hemisphere of shell in the cup is $\frac{1}{2}$ in., and over the edges of the mould he allows the free ends of the pieces of leaf in the cup to hang. The opium is then deposited in the centre of the hemisphere of shell in the cup, and over it the overhanging leaves are brought and carefully imbricated and pasted down with *lewa*, and bound together by fresh portions of leaf, and finally over all one of the finest leaves is pasted on and a complete sphere results. This is turned out of the cup and covered half-way up with "trash," which prevents its sticking to the inside of the porous earthenware cup into which the cake is now put. The cup and cake are put on a shelf in a well-ventilated warehouse. Caking goes on from May till July at the rate of about 20,000 cakes per diem. The cakes remain on the racks till they are fit for packing, and each cake is periodically turned about in the cup so that it shall dry regularly and evenly, and preserve its spherical shape.

Packing begins about the middle of November. Previous to the commencement of the season's packing the chief civil officer or magistrate of the district visits the factory and selects at random out of the whole stock of provision in the factory six cakes for analysis; two are retained at the factory, two sent to the sister factory, and two go to the chemical examiner to Government at Calcutta. The results of the analysis of each of these three sets of two cakes (in terms of their morphia, narcotine, and smokeable extract) are put on the table at the first sale of the season's opium, for the information of the merchants.

Packing is carried on in fine weather only, and is not practicable in damp, cloudy, or rainy weather. 20,000 cakes are packed daily in 500 chests, 40 cakes in a chest, the damage used being the "trash" already described. 500 chests a day are daily despatched from the factory en route for Calcutta, where they are stored in large warehouses under the charge of the Board of Revenue, by whom a certain number are exposed for sale each month on account of the Imperial Government.

The opium intended for Indian consumption is not made up into balls of 70° consistence; it is exposed in the sun in shallow trays until it has become inspissated to a consistence of 90°, at which point it is melted into cubical cakes of 1 ser, each of which is smeared with poppy oil and packed in two layers of bamboo paper. The cakes are then packed in sixties in mango-wood chests, which are distributed as required to the different treasuries of the N. W. Provinces and Oudh and Central Provinces.

Opium, which on examination at either factory is found to be adulterated or otherwise unfit for manufacture, is confiscated, and the morphia and codeia in it are recovered in the laboratory department of the Ghazipur factory

Narcotine used also to be recovered; the demand for it has, however, now almost entirely ceased, and it is no longer prepared at Ghazipur.

"The cultivation of the poppy is popular amongst our cultivators . . . the certainty of receiving a fixed price for their opium, the payment of advances without interest at periods at which the Asámis are generally hard pressed for funds; the obtaining high prices both for the poppy petals and leaves; the getting advances free of interest for wells and frequently for purchase of bullocks; and the remission of all the advances outstanding if their crop has been destroyed by hail: these advantages and the large profits derived from opium attach the Asámis to the cultivation and make it popular. Hindoos of all castes, from Brahmans down to Chamars, and Mahomedans, too, cultivate poppy, but the Koeri caste are our best cultivators."—(Turnbull.)

In one year, for an actual cultivation area of 899,287 highas (562,054 imp. acres), cultivated by 1,448,508 Asámis, the out-turn of opium at 70° consistence was 107,577 maunds (3,952 tons), for which were paid to the cultivators in hard cash Rs. 2,15,15,400 (2½ million pounds sterling nominal), besides which 19,872 maunds of leaf and 28,773 maunds of trash were supplied and paid for.

In the same year there were turned out (from confiscated useless opium)—

	Lb.
Codeia.....	34
Morphia acetate.....	34
" hydrate.....	282
" sulphate.....	17

DISCUSSION.

The CHAIRMAN said he would be obliged if Dr. Weir would tell the meeting: What was the amount of morphia in the opium? Was the leaf that had been shown round—and which he presumed was a collection of poppy petals—used for any other purpose than covering the opium? Did the said leaf contain any morphia? A curious fact he had noticed was that the red poppy which was so common in the fields in this country, and which bore such a strong smell of opium, did not contain morphia. Why did a Chinaman prefer to smoke opium that contained little or no morphia?

Dr. WEIR, in reply to the Chairman, said that the amount of morphia in the opium was from 2 to 5 per cent.; that the leaf referred to was not used for any other purpose than covering the opium, and that it did not contain any morphia. The Chinaman preferred to smoke opium that contained little or no morphia because if not used to excess it would do him no harm.

Obituary.

Dr. JOHN PERCY, F.R.S.

SCIENTIFIC metallurgy in this country has lost its most distinguished representative by the death of Dr. Percy, which occurred at his house in Bayswater on Wednesday, June 19. Born in 1817, the son of a Nottingham solicitor, John Percy was placed at an early age in the medical school of the University of Edinburgh, where he took his degree of M.D. at the age of twenty-one. At Edinburgh he was the pupil of Sir Charles Bell, and a fellow-student with Edward Forbes. Dr. Percy also studied in the medical schools of Paris, and while in France undertook a botanical tour in the Pyrenees. He established himself in practice in Birmingham, where he became physician to the Queen's Hospital. While there he carried on some remarkable researches on the effect of alcohol on the animal economy, and in 1845 read before the British Association some "Contributions to the Chemistry of Diabetes." His residence in Birmingham led him to

take much interest in the chemical principles involved in metallurgical operations; and when the Government School of Mines was established in 1851, De la Beche selected Percy for the post of lecturer on metallurgy, a position which he held for twenty-eight years. Abandoning the practice of medicine, he settled in London, and devoted himself to scientific research, taking special interest in the early development of photography. His great object, however, seems to have been the production of an exhaustive treatise on metallurgy, and after years spent in the accumulation of material, his first volume was given to the world in 1861. This dealt mainly with the subjects of fuel, copper, and zinc. It was followed in 1861 by a voluminous treatise on iron and steel, and in due course other volumes appeared, dealing more or less completely with lead, silver, and gold. But this great work—the worthy object of an active life—was destined to remain incomplete, and after his retirement from the Royal School of Mines in 1879 its completion became practically impossible. So widely, however, was its value recognised, that the successive volumes as they appeared were translated into both French and German. In 1877 the Iron and Steel Institute recognised Dr. Percy's services to metallurgy by the award of the Bessemer medal; and only shortly before his death he held the Presidency of this Institute, and, notwithstanding his failing health, discharged the duties of the chair with characteristic ability. Up to the time of his death he was superintendent of ventilation in the Houses of Parliament, a position which gave him an extensive acquaintance among the members. Dr. Percy was a man of great force of character and versatility of tastes; a writer in command of a vigorous and pure style of English, a lecturer of power and popularity, and a teacher deeply respected by his students. For more than a quarter of a century Dr. Percy practically directed all the metallurgical teaching in this country, and nearly every assayer of scientific reputation had passed through his laboratory. It is understood that he leaves behind him large collections of metallurgical specimens, objects of natural history, and works of art. What will become of them we do not know, but they will not go to South Kensington.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements in Boilers or Vessels Lined with Lead or other Acid-resisting Metal or Alloy. I. S. McDougall, J. T. McDougall, R. K. Hartley, and T. Sugden, Oldham. Eng. Pat. 7061, May 11, 1888. 8d.

This invention is concerned with improvements in the methods of securing the lining to the external shell of boilers and vessels to be lined with lead or other acid-resisting metal, so that no parts which can be injured by the acid are exposed to its action. For this purpose,

holes are made in the shell through which portions of the lining are passed. A cover, also of lead or other acid-resisting material, is placed over each hole, and is there secured to the shell by means of a disc or cover and suitable fastenings not exposed to the interior of the vessel. Four different modifications of the cover and mode of securing it are described, for details of which the drawing attached to the specification must be consulted. The improvements are protected by two claims.—E. S.

Improvements in Tubular Vacuum Pans. F. W. Scott. London. From A. Freitag, Amsterdam, Holland. Eng. Pat. 8064, June 1, 1888. 8d.

In the lower part of a vertical vacuum pan (preferably cylindrical) are arranged three chambers, of varying depths, one above the other. Each is provided with through-tubes fixed in tube-plates, forming the top and bottom walls of the chambers, which are united to the shell by angle-irons. The upper faces of the tube-plates slant down towards a large central passage for discharge (thus making the chambers annular in form). By means of pipes steam can be admitted, say from the bottom of the pan, to any or all of the chambers, or from one to the other, as may be desired. One side of each chamber is provided with an enclosed gauge-glass, or pane, by which the contents can be observed. In boiling sugar or syrup, this separate-heating system forms a strong coarse grain with a "low depth of juice." There are four claims.—E. S.

Apparatus for the Absorption of Gases. F. Carlisle, Franklin, and C. E. Hoffman, Jersey City, U.S.A. Eng. Pat. 293, January 8, 1889. 8d.

A CHAMBER contains a series of "conductors" which are slightly inclined, to promote the flow of the absorbing fluid along them. Each conductor is provided with a small open receptacle at its upper end, the receptacles of each series being placed alternately at the right- and left-hand ends, and the fluid is caused to flow along the under side ("as it is often seen to do on the under side of sloping roof beams when the roof leaks") to the lower end of the conductor, where it is directed by a lip into the receptacle of the next series, and so through the whole system. The fluid is supplied to the uppermost receptacles by a pipe from a tank, and finally drips from the lower ends of the last series of conductors into a tank. The gas to be absorbed enters at the bottom of the chamber, and by the arrangement of the conductors is divided into films, forced to pass between and beneath the whole series of conductors, and passing through a pipe in the upper part of the chamber can be again returned to it, to render its absorption by the fluid more complete. Five claims are made.—E. S.

Improvements in or connected with Filter Presses. J. A. Drake, Maidstone. Eng. Pat. 3681, March 1, 1889. 8d.

SAND or other filtering medium is placed in any number of horizontal metallic trays, each with a central boss, "and mounted on a hollow or fluted vertical spindle, so that each tray rests on the boss of the next one, and is kept apart according to the thickness of the filtering substance." Each tray is also provided with lateral slots for the reception of the liquid to be filtered, which is admitted through an inlet pipe in the base plate, whilst outlets in the boss allow the filtered liquid to flow down the spindle into an outlet pipe at the bottom of the press. The whole series of trays is enclosed in a casing which can be raised by suitable machinery when it is necessary to remove the filtered substance, which is done by rotating arms fixed on a vertical shaft at a distance apart corresponding to the space between the trays, and actuated by any mechanical means, the trays being at the same time caused to revolve slowly. The improvements are protected by three claims, and are illustrated by two drawings.—E. S.

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Rander Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	1d.
Above 8d., and not exceeding 1s. 6d.	1d.
" 1s. 6d., " " 2s. 4d.	1½d.
" 2s. 4d., " " 3s. 4d.	2d.

II.—FUEL, GAS, AND LIGHT.

On Smoke, its Formation, Prevention and Removal.
F. Fischer. *Zeits. f. angew. Chem.* 1889, 213—216.

THE burning of coal gives rise to more smoke than is the case with wood, turf or lignite, on account of the greater cooling effect of fresh additions of the fuel on the fire, and the solid particles composing the smoke diffusing less readily than a pure gas with the incoming air tend to escape unconsumed in their passage over the fire. Smoke seldom consists only of soot, but is usually contaminated with tarry matter which gives to the soot an unpleasant smell and a stickiness which causes it to adhere to the place on which it falls. On this account brown smoke can be a greater annoyance than the black variety. Of the numerous proposals for smoke prevention, those for removing the smoke by so-called soot-catchers or by washing the chimney gases can only lessen the annoyance to the neighbourhood, but do not prevent the loss of heat arising from soot deposits in the boiler flues. The introduction of air behind the fire is mostly prejudicial, as it only cools the mixed gases. A better plan is to conduct the smoky gases through a glowing hot brick grating. The more correct method of procedure is to prevent the formation of smoke by introducing the fuel continuously and moving it forward automatically at the same time that a movement of the firebars secures a passage for a regular supply of air. But the only perfect solution of the smoke question lies in the adoption of gas firing and gas engines, for which water-gas appears to be the only practical means at present.—G. H. B.

Thickening of Tar in the Hydraulic Main. H. Langen.
J. für Gasbeleucht. 32, 311—312.

THE author has previously drawn attention to the fact that the seal in the hydraulic main produces very considerable variations of pressure in the retort. The gas first drives out the liquor in the dip-pipe, and then forms a large bubble at the mouth of the pipe, the pressure in the retort being thereby increased. As soon as the bubble has attained a certain size it rises to the surface, forming, temporarily, an open channel between the retort and the hydraulic main, so that the pressure in the retort is again diminished; eventually the liquor again rises in the dip-pipe and the whole process is repeated. Distillation takes place, therefore, under a pressure which varies constantly between nil and a maximum, the latter being generally considerably greater than that due to the seal alone. Diminished production and partial decomposition of the heavier hydrocarbons result; the carbon thus produced is partly deposited as graphite on the walls of the retort and partly deposited in the ascension-pipe. During the rise of the liquor in the dip-pipe the gas either ceases to move or there is a backward movement favouring the accumulation of tar and graphite in the ascension-pipe; the area of the latter is consequently diminished, causing a further increase of pressure in the retort and greater decomposition of the heavier hydrocarbons. Some of the carbon also collects on the interior of the dip-pipe, diminishing the area and causing increased pressure. The remainder of the graphite mixes with the tar in the hydraulic main, making it much denser, and the heavier particles sink to the bottom, where they gradually accumulate and may ultimately reach the mouth of the dip-pipe.

In order to distribute the gas over a much larger surface of the liquor in the hydraulic main, the author recommends the following arrangement:—The dip-pipes are not cast in one piece with the bridge or H-pipe, but hang vertically in the hydraulic main on to the cover of which they are fastened with screw bolts. They are 25 cm. in internal diameter, 80 cm. in circumference, and 4.9 sq. dm. in area, whereas those usually employed at the present time are 12.5 cm. in internal diameter, equal to an area of 1.22 sq. dm. The equal-limbed bridge-pipe is provided with two self-closing eccentric pressure covers for cleaning purposes; it is, on the average, 15 cm. in internal diameter, the connecting pipe being generally even larger. By this

arrangement the pipes have all the same dip, and their area is increased four-fold, so that only one quarter of the gas produced comes into contact with a given surface of the liquor, and the surface of gas exposed to washing is double what it was before. The variation of pressure in the retort is in this way considerably diminished.

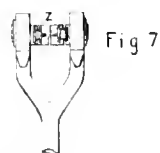
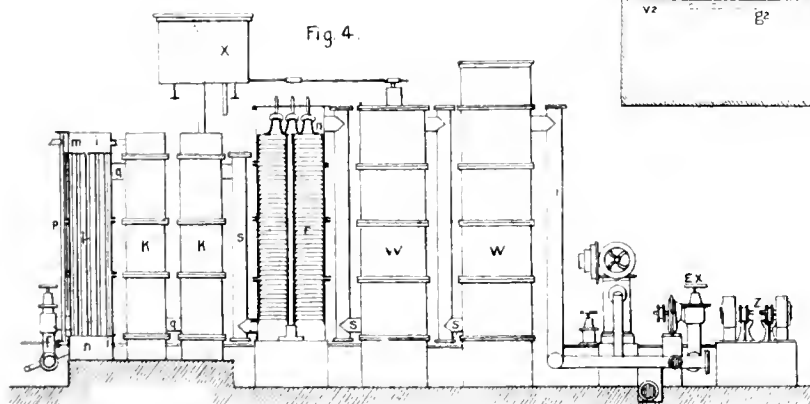
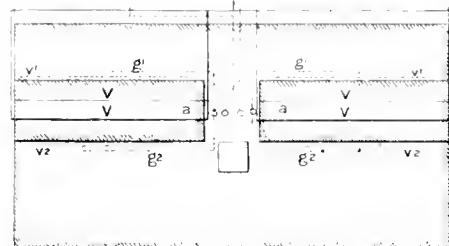
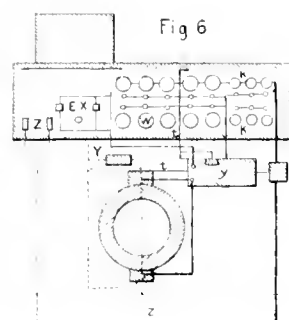
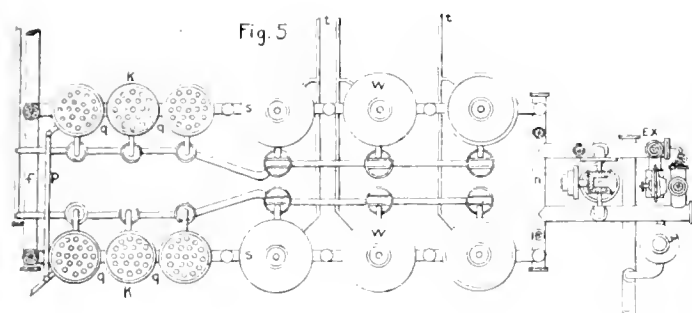
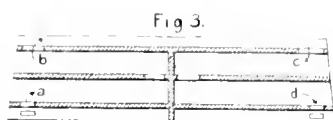
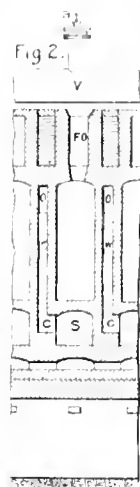
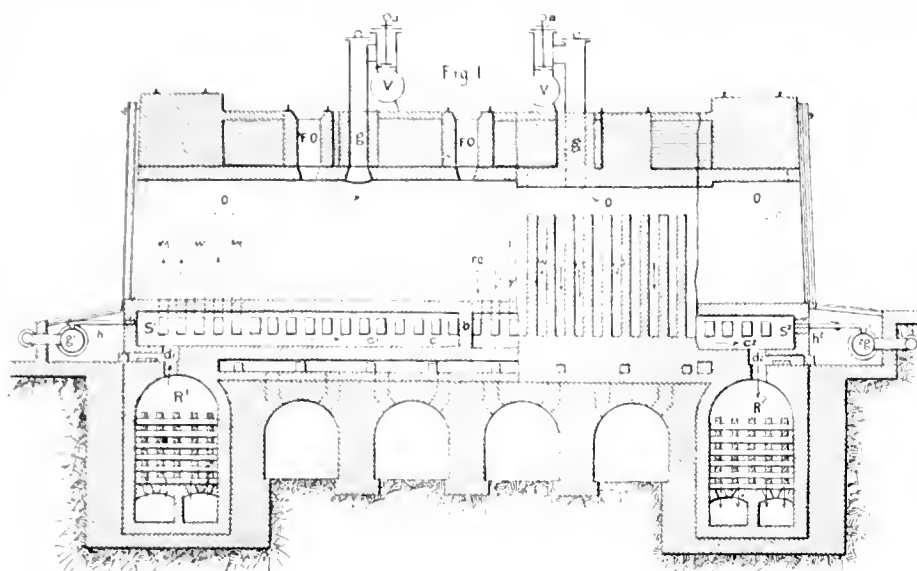
The thick tar can be readily removed during working by an arrangement which can be easily adapted to any existing hydraulic main. At one end of the hydraulic main the cover is removed and a small tank of the same shape as the main is screwed on with bolts. The tank is open above and is in direct connexion with the tar by means of an opening below. A screw is placed longitudinally at the bottom of the hydraulic main, and rests in thrust-blocks placed at opposite ends of the tank. Its axis projects into the tank and is there connected with a driving wheel by means of bevel-gearing. It is also provided with a chain and bucket arrangement, the number of the buckets being regulated according to circumstances, and in this way the tar is emptied into a small tank from which it runs directly by a large, inclined pipe to the tar well. The machinery is worked at stated intervals by hand, or continually by steam power, and the thick tar is thus removed as fast as it is formed, so that only liquor and light tar remain in the hydraulic main. With this arrangement the level in the main can be kept constant or the seal can be entirely taken off during carbonising.—F. S. K.

Heating Gas. L. Meyer. *Ber.* 22, 883—885.

To facilitate calculations of heat of combustion from the percentage volumes of a combustible gas, the author proposes the following method:—As the molecular weights of all gases in grams occupy 22.312 litres at 0° and 760 mm., suppose a gas contains the fraction x volume of a constituent. By multiplying the fraction x by the molecular heat of combustion of the gas, the number obtained is the heat of combustion of that gas in 22.312 litres of the mixture. If this be repeated for each constituent and the total divided by 22.312, the heat of combustion of 1 litre of the gas is obtained.—J. B. C.

The Development of the German Coke Industry. Dingl.
Polyt. J. 271, 444—452.

IN this paper various forms of modern coking ovens are considered as regards their efficiency and ease of working. W. Jicinsky (*Oester. Zeits. f. Berg und Hüttenwesen*, 1888, 530) describes in detail a coke furnace of the type first introduced by Hoffmann, in which the gases and air for combustion are subjected to a preliminary heating by means of a Siemens's regenerator. The oven in question is employed in the manufacture of tar and ammonia. Its dimensions are 10 × 1.6 × 0.5 m., and the charge is from 3,500—4,000 kilos. The interior of the furnace (Figs. 1 and 2) communicates by means of the tube g and valve a with the main V . The latter ends in a tube which leads to the reservoir for the tar and ammonia, about 1 m. underground. The circulation and exit of the gases take place through the tubes g , V , &c. to the ammonia holder, suction being applied by means of the exhauster E X (Figs. 5 and 6). The gases are then collected in a gasometer. A large portion of the gases is carried back from the gasometer to the oven, through an underground pipe which ends in the tubes g_1 and g_2 (Figs. 1 and 2) running parallel to the ground channel S_1 and S_2 , and on the same level. These two tubes are provided with as many gas-taps h_1 and h_2 as there are ovens. By this means the gas can be forced into the ground-channel. The ground-channel is divided in the middle by a partition b , which is perforated on one side next the furnace wall by as many holes c_1 and c_2 as there are vertical channels w_1 and w_2 in the side of the oven. All the vertical tubes w_1 and w_2 end in a common gas-main O . R_1 and R_2 are the two generators. They are 2 m. high and 1 m. broad, and are placed parallel to the gas-pipe g_1 and g_2 , and communicate by means of the openings d_1 and d_2 with the ground passages S_1 and S_2 . Each generator has as many openings d as there are ovens. They also communicate on one side with an air injector by



means of V , v_1 , and v_2 (Fig. 6), and on the other side with the coke-oven grate E . The generators are filled for two-thirds of their height with fire-bricks, so that a large surface is exposed to the gases. The injector Z (Figs. 4, 5, 6, and 7) forces a certain quantity of air alternately through each generator, so that the gases used for heating may be burnt. In the working of the oven the gases coming from the ammonia reservoir are passed only through the tube g_1 and from thence as much gas is allowed to enter the ground-channel S_1 through h_1 as is necessary for the heating of the oven. Simultaneously with these gases, hot air at 1,000° C. enters the ground-channel S_1 from the generator R_1 through the opening d_1 . At the high temperature the mixture of gases is completely burnt, and passes while burning through C , and the vertical passages w_1 into the gas-tube O (Figs. 1 and 2). From here the gases pass through w_2 and v_2 (Fig. 1) into the ground-channel S_2 , and from thence through the generator R_2 to the grate of the oven. During these operations the taps h_2 and the air tubes v_2 leading to the generator R_2 are closed. After about one hour the proper valves are opened and closed, and the gases made to circulate in the opposite direction, i.e. from R_2 to R_1 , instead of from R_1 to R_2 as before. If an oven is to be drawn, or allowed to cool, the tap a is closed, and the entrance of the gases into S_1 or S_2 can be prevented by closing h_1 , h_2 , and d_1 , d_2 . The process of coking is under perfect control, and can be hastened or retarded by suitably regulating the quantity of gas. It usually takes from 30—48 hours. The exhaust gases from the coke oven contain benzene vapour, 0.61 per cent.; ethylene, 1.63 per cent.; sulphuretted hydrogen, 0.43 per cent.; carbonic acid, 1.41 per cent.; carbon monoxide, 6.49 per cent.; 53.32 per cent. water; and methane, 36.11 per cent. They pass through the tube F into the gas-cooler K (Figs 4 and 5), which consists of an iron cylinder. Cold water trickles continually from m to n , over the plates l , and finds its exit at p . The gas enters at f_1 , passes upwards, is cooled, and leaves at g , from whence it passes through two more coolers. From the coolers the gas passes through the scrubbers W , which consist of large iron cylinders fitted inside with a number of perforated iron plates at 10 cm. interval. Water drips continually over these plates. The ammoniacal liquor and tar flow off at t . The gas loses 75 per cent. of its ammonia and nearly all the tar in the coolers, the remainder being deposited in the washers. The tar and ammonia are collected in the cisterns Y (Fig. 6). The coolers and washers are supplied with water from the tank X (Fig. 4).—H. T. P.

PATENTS.

Improvements in Gaseous Fuel-producing Apparatus. B. H. Thwaite, Liverpool. Eng. Pat. 6432, May 1, 1888. 1s. 3d.

THESE improvements consist mainly in the arrangement of valves and fittings to facilitate the alternate production of "water-gas" and "producer-gas" from two generators containing coal or other suitable carbonaceous material. Seven sheets of drawings are appended to the specification.

—A. R. D.

Improvements in the Process and Apparatus for making Illuminating and Heating Gas from Water in combination with Carbonaceous Substances. S. H. Linn, London. From J. Flannery, New York. Eng. Pat. 7400, May 18, 1888. 8d.

WATER-GAS is passed through a highly-heated annular retort in order to promote the dissociation of any excess steam, the oxygen thus set free converting its equivalent of carbonic oxide into carbonic acid. The resultant gases are caused to travel through a heated chamber to which liquid hydrocarbon is also admitted. Here the carbonic acid is again reduced to carbonic oxide, and the water-gas, mingled with hydrocarbon vapours, is converted into an illuminating gas of high candle-power.—A. R. D.

Improvements in the Mouthpieces and Lids, Doors, or Covers of Gas Retorts and Ovens, and other Vessels and Articles requiring Gas and Air-tight Joints. W. H. Westwood and E. T. Wright, Brierly Hill. Eng. Pat. 8551, June 11, 1888. 8d.

THE retort lid, instead of bearing or seating itself upon the extreme front end of the mouthpiece, is made to seat itself against a flexible joint external to the retort and some distance back from the front edge. By this means the joint is protected from any deposit of tar or dirt. The flexible material forming the joint is held in position by a ring piece either cast on or otherwise fastened to the retort mouthpiece.—A. R. D.

Improved Means of Increasing the Luminousness of Ignited Gas. J. Mactear, Westminster. Eng. Pat. 4124, March 8, 1889. 4d.

FINE platinum wire is braided or otherwise interwoven with cotton or other fibrous material, and the fabric so obtained is used for "mantles" in incandescence gas-lighting.

—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Perhydrides of the Higher Aromatic Hydrocarbons. C. Liebermann and L. Spiegel. Ber. 22, 779—781.

HAVING in a previous communication described the preparation and properties of chrysene hydrides, the authors have extended their researches to the perhydrides of other aromatic hydrocarbons. In each case the hydrocarbon (1 part) was heated with phosphorus (1.25 parts) and hydriodic acid (5 to 6 parts, sp. gr. = 1.7) for 12 to 16 hours at 250°—260°. *Phenanthrene perhydride*, $C_{11}H_{24}$ (prepared and examined by Lucas), solidifies in a freezing mixture, melts at -3° , and has a sp. gr. of 0.933 at 20° compared with water at the same temperature. It is not affected by cold fuming sulphuric acid, nitric acid and bromine, is gradually decomposed when boiled with acetic and chromic acids, but without yielding phenanthraquinone. When distilled over zinc dust some phenanthrene and a comparatively large amount of anthracene is obtained. *Retene dodecahydride*, $C_{14}H_{30}$, is a colourless oil exhibiting a bluish fluorescence. It boils at 336° (uncorr.). When distilled over zinc dust retene is formed in small quantity. It is readily affected by bromine, less readily by cold fuming nitric acid, and oxidised when boiled with chromic and acetic acids, but without yielding the quinone. *Picene perhydride*, $C_{22}H_{36}$, crystallises from alcohol in white needles melting at 175°, and boils above 360°. In its chemical properties it resembles the preceding compound. When distilled over zinc dust it forms picene, melting at 330°. *Picene-icosahydride*, $C_{22}H_{34}$, is liquid and boils at 360°. *Acenaphthene perhydride*, $C_{12}H_{20}$, forms a colourless liquid which boils at 235°—236° (uncorr.) and emits a peculiar sweetish odour. It is optically inactive. *Fluorene perhydride*, $C_{15}H_{22}$, is a colourless liquid boiling at 230° (uncorr.), and resembling the preceding perhydride in properties.

—D. B.

IV.—COLOURING MATTERS AND DYES.

Colouring matters derived from Benzidine Tetra benzyl Ether. A. Colson. Bull. Soc. Chim. 1889, 347—348.

QUIXOL is treated with alcoholic potash and the potassium salt so obtained with benzyl chloride to form the dibenzyl ether of quinol, $C_6H_4(O.C_6H_5)_2$. On nitration the mononitro compound, a yellow crystalline substance melting at

78°, is obtained. This reduced with zinc in alkaline solution forms a yellow substance melting at 140°, and a small quantity of a base, which dissolves in alcohol, and on boiling with dilute hydrochloric acid deposits the hydrochloride of a benzidine which becomes red on exposure to air. This benzidine combines in the cold with naphthol sulphonic acids, salicylic acid and phenols, forming colouring matters which dye cotton directly in an alkaline bath. They do not, however, possess the brilliancy of the colours derived from the tetramethyl- and tetra-ethyl ethers of benzidine.—O. H.

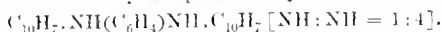
Amido-para-cresylmethyl ether. L. Limpach. Ber. 22, 789—791.

In a previous paper the author proved the position occupied by the amido group in amido-para-cresylmethyl ether by its conversion into hydroxytoluic acid. He now attempts to explain the position when a nitro group is introduced into this compound. *Nitroacetamido-para-cresylmethyl ether*, $C_{10}H_{12}N_2O_4$, is formed by the action of cold nitric acid on acetamido-para-cresylmethyl ether. It crystallises from alcohol in small needles, melting at 156°. *Nitroamido-para-cresylmethyl ether*, $C_{10}H_{10}N_2O_4$, is obtained from the acetyl compound by boiling with caustic soda. It crystallises in yellow needles, melting at 132°. *Diamido-para-cresylmethyl ether*, $C_8H_{12}N_2O$, forms a colourless compound, melting at 166°, with decomposition. Its aqueous solution becomes green when exposed to air, whilst its hydrochloric acid solution when added to an alkaline solution of α -naphthol yields a blue colouring matter, which was found to be an indophenol compound. As indophenols are yielded by para-diamines only, both amido groups must occupy the para position, and from this it follows that when diamido-para-cresylmethyl ether is nitrated, the nitro group must occupy the para position relatively to the amido group. *Orthoamido-para-cresylmethyl ether*, $C_8H_{12}NO$, is obtained by splitting up the amido group and subsequently reducing the nitro group. It fuses at 111°.

The author intends to pursue this investigation at a future date.—D. B.

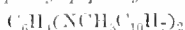
β -Dinaphthyl-p-phenylenediamine. L. Rueff. Ber. 22, 1080—1083.

This body is obtained by heating *p*-phenylene diamine with an excess of β -naphthol to 200° so long as water continues to be formed. The reddish-brown crystalline mass is then boiled with dilute sodium hydrate, and the substance, after being powdered, is extracted successively with warm dilute hydrochloric acid, alcohol, and ether, and the residue is finally recrystallised from boiling glacial acetic acid, cumene, or nitrobenzene, but preferably from aniline. The substance crystallises in white plates, melts at 235°, and distils in a vacuum with slight decomposition above 400°. The constitution of the body is represented by the formula—



It is scarcely affected by dilute acids, but dissolves in concentrated sulphuric acid. If potassium nitrate or nitrite be added to this solution it turns greenish-violet and finally deep blue. The picrate, $C_6H_4(NH(C_{10}H_7)_2) \cdot 2C_6H_4(NO_2)_3OH$, is prepared by heating the diamine with an alcoholic solution of picric acid. It crystallises from a mixture of benzene and petroleum ether in small black needles, melting at 217°.

Dimethyl-di- β -naphthyl-p-phenylene diamine—

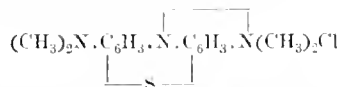


is obtained by heating the diamine with an excess of methyl iodide and methyl alcohol to 140°. The substance after purification crystallises from benzene in white plates melting at 180°, which are sparingly soluble in alcohol and ether. The solution of this substance in concentrated sulphuric acid is green and then blue; the addition of potassium nitrate causes a reddish-brown and of potassium nitrite a bluish-violet colouration. Acetyl chloride acts in the cold on the diamine, the reaction being completed by warming, with the formation of the compound

$C_6H_4(NC_2H_5O \cdot C_{10}H_7)_2$, a substance crystallising from hot benzene in white plates, melting at 210°. The dibenzoyl derivative, $C_6H_4(NC_6H_5CO \cdot C_{10}H_7)_2$, also crystallises in white plates melting at 220°, and is obtained by heating the diamine with benzoyl chloride to 140°. The substance is very slightly soluble in spirit and ether, but dissolves readily in hot benzene.—T. A. L.

Studies in the Methylene-blue Group. Aug. Bernthsen. Ann. 251, 1—97.

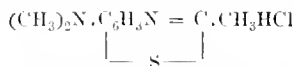
METHYLENE-BLUE has, according to the author's former researches, the constitution



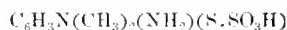
and belongs, therefore, to the class of the indamines. In this compound the sulphur atom joins two benzene rings. Now it appeared to be of great interest to examine whether the sulphur atom could be introduced into one benzene ring and thus give rise by coupling this new body afterwards with a second benzene group (*i.e.*, dimethylaniline or similar compounds) to new methods for preparing Methylene-blue. Experiments in this direction have already been set on foot by Roth (Ger. Pat. 38,573). He treats Dimethyl-phenylene-green or its leuco base with sodium thiosulphate and potassium bichromate, and obtains compounds yielding on further treatment Methylene-blue. A second method, *viz.*, that of combining sulphur with one of the two generators of Dimethylphenylene-green had, however, not been attempted, and it seemed essential before trying it to study very exactly the constitution of the Methylene-red. Koch's formula of this body, $C_{16}H_{15}N_3S_2 \cdot 2HCl \cdot ZnCl_2 + 2H_2O$, is analytically correct, but its molecule is only represented by half of the above formula, *viz.*, $C_8H_9N_2S_2CH$. Former experiments had shown that part of the sulphur is very unstable in this body, and that reducing agents remove it as sulphuretted hydrogen. Ammonia acts on Methylene-red and forms a well-crystallised acid. The former product, resulting from the action of reducing agents on Methylene-red, is, indeed, a simple sulphur derivative of amidodimethylaniline—



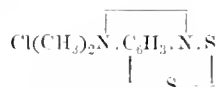
amidodimethylaniline mercaptan. The ortho position of the NH_2 group to the SH residue can be easily proved by treating the zinc mercaptide with acetylchloride, when an anhydro base of the formula—



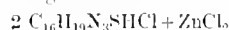
is formed. With nitrous acid the mercaptide forms, like all ortho compounds, an intramolecular diazothio-compound. By the action of ammonia on Methylene-red an oily product is formed, insoluble in water, consisting principally of the disulphide of the above-mentioned mercaptan, and of another strange product crystallising in yellow needles, which the author calls Supersulphide. Furthermore, another compound is contained in the alkaline solution—



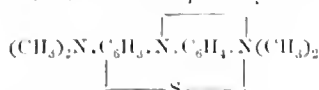
Amidodimethylanilinedithiosulphonic acid. These experiments rendered it possible to explain the constitution of Methylene-red, which is—



If equal molecules of the mercaptan and dimethylaniline be oxidised in neutral solution or in a solution of hydrochloric or acetic acid by potassium bichromate, a green colouring matter is formed, easily soluble in water. The same product is formed if the bisulphide of dimethylaniline be treated in an analogous manner. Its formula is—

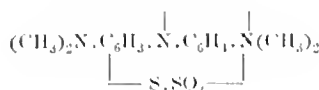
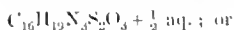


and the constitution of the base probably



Tetramethylindaminesulphide, or, as the author calls it for simplicity's sake "*Soluble*" or "*Sulphide-green*."

On oxidising amidodimethylanilinethiosulphonic acid with dimethylaniline a green indamine is formed, containing more sulphur than the above. Its formula is—

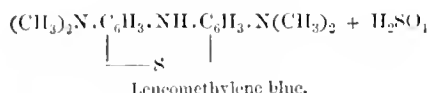
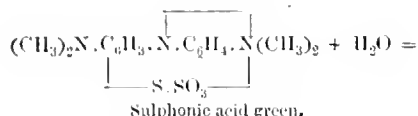
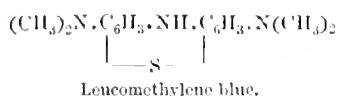
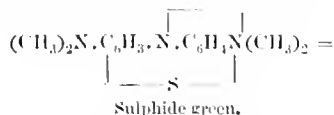


Tetramethylindaminethiosulphonate or "*Insoluble green*" or "*Sulphonic acid green*."

These green colouring matters can be easily converted into Methylene-blue or its leuco-compounds.

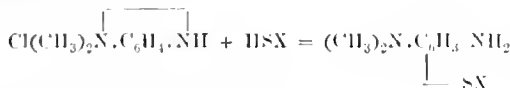
The Soluble or Sulphide-green produces Methylene-blue on standing, quicker on heating its aqueous solution, whilst an equivalent quantity of the leuco-base of the green indamine is formed. The Insoluble or Sulphonic acid green can be recrystallised from hot water without decomposition, but after boiling for several hours it is converted into leuco-methylene blue and sulphuric acid. The same action is produced by prolonged boiling with zinc chloride solution, whilst a brief boiling with it forms equivalent quantities of Methylene-blue and "Leucosulphonic acid green."

These reactions are easily comprehensible. Sulphide green and Leuco blue are isomeric. Sulphonic acid green differs from Leuco blue only by the SO_3 group, which can be readily eliminated.



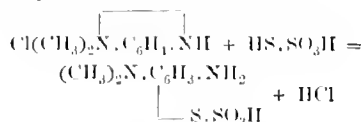
These discoveries have an important bearing on the manufacture of Methylene blue. It is now possible to produce from the technically valueless Red the important Methylene blue. If further new methods could be discovered for producing sulphur derivatives of paradiamines, these reactions would assist in the preparation of a great variety of new compounds.

By acting with sulphuretted hydrogen on the oxidation product of amidodimethylaniline, the two hydrogen atoms of the sulphur compound were always attacked, and the two bonds of the sulphur served to unite two benzene rings together. But if one hydrogen atom were replaced by another group, different results might be expected, according to the formula—



(X refers to one element or group).

Amongst the known derivatives of sulphuretted hydrogen, its sulphonic acid, $\text{HS} - \text{SO}_3\text{H}$ was the first to be considered. This compound has been applied for making Methylene blue by a number of patentees (W. Majert, Ger. Pat. 13,281; W. Conrad, Ger. Pat. 11,014; Majert, Ger. Pat. 19,841; Ochler, Ger. Pat. 24,125; Moldau, Ger. Pat. 25,828; C. Roth, Ger. Pat. 38,573 and 39,757). But in most of these patents the action of this thiosulphonic acid was merely to reduce the nitrosodimethylaniline, or to serve as a source of sulphuretted hydrogen, and in most cases the yield of colouring matter was very small. An exception is to be found in Roth's patent (Ger. Pat. 38,573), according to which a considerable yield of Methylene blue can be obtained. Roth proposes to act with thiosulphonic acid in presence of an oxidising agent on the leuco base of an indamine, especially of Dimethylphenylene green. The author has shown in former researches that by application of sulphuretted hydrogen only small quantities of the desired product can be obtained. This circumstance, as well as the fact that unsymmetrical thionine colouring matters can be obtained according to Roth's patent, led to the consideration that the sulphur enters the molecule before the formation of the indamine, and experiment confirmed theory in this regard. On acting with thiosulphonic acid on the crude oxidation product of amidodimethylaniline, an abundant quantity of the sulphonic acid of the mercaptide is formed, identical with the above-described amidodimethylanilinethiosulphonic acid:—



The effective agent is the free thiosulphonic acid. But as this compound decomposes very quickly, it was found useful to apply it in the form of its stable but very acid aluminium and chromium salts.

As amidodimethylaniline, mercaptan can also be obtained from its homologues.

The author has prepared derivatives of *p*-amidodiethylaniline:—

- (a.) *Amidodiethylanilinethiosulphonic acid*,
 $\text{C}_6\text{H}_3\text{N(C}_2\text{H}_5\text{)}_2\text{(NH}_2\text{)(S.SO}_3\text{H)}.$
- (b.) *Amidodiethylanilinemercaptide*,
 $\text{C}_6\text{H}_3\text{N(C}_2\text{H}_5\text{)}_2\text{(NH}_2\text{)(SH)}.$
- (c.) *The corresponding disulphide.*

Derivatives of *Tetramethylphenylenediamine*:—

- (a.) *Tetramethylphenylenediaminethiosulphonic acid*,
 $\text{(CH}_3\text{)}_2\text{N.C}_6\text{H}_3\text{.N(CH}_3\text{)}_2\text{(S.SO}_3\text{H)}.$
- (b.) *Tetramethylphenylenediaminemercaptide*,
 $\text{(CH}_3\text{)}_2\text{N.C}_6\text{H}_3\text{.N(CH}_3\text{)}_2\text{(SH)}.$

Derivatives of *p*-Phenylenediamine:—

- (a.) *p*-Phenylenediaminethiosulphonic acid,
 $\text{C}_6\text{H}_3\text{(NH}_2\text{)}_2\text{(S.SO}_3\text{H)}.$
- (b.) *p*-Phenylenediaminemercaptide,
 $\text{C}_6\text{H}_3\text{(NH}_2\text{)}_2\text{(SH)}.$
- (c.) *The corresponding disulphide.*

Analogous derivatives of Tetramethylindaminethiosulphonate A.

- (1.) $\text{C}_{18}\text{H}_{23}\text{N}_3\text{S}_2\text{O}_3$ from Diethylthiosulphonic acid and Dimethylaniline.
- (2.) $\text{C}_{18}\text{H}_{23}\text{N}_3\text{S}_2\text{O}_3$ from Dimethylthiosulphonic acid and Diethylaniline.
- (3.) $\text{C}_{20}\text{H}_{27}\text{N}_3\text{S}_2\text{O}_3$ from Diethylthiosulphonic acid and Diethylaniline.
- (4.) $\text{C}_{14}\text{H}_{15}\text{N}_3\text{S}_2\text{O}_3$ from Dimethylthiosulphonic acid and Aniline.
- (5.) $\text{C}_{15}\text{H}_{17}\text{N}_3\text{S}_2\text{O}_3$ from Dimethylthiosulphonic acid and *o*-Toluidine.

- (6.) $C_{17}H_{21}N_3S_2O_3$, from Diethylthiosulphonic acid and *o*-Toluidine.
 (7.) $C_{14}H_{15}N_3S_2O_3$, from *p*-Phenylenediaminethiosulphonic acid and Dimethylaniline.

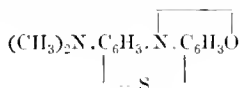
Analogous Derivatives of Tetramethylindaminesulphide B.

- (1.) $C_{18}H_{23}N_3S$, from Amidodimethylanilinemercaptide and Dimethylaniline.
 (2.) $C_{18}H_{23}N_3S$, from Amidodimethylanilinemercaptide and Diethylaniline.
 (3.) $C_{20}H_{27}N_3S$, from Amidodimethylanilinemercaptide and Diethylaniline.
 (4.) $C_{18}H_{17}N_3S$, from Amidodimethylanilinemercaptide and *o*-Toluidine.
 (5.) $C_{17}H_{21}N_3S$, from Amidodimethylanilinemercaptide and *o*-Toluidine.

Thionine Colouring Matters C.

- (1.) $C_{18}H_{23}N_3S_2Cl$, from the indamines A 1 and 2, B 1 and 2.
 (2.) $C_{20}H_{26}N_3S_2Cl$, from the indamines A 3 and B 3.
 (3.) $C_{14}H_{14}N_3S_2Cl$, from Amidodimethylanilinemercaptide and Aniline.
 (4.) $C_{13}H_{16}N_3S_2Cl$, from the indamines A 5 and B 4.
 (5.) $C_{17}H_{20}N_3S_2Cl$, from the indamines A 6 and B 5.
 (6.) Thionine, from *p*-Phenylenediaminemercaptide and Aniline.

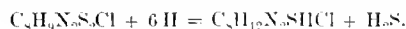
Phenols can also be used for these reactions. From Amidodimethylanilinemercaptide and ordinary phenol, the Methylene-violet—



is obtained.

Amidodimethylanilinemercaptide and some of its derivatives.

Amidodimethylmercaptide from Methylene-red.—A one per cent. or two per cent. solution of Methylene-red is acidulated with hydrochloric acid, zinc dust is added and the mixture heated on the water-bath. It is decolourised, sulphuretted hydrogen escaping—



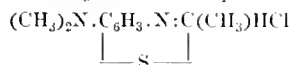
The mixture is filtered, boiled to remove H_2S , and ammonia is added to saturate the free acid. Then the zinc mercaptide is precipitated by sodium acetate. It could not be purified by crystallisation, but is easily soluble in hydrochloric and concentrated acetic acid. Ammonia does not decompose it; caustic soda dissolves it. If this solution be shaken with ether, air being admitted, a yellow basic oil is dissolved by the ether, which is no longer a mercaptan, but the corresponding disulphide. A dilute weak hydrochloric acid solution of the mercaptide shows on addition of ferric chloride a faint blue colouration, changing rapidly from a dirty violet-brown to a blue colour. In concentrated solutions of the mercaptide ferric chloride produces at first a blue colouration, which, however, soon disappears. Finally a blue colouring matter is formed as a precipitate, whilst the solution contains a violet-red colouring matter, which is rapidly decomposed. The blue consists partly of Methylene-blue, partly of another colouring matter not belonging to the group. If in these reactions H_2S be present Methylene-red is formed.

If the neutral solutions of the mercaptan hydrochloride and dimethylaniline hydrochloride be oxidised with potassium bichromate, a red colouration is formed, changing through blue into green. Tetramethylindaminesulphide is thus produced. On heating, the green colour changes into blue. Mercuric chloride throws down from the neutral solutions of the zinc mercaptide a dirty white precipitate; on heating the solution turns red. Mercurous nitrate oxidises the mercaptan to a dark red liquid.

The mercaptan can also be obtained by reducing the amidodimethylanilinethiosulphonic acid in a solution of caustic soda with zinc dust, or by reducing the disulphide or supersulphide in hydrochloric acid solution with the same agent.

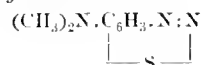
The free mercaptan was obtained by treating the bisulphide or Methylene-red or the supersulphide with H_2S , until the solution was colourless. The sulphuretted hydrogen was removed by boiling in an atmosphere of carbonic acid. On addition of sodium acetate a yellowish oil was obtained, showing all the reactions of a mercaptan. Its hydrochloride could not be obtained in crystals; it is very soluble in water and alcohol.

Ethynylamidodimethylaniline mercaptan—



The mixture of the zinc salt with benzene is treated in a sealed tube with an excess of acetyl chloride for four to five hours at $100^\circ C$. The product thus obtained is nearly soluble in water; caustic soda precipitates an oil, soluble in ether. Gaseous hydrochloric acid separates the hydrochloride, the alcoholic solution of which, after purification with animal charcoal, crystallises in small white or light green needles or prisms.

Diazothiodimethylaniline—



3.5 grms. of sodium nitrite are added to a well cooled solution of 10 grms. of the zinc mercaptide, which is acidulated with sulphuric acid. First a diazo-compound is formed, which is instantaneously changed into the diazothiodimethylaniline. The base crystallises in long yellowish needles melting at $78^\circ C$, easily soluble in ether, alcohol, benzene, chloroform, with difficulty in petroleum spirit and water.

Ferric chloride does not produce any reaction.

Platinum chloride does not precipitate dilute solutions. In concentrated solutions it produces a precipitation of a double salt crystallising in large yellow needles.

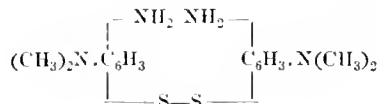
Gold chloride produces a yellow double salt, crystallising in plates.

Potassium bichromate gives a dirty yellow crystalline precipitate. Zinc dust reduces the base to the mercaptan. Sulphuric or hydrochloric acid do not change the base on heating for a short time.

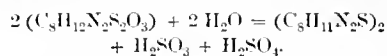
Fuming nitric acid forms a nitro-compound, which on addition of water is precipitated in fine yellow needles, insoluble in dilute hydrochloric acid.

On heating with nitric acid a compound is formed, soluble in ammonia with a red colour. The yield is, however, bad. Better results are obtained when the sulphonic acid is used instead of the mercaptan.

B-Amidodimethylaniline mercaptan disulphide is best obtained by oxidising the mercaptan with air. Freshly precipitated zinc mercaptide is suspended in water, ammonia is added and air passed through the mixture for 24 hours, the ammonia being removed from time to time. Its formula is—



It can also be obtained from amidodimethylanilinethiosulphonic acid, by treating it with an excess of caustic soda at $40^\circ-50^\circ C$.—



and from Methylene red with caustic alkalis; but in both cases the product is impure.

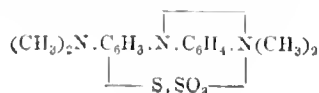
Amidodimethylanilinepersulphide crystallises from the solutions of the crude sulphide in benzene in beautiful yellow needles, melting at 97° C. The analytical results coincide with the formula $C_{12}H_{10}N_2S_2$. It is easily soluble in benzene and ether, with difficulty in petroleum spirit. Dilute acids dissolve it, but it suffers decomposition on standing, sulphur separating from its solutions. It becomes thus partly rechanged into the disulphide. Ferric chloride produces in the hydrochloric acid solution of the pure supersulphide a beautiful purple colouration due to the formation of *Methylene-red* and of a *blue colouring matter*. With dimethylaniline and chromates a deep purple colouration is likewise formed. Ferric chloride colours the hydrochloric acid solution in presence of H_2S a rose tint; if it be reduced before *Methylene-red* is however formed. The constitution of the persulphide is not yet cleared up; the author concludes from the formation of the red and blue colouring matter on oxidation with ferric chloride, that it is not a uniform body, but consists probably of two compounds.

Amidodimethylanilinthiosulphonic acid is obtained from *Methylene red*, by treating its aqueous solution (1:100) with dilute ammonia or caustic alkali, until it is decolourised. The alkaline solution is then acidulated with acetic acid and exposed for 24 hours in flat vessels to the influence of the air. A little ammonia is added, the disulphide removed by ether, and then the liquid, after acidifying with acetic acid, is treated with animal charcoal. After evaporation the sulphonic acid crystallises out on cooling and is purified by repeated recrystallisations. The yield is 20—25 per cent. of the weight of the *Methylene red*. It is with difficulty soluble in cold (1:270), easier soluble in hot water (1:25 or 30), with difficulty in alcohol, very easily in caustic or carbonated alkalis. The melting, i.e., decomposition point, was found on quick heating to be 201°—204° C., with gradual heating, 193—195° C.

Traces of iodine or ferric chloride produce in its dilute aqueous solutions a beautiful but unstable purple colouration, it disappears on addition of hydrochloric acid. Bichromates produce likewise a purple colouration. On being oxidised in presence of dimethylaniline, but absence of acids, "Sulphonic acid green" is formed. Mercuric chloride produces a white precipitate, passing, however, soon through a salmon colour into grey, whilst the solution is coloured red. Copper sulphate forms a blue precipitate, turning black on boiling. Platinum chloride produces a purple colouration, which disappears on boiling, a black precipitate being formed. Fuming hydrochloric acid precipitates in the dilute hydrochloric solution the hydrochloride in the form of small white prisms.

The thiosulphonic acid can also be obtained from *p*-amidodimethylaniline in the following manner:—10 grms. of neutral amidodimethylaniline sulphate are dissolved in 100 cc. of water, an aqueous solution of 5.5 grms. of potassium bichromate, acidulated with 1.5 grms. of acetic acid, are added. A mass of crystals is formed into which a solution of 22 grms. of sodium thiosulphate and 27 grms. of aluminium sulphate are poured. The product of the reaction is a clear liquid, from which, after standing, crystals of the sulphonic acid separate. Another way to prepare this compound is to treat the mercaptan with sulphurous acid and bichromate, or to treat the disulphide with sulphurous acid. The author describes further a series of analogous derivatives, which have been mentioned before, and were obtained from *amidodimethylaniline tetramethylid-aniline*, and *p*-phenylenediamine, *tetramethylindaminethiosulphonate*, *tetramethylindaminesulphide*. He also describes the methods for their conversion into *Methylene blue*.

If a neutral solution of equal molecules of dimethylanilinehydrochloride and amidodimethylanilinthiosulphonic acid be oxidised with potassium bichromate, the solution passes through red and a dirty violet into green and a copper looking resin or green needles, glittering like brass, are separated, which are recrystallised from hot water. Their formula is $C_{16}H_{19}N_3S_2O_2 + \frac{1}{2} aq.$ or—



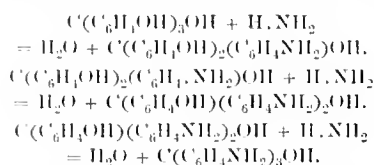
This body can be reduced to a leuco-compound and is destroyed by treating with hydrochloric acid, a quinone being formed.

The sulphide green is formed in a similar way, by oxidising the mercaptan with dimethylanilinehydrochloride. Mineral acids decompose this compound, a quinone being formed. Reducing agents produce two leuco-compounds. When a sulphide green solution is left to itself it begins to turn blue, and after 2—3 days the reaction is finished. From the deep blue solution there separates out *Methylene blue* on addition of salt and zinc chloride. At the same time leuco-sulphide green is formed. Finally, boiling with zinc chloride produces only leuco-methylene blue. From the Thiosulphonic acid green the free base of leuco-blue is obtained by boiling its aqueous solution for some time. The author further describes a series of homologous green indamines, and blue colouring matters obtained therefrom, which vary in shade from a violet to a greenish blue. Their names have already been mentioned and their modes of preparation are analogous to those above given in more or less detail.

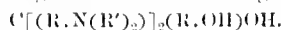
—A. L.

The Preparation of Rosanilines from Hydroxytriphenylcarbinols by the Action of Ammonia or Amines. O. Mühlhäuser. Dingl. Polyt. J. **271**, 459—461.

By the action of ammonia, or its primary and secondary substitution products, on hydroxytriphenylcarbinols, under pressure, rosanilines are obtained. The number of amido groups introduced depends upon the duration of the reaction. Aurin yields as final product pararosanine. The reaction is—



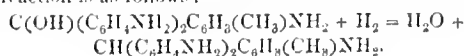
J. Persoz was the first to observe the action of ammonia on a mixture of hydroxytriphenylcarbinols, viz., corallin. Soon after, Rigond prepared the so-called azulin by the action of hot aniline on corallin. In 1877, Dale and Schorlemmer isolated trihydroxytriphenylcarbinol from corallin and treated this pure substance with ammonia. They obtained pararosanine. The same chemists obtained trimethylparosanine by the action of methylamine on trihydroxytriphenylcarbinol, and by the action of aniline and a little acetic acid on the same substance, prepared triphenylparosanine. In 1878, A. W. Hofmann prepared hexahydroxymethylparosanine by heating epinitonic acid and ammonia to 160—170° C. In 1881, Zulkowsky obtained an isomeric magenta from methylaurin and ammonia; and in the same year Breidl prepared triphenylparosanine from corallin and aniline chloride. Ewer and Pick obtained pure amidotriphenylcarbinols by the action of primary and secondary amines, especially methylamine, dimethylamine, aniline, *o*- and *p*-toluidines, xylydine, cumidine, and α - and β -naphthylamine on colouring matters of the following type:—



For example, hydroxytetramethyldiamidotriphenylcarbinol yielded with ammonia, aniline, and α -naphthylamine respectively, tetramethylparosanine, phenyl, and α -naphthyltetramethylparosanine respectively. The same chemists prepared from hydroxytetramethyldiamidotriphenylcarbinol-sulphonic acid and aniline, a phenyltetramethylparosanine-sulphonic acid.—H. T. P.

The Preparation of Amido-Triphenylmethanes from Amido-Triphenylcarbinols. O. Mühlhäuser. Dingl. Polyt. J. **271**, 457—459.

When a rosaniline base is submitted to the action of a reducing agent the carbinol is changed into the corresponding leuco-base. In the case of rosaniline itself, for instance, the reaction is as follows:—



A. W. Hofmann in 1861 first effected the reduction of rosaniline by means of ammonium sulphide, and also by zinc and hydrochloric acid. Two years later he prepared by similar means the leuco-base from triphenylrosaniline. L. Durand first employed zinc dust for reducing carbinols.

In 1867 H. Schiff showed that sulphurous acid could be used to reduce rosaniline. In 1872 Bulk reduced some of the sulphonic acids of the rosaniline series. The literature of the subject is given in the following table:—

Year.	Author.	Reducing Agent.	Colour-base.	Leuco-base.	References.
1873	A. W. Hofmann.	Alcoholic ammonium sulphide.	Methyl violet.	A mixture of tetra-, penta-, and hexamethylparaleucanilines.	Ber. 6, 360. Sn and HCl; Wichelhaus, 14, 1952; zinc dust and acetic acid; Bayer and Co. (Ger. Pat. 31,509, 1884).
1878	O. Doebner.	Zinc and hydrochloric acid.	Malachite green.	Tetramethyldiamidotriphenylmethane.	Ber. 11, 1236, and E. and O. Fischer, 12, 797.
1879	E. and O. Fischer.	Zinc dust and hydrochloric acid.	Tetramethylpararosaniline.	Tetramethylparaleucaniline.	Ber. 12, 861.
"	Do.	Zinc dust and acetic acid.	Methyl green.	$\text{CH}(\text{C}_6\text{H}_4\text{N}(\text{CH}_3)_2)_2\text{C}_6\text{H}_4\text{N}(\text{CH}_3)_2$	Ber. 12, 2352.
1882	Doebner.	Zinc dust and hydrochloric acid.	Diamidotriphenylcarbinol.	Diamidotriphenylmethane.	Ber. 15, 231.
1883	Wichelhaus.	Tin and hydrochloric acid.	Pentamethylpararosaniline.	Pentamethylparaleucaniline.	Ber. 16, 2006, and 19, 103.
"	Do.	Do.	Hexamethylpararosaniline.	Hexamethylparaleucaniline.	Ber. 16, 2006, and 19, 108; Zn and HCl, Fischer and Hermann 16, 707; zinc dust and acetic acid; Bayer and Co. (Ger. Pat. 31,509, 1884).
1884	Dyeworks, Bayer and Co.	Zinc dust and acetic acid.	Benzyl violet.	Pentamethylbenzylparaleucaniline.	Ger. Pat. 31,509, 1884.
"	Do.	Do.	Hexa-ethylpararosaniline.	Hexa-ethylparaleucaniline.	Do.
1886	Heumann and Herdberg.	Zinc dust and hydrochloric acid.	Dichloropararosaniline.	Dichloroparaleucaniline.	Ber. 19, 1989.
1887	Bamberger and Muller.	Do.	Carbazol blue.	....	Ber. 20, 1906.

When it is desired to reduce a colour-base in practice, it is dissolved in dilute hydrochloric or acetic acid, with the addition of alcohol if necessary; the solution is slightly warmed and zinc dust gradually added till the solution is decolourised. It is then filtered, diluted with water, and the base precipitated with soda. If ammonium sulphide be used the colour-base is best dissolved in alcohol, ammonium sulphide added, and the whole heated to 100° C. in a closed vessel. The alcohol is then distilled off, the residue poured into water, and the leuco-base purified by removing the sulphur.—H. T. P.

Oxidation of β -Naphthol. E. Ehrlich. Monatsh. Chem, 10, 115—122.

In preparing orthocinnamic carboxylic acid from β -naphthol (compare this Journal, 1888, 671) considerable quantities of a complicated colouring matter and resinous products are formed, and in addition there is formed a second crystalline acid, but only in small quantities (2 per cent.). This acid is best prepared by running a solution of 200 grms. of potassium permanganate in 4 litres of water, in a fine stream, into a well-cooled solution of 100 grms. of β -naphthol and 100 grms. of potash in 3 litres of water. After standing for a short time the whole is filtered, the filtrate slightly acidified with dilute sulphuric acid, again filtered from the coloured substance, the filtrate mixed with excess of dilute sulphuric acid, and, after 36 hours, the brown resinous deposit collected, washed with water and dried in the air. The solution contains considerable quantities of orthocinnamic carboxylic acid, which can be extracted with ether. The dry resinous product is repeatedly extracted with boiling alcoholic ether, the solution concentrated and the crystalline mass, which separates on cooling, first washed with alcohol and then boiled with a little dilute alcohol to remove orthocinnamic carboxylic acid. The residue is dissolved in boiling alcohol, hot water added to the filtered solution, and the precipitate recrystallised from alcohol.

The pure acid crystallises in colourless plates, melts at 281°, has the composition $\text{C}_{20}\text{H}_{12}\text{O}_4$, and is dibasic; it is insoluble in water, and only sparingly soluble in the ordinary solvents. The ammonium salt is very unstable and the silver salt is amorphous. The barium salt, $(\text{C}_{20}\text{H}_{11}\text{O}_4)_2\text{Ba} + 7 \text{H}_2\text{O}$, crystallises in colourless plates. The ethyl salt melts at 123°—124°.

A colourless crystalline dibasic acid, $\text{C}_{20}\text{H}_{14}\text{O}_4$, is obtained when the preceding compound is reduced with sodium amalgam; it melts at 223°—224°, but at a higher temperature it evolves carbonic anhydride. This acid is probably nearly related to the acid $\text{C}_{20}\text{H}_{11}\text{O}_8$, which Henriquez obtained by oxidising α -naphthol with potassium permanganate. (Compare Ber. 21, 1614.)—F. S. K.

PATENTS.

Improvements in and Relating to the Manufacture of Colouring Matters. H. H. Lake, London. From K. Ochler, Offenbach-on-the-Main, Germany. Eng. Pat. 7997, May 31, 1888. 6d.

Yellow and orange azo dye-stuffs, which dye cotton in an alkaline soap-bath without a mordant, are obtained, according to this patent, by combining one molecule of the *o*- or *m*-cresol carboxylic acids ($\text{CH}_3\text{OH}:\text{CO}_2\text{H} = 1:2:3$ or $= 1:3:4$) with diazotised benzidine or tolidine, and acting on these intermediate products with another molecule of cresol carboxylic acid, salicylic acid or toluylene diamine sulphonic acid. The cresol carboxylic acids are obtained from the isomeric cresols by the methods of Kolbe (Ger. Pat. 426), or of Schmitt (Ger. Pat. 29,939). The following are the methods for preparing some of the dye-stuffs:—18.4 lb. of benzidine are dissolved in 500 lb. of water and 48 lb. of hydrochloric acid of 20° B., and diazotised with a solution of 28 lb. of sodium nitrite in 150 lb. of water. This is then run into a solution containing 30.4 lb. of *o*-cresol carboxylic acid and 27 lb. of sodium hydrate in

600 lb. of water. The mixture is agitated, and after some hours the dye-stuff separates out as a yellow-brown powder which is filter-pressed and dried. It dyes cotton from a soap-bath light lemon-yellow. An orange dye-stuff is formed as follows:—2½ lb. of toluidine are diazotised, and to the solution are added 15·2 lb. of *o*-cresol carboxylic acid, 20 lb. of "calcined soda," and 300 lb. of water. The intermediate product thus formed is a gelatinous brown mass. To this is added a solution containing 20·2 lb. of toluenylenediamine sulphonic acid, 6 lb. of soda and 300 lb. of water. The whole is then stirred for 24 hours, raised to the boil, the dye-stuff precipitated with salt, filter-pressed, and dried. The acids are precipitated from their aqueous solutions by dilute acids as brown flakes. They dissolve with a violet colour in strong sulphuric acid.—T. A. L.

New Colouring Matters. H. H. Leigh, London. From R. G. Williams, Albany, U.S.A. Eng. Pat. 16,133, November 7, 1888. 6d.

ONE molecule of tetrazo-diphenyl, tetrazo-stilbene, tetrazo-fluorene, tetrazo-naphthalene, their homologues or sulphonic acids, is combined with one molecule of naphthylamine or one of the sulphonic acids of naphthylamine, and subsequently with one molecule of orcinol or its sulphonic acids, forming in this manner red dye-stuffs which dye cotton from an alkaline or soap-bath, the colour being fast to washing. 28 lb. of benzidine sulphate are diazotised and run into 25 lb. of sodium β -naphthylamine sulphamate, 100 lb. of sodium hydrate and 500 gallons of water. After stirring for 12 hours, 14·4 lb. of orcinol dissolved in water are added. The mixture is stirred for another 15 hours, raised to the boil, the dye-stuff salted out, filter-pressed and dried. Blue shades are obtained by using toluidine in place of benzidine, and also by employing Casella's naphthionic acid F in place of the naphthylamine sulphonic acid mentioned above. The colouring matters are insoluble in dilute acids, but soluble in alkalis and concentrated sulphuric acid.—T. A. L.

An Improved Manufacture of Para-diorg-benzol in Yellow Stable Crystals. S. Meyer, Berlin, Germany. Eng. Pat. 4404, March 13, 1889. 4d.

A HOT saturated solution of *p*-dihydroxybenzene (quinol) is treated with gaseous sulphurous acid. On cooling the solution, crystals of a bright yellow colour separate out. They contain a small quantity of sulphurous acid, and are much more stable than quinol both in the solid form and in solution. It is proposed to use this substance in a similar manner to quinol as a developer in photography.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

PATENT.

A Novel Method of Operating on Jute and Rhea Canes. J. R. Dry, London. Eng. Pat. 6581, May 2, 1888. 6d.

FOR the purposes of this invention the fibres are stripped off the stems in the form of "ribbons," which are laid in alternate layers, cross-wise, in crates or frames. The crates are then placed in tanks containing strong boiling soda solution. After remaining here for 15 minutes they are removed to another vessel containing a solution of soap, the strength being such that there is one pound of soap to five pounds of "ribbons." The solution is boiled for from 1½ to 3 hours. The material is rinsed in a bath of solution of soda of the same strength as that already referred to, and is then dipped in dilute sulphuric acid. If necessary, it is further treated with a weak solution of bleaching powder, after which it is thoroughly washed in cold water and dried by exposure to the air or by artificial heat.

—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

On some Chemical Properties of Wool and Allied Bodies, and on the Behaviour of these Bodies towards the Substantive Dyes. E. Knecht and J. R. Appleyard. J. Soc. Dyers and Colourists, 1889, 71—78.

THIS is a continuation of Knecht's paper "On the behaviour of the animal fibres towards the acid colouring matters" (this Journal, 1888, 621—623), in which the author endeavoured to produce further proofs in favour of the chemical theory of dyeing. By dissolving wool in sulphuric acid, and carefully neutralising the clear solution with soda, a precipitate was obtained which, when collected, washed, and dried, formed an amorphous brown powder, insoluble in water, but soluble in acids and alkalis. The solution in acids gave similar reactions with the acid coal-tar colours to those of the original solution. The authors have since endeavoured to purify this product, but found that after standing some time in the air it had become changed, being only partially soluble in alkalis; moreover, the yield from the wool was so small (less than 1 per cent.) that they were obliged to look for some better means for isolating the lake-giving constituent.

By dissolving wool in caustic soda,* and acidulating the solution with dilute sulphuric acid, a solution was obtained which showed properties identical with those of the original sulphuric acid solution. As the yield appeared to be much greater by this method, the authors therefore determined to discard the sulphuric acid solution and to restrict their attention to the solution in caustic alkali. After numerous futile attempts to isolate the lake-giving substance from the alkaline solution, they determined to try whether the so-called lanuginic acid, prepared from wool many years ago by Champion (Compt. Rend. 72, 330) possessed the property of precipitating the substantive dyes from their solutions. This was found to be the case, and they consequently prepared a quantity of this substance. The following was the *modus operandi*:—

About 500 grms. of Botany noils were first carefully washed and then dissolved in a moderately strong solution of barium hydrate. The barium was then precipitated by means of carbonic acid, and from the filtered solution the lanuginic acid was thrown down by means of lead acetate. After having removed all the excess of lead acetate by repeatedly washing with water, the lead salt was suspended in a large volume of water, and decomposed by sulphuretted hydrogen. The filtrate from the lead sulphide was evaporated to dryness. In this manner about 30 grms. of a brownish-yellow mass were obtained, which on grinding yielded a light dirty yellow powder. Here the authors were struck by a great discrepancy between their results and those of Champion, who described the product obtained as a light yellow deliquescent mass, while this was not in the least deliquescent. By working, however, exactly according to his method—viz., dissolving in barium hydrate, precipitating with carbonic acid, then with lead nitrate (instead of acetate), and decomposing the (perhaps not thoroughly washed) precipitate with sulphuretted hydrogen—on evaporating to dryness a product was obtained which corresponded exactly to his description; but it contained nitric acid, and there appeared to be no doubt that his also contained nitric acid. From analyses of the barium and lead salts, Champion ascribes to lanuginic acid the composition $C_{10}H_{20}N_2O_{10}$. The analyses agree indeed very closely with the formula, but he has left altogether out of consideration that the substance contains about 3 per cent. of sulphur, and his formulae cannot, therefore, be accepted as correct.

* The amount of caustic soda necessary to completely disintegrate the wool fibre was roughly estimated, and it was found that after boiling for three hours with 0·3 per cent. of caustic soda (of the weight of the wool), the fibre was not disintegrated, whereas when the amount was increased to 0·6 per cent., complete disintegration and almost complete solution had taken place.

The lanuginic acid obtained by the authors possesses the following properties:—It dissolves slowly in cold, easily in hot water. In alcohol it is sparingly soluble, in ether insoluble. The aqueous solution precipitates the acid and basic colouring matters forming coloured lakes. Tannic acid and bichromate of potash also yield precipitates. When heated to 100° it becomes soft and plastic, and this property is shown more strikingly by the coloured lakes, most of which melt at this temperature. If heated still further it swells up, turns brown and gives off a smell resembling that of burning wool. On ignition a considerable quantity of ash is left, which consists chiefly of barium carbonate. Suspecting that the reactions described might have been partially due to the presence of barium, the authors prepared a fresh quantity of the product by dissolving in caustic soda instead of barium hydrate, proceeding further as already indicated. The product obtained, which contained only a very small amount of ash, exactly resembled, however, the first product, not only in external appearance, but in all its properties.

The following further reactions were noted with the aqueous solution:—

Alum, in presence of sodium acetate, yields on standing a white precipitate.

Stannous chloride, in presence of sodium acetate, gives a similar precipitate.

Copper sulphate, in presence of sodium acetate, gives a light green curdy precipitate.

Ferric chloride, in presence of sodium acetate, yields a light brown precipitate.

Ferrous sulphate, in presence of sodium acetate, yields a dirty white precipitate.

Chrome alum, in presence of sodium acetate, a white precipitate.

Silver nitrate, in presence of sodium acetate, a white precipitate.

Platinum chloride yields a light yellow precipitate, which melts on heating.

Lanuginic acid parts with all its moisture at 110° C., the weight remaining constant when the temperature was raised to 130° C.

Lanuginic acid shows all the properties of a proteid, and may therefore be classed among the albuminoids; it is soluble in water at all temperatures, and its solution is not coagulated. With Millon's reagent, and with the double compound of phosphoric and tungstic acids, it shows the characteristic albuminoid reactions. An ultimate analysis yielded the following average percentage results:—

C=41.61; H=7.31; N=10.26; S=3.35; and O=31.44.
Total 93.97.

The nitrogen was estimated by Kjeldahl's method, and the sulphur by fusing with soda and saltpetre in a platinum crucible, and precipitating with barium chloride.

The product used in these estimations contained barium, which was estimated in the ash in the usual manner, and was taken into account in calculating the above percentages. It is noteworthy that this barium is combined so tenaciously with the lanuginic acid that it cannot be removed from the aqueous solution by means of carbonic acid. Another but more expensive method which the authors devised for isolating lanuginic acid is based upon the fact that the substance is completely thrown down by means of Night blue as a coloured lake. The method adopted was as follows:—Wool was dissolved in caustic soda, the solution slightly acidulated with sulphuric acid, and after filtering precipitated with a strong solution of Night blue. The Night blue lake was then decomposed with barium hydrate, which left behind the Night blue base in an insoluble state, while the lake-giving substance passed into solution. After precipitating the excess of barium with carbonic acid, the liquid was filtered and evaporated to dryness. The residue showed properties similar to the product obtained by the first method, and it appeared that the two substances were identical.

As is well known, wool is slowly changed by boiling water; at higher temperatures this change is still more marked. Leyer and Koller* first drew attention to the solubility of feathers, human hair, &c., in water at 200° C. Breinl describes the solution of wool in water at 200° C., and notes that the solution thus obtained also possesses the property of precipitating the substantive colouring matters. Previous to the publication of Breinl's results, the authors carried out the following experiment:—10 grms. of wool were heated with about 50 cc. of distilled water in a sealed tube for four hours to a temperature of 200°–230° C. On opening the tube there was a considerable pressure, and foul smelling gases, consisting chiefly of sulphuretted hydrogen, were given off. Most of the wool was dissolved, leaving a small quantity of a brown residue in the tube. The liquid, which was of a dirty orange colour, was strongly alkaline, owing to the presence of ammonia; it was distilled to about one-half of its volume, and the distillate, which was of a yellow colour, smelt strongly of ammonia. On evaporating the aqueous solution to dryness, a residue was obtained which resembled glue while hot, and, when cooled, solidified to a light brown hygroscopic mass, which weighed 5.5 grms. From the acidulated aqueous solution of this substance, ether extracted a light yellow oil, the smell of which resembles that of some of the higher fatty acids. The aqueous solution gave with sulphuric acid a yellow precipitate. Bichromate of potassium yielded with the filtrate from this a yellow precipitate. Hydrochloric acid also yielded a yellow precipitate, soluble in excess, and with this solution bichromate of potash gave a brown precipitate. Lead acetate yielded a light yellow precipitate, soluble in dilute nitric acid.

The acidulated aqueous solution yielded precipitates with the acid colours.

From these results it seemed probable that the aqueous solution of wool also contained lanuginic acid.

Horn boiled with caustic soda also dissolved, and the acidulated solution gave reactions similar to those of wool. Human epidermis, treated in a similar manner, was only partially dissolved, but the acidulated solution gave precipitates with the acid colours.

Sulphur in Wool.—Chevreul has shown that, by treating wool with alkalis, the greater part of the sulphur is removed as sulphuretted hydrogen, but he was not able to remove all in this manner. By steeping wool 28 times in lime water, 24 hours each time, and washing with hydrochloric acid between each treatment, he was able to reduce the percentage of sulphur to 0.46. The wool treated in this manner was no longer blackened by an alkaline solution of lead. It was thus shown that the sulphur in wool exists in two different forms.

Having found that lanuginic acid is not blackened by an alkaline solution of lead, the authors considered that the sulphur, which cannot be removed from wool by treatment with alkalis, must be contained in it, in this, or in a similar condition, and thought it of interest to estimate, quantitatively, the amount of sulphur which could be removed as sulphuretted hydrogen by another process.

For this purpose, the sulphur was estimated in wool by fusing with soda and saltpetre, and precipitating as barium sulphate. The sulphur removable by alkali was estimated by dissolving a known weight of wool in caustic soda, and passing the gas given off on acidulating, and boiling with sulphuric acid into decinormal iodine solution.

In the first experiment, wool containing 2.36 per cent. of sulphur was found to give off 1.66 per cent. as sulphuretted hydrogen; the rest, 0.70 per cent., remained in the liquid.

The percentage of sulphur (calculated on the total sulphur) evolved as sulphuretted hydrogen, was, according to this experiment, about 70 per cent.

In the second experiment, a different quality of wool was used. It contained 1.45 per cent. sulphur, of which 1.02 grm. (or again about 70 per cent. of the total) was given off as sulphuretted hydrogen. From the results of these two experiments, it would appear that the percentage of active to that of inactive sulphur in wool, is in a constant ratio.

Coloured Lakes from Wool.—Lanuginic acid precipitated in acidulated aqueous solution all the acid substantive dyes. The authors have prepared a large number of these coloured lakes, including those formed with Crystal scarlet, Orange, picric acid, Naphthol yellow S, Fast red, Naphthol black, Soluble blue, Acid violet, and indigo extract. All these lakes were intensely coloured; in cold water they were almost insoluble; in boiling water they mostly melted and partially dissolved, but separated out again on cooling. They were all easily soluble in alkalis, but re-precipitated by acids.

The *Picrate* was an orange precipitate, which, when finely ground, formed a bright yellow powder.

In preparing these lakes, the relative weights of the precipitates formed from the acidulated solution of wool in caustic soda were in nine cases roughly estimated. From 15 grms. of wool were obtained:—

	GRMS.	Per Cent.
Crystal scarlet lake	2.4	16.0
Fast red lake	2.5	16.6
Soluble blue lake	2.7	18.0
Orange lake,	3.1	20.6
Acid violet lake	2.9	19.3
Naphthol black lake	2.1	14.0
Picric acid lake	2.45	16.3

The lakes formed with the basic dyes may be obtained by adding the solution of the basic dye to the neutral solution of lanuginic acid. Most of these lakes differed from those formed by the acid dyes in being soluble in acids. In only one case—namely, that of magenta—was the weight of lake formed roughly estimated. 10 grms. of wool were dissolved in caustic soda, the solution carefully neutralised with sulphuric acid, and filtered. Excess of magenta was then added, and the precipitate formed was collected, washed and dried. It yielded 0.5 gm.

Maximum Amount of Colour absorbed by Wool in Dyeing.—In order to obtain an idea of the amount of colour which wool is capable of combining with, small pieces of flannel were dyed with a large excess of picric acid, Naphthol yellow S, and Tartrazin under similar conditions. The excess of colouring matter was then estimated in the residual solution in each case by titrating with Night blue. The amount of colour used was 50 per cent. of the weight of wool, and the dye-bath was acidulated with 50 per cent. of sulphuric acid. We found that the amount of acid used in dyeing did not materially affect the amount of colour fixed. Thus, whether 50 per cent. or 10 per cent. of sulphuric acid were used in dyeing with picric acid, exactly the same quantity was fixed. The maximum amount of colour had been fixed in the first hour; the amount fixed by prolonging the treatment to three hours was not greater. The estimation was effected by diluting the residual liquid to 2½ litres, and titrating the solutions thus obtained with a known quantity of Night blue.

The following amounts were fixed:—

(A.) PICRIC ACID.

	Time—1 hour.		Time—3 hours.
	I.	II.	III.
	Per Cent.	Per Cent.	Per Cent.
Amount fixed.....	13.00	13.3	13.20
Amount in solution.....	37.00	36.7	36.8
	50.00	50.0	50.00

These results were checked by estimating the actual increase in weight of a piece of flannel weighing 10 grms.,

after dyeing with 50 per cent. of picric acid, and were found to agree with those already obtained.

(B.) NAPHTHOL YELLOW S.—Time—1 hour.

	Per Cent.
Amount fixed	20.8
Amount in solution	29.2
	50.0

(C.) TARTRAZIN.—Time—1 hour.

	Per Cent.
Amount fixed.....	22.65
Amount in solution.....	27.35
	50.0

The temperature was in each case 100° C.

These figures show something very striking and interesting. Taking the amount of picric acid absorbed by wool as a basis, it is easy to calculate that the amounts of Naphthol yellow S and Tartrazin are almost exactly 1 and $\frac{3}{4}$ mol. respectively.

	Calculated.	Found.
	Per Cent.	Per Cent.
Picric acid	—	13.3
Naphthol yellow (1 mol.)	20.6	20.8
Tartrazin (1 mol.)	23.1	22.6
Crystal violet (1 mol.)	7.94	18.4

The amount of basic dyes absorbed is considerably less. Only one estimation was made, viz., in the case of Crystal violet. The amount of this dye absorbed, under similar conditions as already given, was found to be only 8.4 per cent. This corresponds to one-third of a molecule.

Summary and Conclusions.—The main object of this investigation was to establish as clearly as possible the correctness of the chemical theory of dyeing. During the course of their work a number of other points have been elicited, which the authors have considered of sufficient interest to include in the paper. They isolated from wool a substance soluble in water, which possesses most of the characteristic properties of keratine. It yielded precipitates with all the metallic salts used in mordanting, and also coloured precipitates with the substantive dyes. That actual chemical combination takes place was shown by the analysis of the picrate, which latter was found to contain sulphur as an essential constituent, whereas picric acid itself contains no sulphur. The percentages of carbon, hydrogen, nitrogen, and oxygen also point to the existence of a new compound.

It was not the wish of the authors to assert definitely that lanuginic acid exists as such in the wool, although it might be assumed that it is held there in an insoluble state by some other constituent of the fibre. They considered it more correct to assume that lanuginic acid is a simple decomposition product, or a more soluble form of that portion of the wool not yielding up its sulphur to alkalis.

Assuming, however, this hypothesis to be correct, all the reactions which take place in the mordanting and dyeing of wool might be explained by means of it. So far as mordanting is concerned, it had hitherto been asserted that when wool was boiled with solutions of the metallic salts a more or less complete dissociation of the salt took place, and the hydrate, or a very basic salt, became precipitated on the fibre. It appears now more probable that the mordants are not fixed in this manner, but actually combine with a constituent of the wool to form different chemical compounds, like those which have actually been produced from the solution of lanuginic acid. These compounds are capable of yielding coloured lakes with the adjective dyes, a property which is not possessed in all cases by the metallic hydrates themselves. Thus it was found that, whereas a solution containing Alizarin S, oxalic acid, and alum, could be boiled for an indefinite period without under-

going any apparent change, when lanuginic acid was added a bright scarlet precipitate rapidly formed at the boiling temperature. A similar reaction was noticed with cochineal, stannous chloride and oxalic acid.

The behaviour of wool towards the colouring matters is still more noteworthy. Here again the theory of simple mechanical absorption is quite out of question. This has already been made evident by the results of investigations already published by Knecht. The quantitative results which were obtained with picric acid, Naphthol yellow, and Tartrazin are especially noteworthy, and point unmistakably to strictly chemical reactions between the fibre and the colouring matters. The behaviour of Alkali blue was one which the authors could not at first easily explain, but they found subsequently that it was precipitated in neutral solution by lanuginic acid, and that the colour of the precipitate became considerably darker on the addition of sulphuric acid. An interesting result was also obtained with a solution of camwood in very dilute soda, which yields, with lanuginic acid, a copious red-brown precipitate, thus explaining the curious behaviour of this class of insoluble woods in wool dyeing.

Knecht further drew attention to the difficulty of completely removing the natural grease from wool by means of bisulphide of carbon. Wool was first treated with hydrochloric acid, in order to decompose any lime soap which the fibre might contain; it was then dried and extracted for three hours in a Soxhlet with bisulphide of carbon. Wool treated in this manner, then dissolved in caustic soda, gave with sulphuric acid a precipitate which when dried and ground was found on extracting again with bisulphide to contain grease which in its properties resembled cholesterol. From this it would appear that the woollen fibre contained grease in its interior not easy to remove on account of the dense character of the fibre.—E. K.

PATENTS.

Improvement in the Art or Process of Dyeing Cotton.
H. Gross, Crimmitschau, Saxony. Eng. Pat. 6029, April 23, 1888. 4d.

For the purpose of dyeing black on cotton, without the employment of a special mordanting process, a decoction of the common heath (*Erica vulgaris*) is added to the dye-liquor containing the dye-wood extract, together with catechu, copper sulphate, chromate of potash, borax, and bicarbonate of soda. The cotton is dyed in one bath, and it is claimed that a colour is obtained which is fast to light, whilst the rinsing-water is not appreciably polluted.—W. E. K.

Improvements in Apparatus for Treating Textile Materials with Liquids, Gases, or Vapours. W. Mather, Salford. Eng. Pat. 1172, January 22, 1889. 11d.

THE present invention relates to improvements in the construction of the apparatus described in Eng. Pats. 1912, 3096, and 8793 of 1885, and 10,053 and 15,343 of 1886, whereby the opening and closing of the doors is facilitated, and the charging, discharging, and circulation of the fluids employed are rendered more easy and effective.—E. J. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Contributions to the History of the Ammonia-Soda Process.
R. Lucien. Chem. Zeit. 13, 627.

As in the case of many important discoveries, so in that of the origin of the ammonia-soda process, there has been considerable contention on the question of priority.

The French have ascribed the honour of the discovery to Schöslöng and Rolland (1854), whereas it is easy to prove

that Hemming and Dyar, in 1838, had set up apparatus for manufacturing soda by the aid of this process; and still earlier, John Thom had made his friend, the late Dr. R. Angus Smith, acquainted with the intrinsic reaction on which the process depends. (This Journal, 1885, 527—529.) A. Vogel has, however, discovered an indication of the knowledge of this now well-known double decomposition in his father's notebook, and dated 1822.

W. Cesaro, of the University of Lüttich, in examining the correspondence of Fresnel, finds that this great physicist had tried the ammonia process in the year 1811, and had commended it to the attention of Thénard, Vanquelin, Darcet, and Chevreul; but these savants took no further interest in the reaction, and failed to recognise any important future for it.

The following are the extracts from the correspondence of L. Mérimée with his nephew, A. Fresnel. The delay in the reproduction of this evidence for so long is doubtless due to the fact that it is fragmentary, and the links in the chain must be connected; in other words, the extracts from several letters read together, in order that a correct conclusion may be arrived at.

Paris, 5 Août 1811.

... Mr. Vanquelin a paru flatté de ta confiance en lui et va répéter tes expériences. Je suis allé le revoir avant hier. Il n'avait pas encore commencé. Je pense, moi indigne, que tu ne l'es pas trompé et ce qu'il y a de piquant, c'est qu'un très habile fabricant de Soude, Mr. Darcet, a essayé ton moyen

31 Octobre 1811.

... Je rapporte encore de Mr. Vanquelin des promesses de vérifier tes expériences et l'opinion on il est qu'elles doivent réussir. Ce qui me donne un peu plus confiance dans ces nouvelles promesses, c'est qu'il doit charger son élève Mr. Chevreul et la besogne En attendant tu pourrais employer tes soirées à répéter un peu plus en grand ton expérience dans l'intention de déterminer ce que tu perds de carbonate d'ammoniaque.

Paris, 14 Avril 1812.

... Thenard m'a répondu que ton procédé est bon, mais il lui paraît plus dispendieux que celui qu'on suit Ce pendant il le trouve susceptible d'être exécuté en grand, surtout dans une fabrique de muriate d'ammoniaque.

If these passages be compared with a communication of L. Fresnel's, according to which the famous creator of the modern science of physical optics, prior to commencing his studies in this branch, busied himself with the question of the cheap production of soda from common salt, the conclusion is inevitably enforced that the gist of this question was the obtainment of soda from common salt and ammonium carbonate, with collateral formation of ammonium chloride.—W. S.

On the Disengagement of Chlorine during the Decomposition of Chlorates by Heat. W. Spring and E. Prost. Bull. Soc. Chim. 1889, 340—342.

THE authors refer to Wagner's work (Zeits. Anal. Chem. 24, 508), in which it is shown that pure chlorate of potassium does not yield chlorine when heated, while the commercial salt does; but the pure chlorate yields oxygen containing a small quantity of chlorine when heated in a current of carbonic anhydride. Wagner has attributed the origin of this chlorine partly to organic matters in the commercial chlorate and partly to the chlorate of calcium which it often contains; but he does not explain the manner in which these bodies act, and he does not connect the facts observed with other known phenomena.

The authors have attempted to supply this deficiency. They have submitted to the action of heat the chlorates of nine different metals (K, Na, Ba, Al, Ag, Cu, Zn, Pb, Hg), heating them, according to circumstances, in platinum or porcelain vessels, at first alone, dry or moist, then in contact with carbonic anhydride, silicic anhydride, and phosphoric anhydride.

In each case the manner of heating was varied, either rapidly or slowly. The following shows the results of the experiments:—

Proportion per Cent. of Chlorine disengaged.

Chlorate of	Chlorate heated slowly in contact with					Chlorate heated rapidly in contact with				
	Platinum.	Porcelain.	SiO ₂ .	CO ₂ .	P ₂ O ₅ .	Platinum.	Porcelain.	SiO ₂ .	CO ₂ .	P ₂ O ₅ .
K.....	..	0.02	1.08	0.27	2.18	0.03	0.05	0.72	0.50	55.85
Na.....	0.03	0.08	1.30	1.17	8.10	0.12	..	..	..	98.32
Ba.....	..	0.28	0.37	0.75	..	..	..	..	..	..
Al.....	97.87	..	..
Ag.....	..	0.10	1.11	0.56	..	..	..	8.65	..	..
Cu.....	..	12.55	14.70	13.20	..	..	..	91.20	..	..
Zn.....	..	11.45	26.78	48.50	..	..	..	95.10	..	..
Pb.....	..	8.05	10.76	..	..	..	..	16.00	..	..
Hg.....	..	3.70	2.00	2.10	..	..	..	100.00	..	..

The majority of the chlorates decomposed so quickly on being rapidly heated or in contact with P₂O₅ that it was impossible to measure the chlorine set free.

Conclusions.—The proportion of chlorine disengaged greatly varies with the nature of the chlorate and the circumstances. It is, however, noticeable that it increases when the chlorate has a relatively feeble base, and above all when the decomposition takes place in presence of an anhydride capable of forming a salt with the base of the chlorate.

According to the authors' view, the production of oxygen from the decomposition of the chlorates by heat is not an immediate but an indirect phenomenon. They split up at first into a base and an anhydride, according to the equation, $2\text{MClO}_3 = \text{M}_2\text{O} + \text{Cl}_2\text{O}_5$ (M being a monovalent metal). The anhydride is immediately decomposed into chlorine and oxygen, the former uniting with the base, thus:—

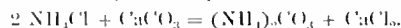


In cases where a notable increase of chloride is observed when the heat is rapidly applied, it appears that the chlorine is not carried away in the gaseous product if it be allowed time to react with the base, which is set at liberty for an instant, at least. The reaction is incomplete if the chlorine is carried away by its violence, or if the base form a salt on which the chlorine has no action (silicate or phosphate).

Finally, when the base is sufficiently strong (K₂O) the chloric anhydride may be further oxidised and a perchlorate produced.—W. M.

On the Action of Calcium Carbonate on Ammonium Chloride in Aqueous Solution. H. Schreib. Zeits. f. angew. Chem. 1889, 211—213.

CALCIUM carbonate has no action on a cold solution of ammonium chloride, but with the aid of heat decomposition takes place according to the equation—



The author finds by laboratory experiments that the decomposition may be complete whether the calcium carbonate or ammonium chloride be in excess, but much time is always taken up in the later stages of the reaction. The degree of fineness of the calcium carbonate exercises a very important influence on the rapidity of the reaction whilst the presence or absence of a small proportion of magnesium chloride is immaterial. The fact that this reaction yields carbonic acid along with ammonia would render it applicable to the treatment of ammonium chloride liquors in the ammonia-soda process if the time required were not so considerable, though the author considers that it might still be made available by the use of the finely-divided precipitate of calcium carbonate obtained in the manufacture of caustic soda, and the subsequent addition of a small proportion of quicklime to hasten the end of the reaction. The following table shows the mean results of two experiments in each case, in which 5 grms. of ammonium chloride in aqueous solution were decomposed with 7 grms. of each form of calcium carbonate in a fine state of division, in a flask through which a strong current of steam was passing. The evolved ammonium carbonate was received in successive portions of normal sulphuric acid:—

Material used.	Marble.	Ordinary Chalk.	Caustic Sludge.	Precipitated Calcium Carbonate.
20 cc. of N acid = 1.070 grm. of NH ₄ Cl = 21.40 per cent. decomposed in minutes	18	7	5	7
20 " " 1.070 " " 21.40 " " "	23	11	5	8
20 " " 1.070 " " 21.40 " " "	31	37	27	22
20 " " 1.070 " " 21.40 " " "	64	54	32	25
13 " " .695 " " 13.91 " " "	88	78	55	43
93 " " 4.975 " " 99.51 " " "	224	187	124	105

The author observes that the process would hardly be applicable to a continuous method of working, but would present no obstacle where the apparatus was worked intermittently.—G. H. B.

PATENTS.

New or Improved Method and Apparatus for Extracting Magnesia from Sea Water. L. G. G. Dandenart, Brussels, Belgium. Eng. Pat. 5953, April 24, 1888. 8d.

THE sea water is treated with slaked lime and the magnesium hydrate formed, allowed to settle by making the

liquors traverse very slowly extensive settling tanks. The slush deposited therein is carbonated, and the magnesium carbonate filter-pressed and dried.—S. H.

Improvements in Distilling, Purifying, and Concentrating Ammoniacal and other Liquids. P. A. Mallet and T. A. Pagniez, Paris, France. Eng. Pat. 7285, May 16, 1888. 8d.

THE object of this invention is the production of an apparatus by means of which a constant supply of solid reagents is obtained in distilling vessels. The distilling column, described in Eng. Pat. 3452 of 1884 (this Journal, 1885, 195) is connected with a hopper, at the bottom of which revolves an endless feeding screw at a convenient speed. The hopper is also fitted with a stirring mechanism, which prevents the clogging of the material inside the hopper. When distilling ammoniacal liquors burnt lime is continuously supplied by this hopper to the column.—S. H.

Improvements in the Process and Apparatus Used for Obtaining Anhydrous Liquid Ammonia. G. S. Page, New York, U.S.A. Eng. Pat. 8351, June 7, 1888. 8d.

AMMONIACAL liquor is treated with steam in a still to drive off the ammonia, which after passing through several purifiers, is absorbed in distilled water. The concentrated solution of ammonia thus obtained is heated by a steam-coil, and the gaseous ammonia again liberated, made to pass through a receiver containing caustic lime, which eliminates all aqueous vapours. The gas is then admitted into a compressor where it is converted into a liquid.—S. H.

An Improved Process for the Manufacture of Sugar of Lead. J. Löwe, Frankfurt-on-the-Main, Germany. Eng. Pat. 9858, July 6, 1888. 6d.

GRAVITATED or sheet lead is digested with acetic acid and such a quantity of oxygen-yielding compounds, such as nitric acid, nitric or nitrous salts of lead, sodium or potassium nitrate, lead peroxide, &c., as will just suffice to completely oxidise the lead. The whole is then heated nearly to boiling point, whilst the vapours evolved are condensed and permitted to flow back into the liquid. In order to carry out this process, 54—55 parts of dilute nitric acid of 1·2 sp. gr., 145 parts of 40 per cent. acetic acid, and 100 parts of lead are heated nearly to boiling until the metal is dissolved. The solution obtained, consisting of neutral lead acetate, is evaporated down to crystallisation.

—S. H.

An Improved Construction of Kiln for Burning Limestone. J. Winskill, jun., York. Eng. Pat. 4286, March 12, 1888. 6d.

THE kiln consists of two vertical chambers, which are connected by an elbow. Fuel and limestone are charged in alternate layers into the top chamber, while the burnt lime is withdrawn from time to time from the bottom. The working of the kiln is thereby rendered continuous.—S. H.

Improved Method and Apparatus for Calcination of Limestone. G. E. Carleton, Rockport, U.S.A. Eng. Pat. 4325, March 12, 1889. 8d.

THE object of this invention is the production of a kiln in which the heat is uniformly distributed, and the fuel thoroughly burned, whereby injury to the kiln is prevented and economy of the fuel secured. To attain this end, an air-blast is applied underneath the grate, while a jet of steam or water is at the same time injected in front or over the bed of coal in the fire-chamber. Provision is also made to supply an extra amount of air to the combustion chamber whenever a fresh supply of coal is added to the fire.—S. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

PATENTS.

Improvements in the Manufacture of Artificial Stone. A. C. Ponton, Parkstone, B. L. Mosely, and C. Chambers, Hastings. Eng. Pat. 5808, April 18, 1888. 6d.

VARIOUS materials, such as silicates, fluorspars, felspars, micas, &c., are taken according to the stone—marble or granite, for example—which is to be imitated. These substances can be either employed as fine powders or in pieces of varying size. The materials are mixed with a siliceous cement, averaging from 1 to 6 per cent. of anhydrous silica to each cubic foot of the fabricated hard stone, a plastic mass being thus obtained. The siliceous cement consists of silicates of potash or soda, with or without the addition of free silica. The mass thus obtained is moulded by great pressure to any required form, and then fired at a red or white heat in a porcelain kiln "until all, or nearly all, of the contained silica has been converted into the tridymite form of crystallisation." If the mass is too porous, it is again treated with the siliceous liquid until saturated, and then re-fired."

The term "Tridymite" is applied "not only to loose burnt sand and burnt flint, but also to a compacted or moulded mass of material after it has been fired in a kiln, in which case it includes the contained silica that was previously in a state of solution."—S. G. R.

Improvements in or Relating to the Utilisation of the Lime-Mud Refuse of Sugar and other Industries for Cement and other Purposes. J. S. Rigby, Liverpool. Eng. Pat. 7456, May 19, 1888. 6d.

THE lime-mud obtained in the manufacture of sugar, borax, &c., is mixed with clay or other earthy silicates and calcined, and is then used as ordinary cement. The carbonic acid gas liberated in the calcination is utilised for decomposing more saccharate of lime, or for other purposes. When the mud is impure, methods are indicated by which it can be purified; thus sulphides are removed by carbonic acid gas, and caustic alkali by washing.—S. G. R.

Improvements in the Manufacture of Portland Cement. A. Fleiner, H. Hauenschield, and A. Bauermeister, Switzerland. Eng. Pat. 7915, May 30, 1888. 8d.

THE substances, having been ground and mixed, are worked into a plastic condition with water. The mixture is then forced through an ordinary brick-moulding machine with cylindrical mouthpieces, and cut into lengths equal to the diameter of the cylinder. The pieces so obtained are made roughly spherical by being placed in inclined tubes having repeated corners or bends, and are then burnt in shafts or pit kilns, the process being a continuous one. To prevent the balls from caking together during the drying or burning, powdered limestone or some other non-smelting substance is strewn into the tubes down which the balls are rolling. The burnt cement should be drawn off at the bottom of the kiln at intervals not exceeding three hours.

—S. G. R.

A New Combination of Machinery for Mixing or Making Cement. T. C. Fawcett and T. Castle, Leeds. Eng. Pat. 8879, June 18, 1888. 8d.

THE substances to be employed, such as chalk and clay, are ground and at the same time mixed in an ordinary grinding pan with perforated bottom. They then pass into a mixer furnished with revolving screws, which first thoroughly mix and then force the mass between revolving rollers to be further ground. The homogeneous mixture is then conveyed by means of an endless travelling belt either to the kilns or to the drying floor. The specification is illustrated by drawings of the required machinery.—S. G. R.

Improvements in and Relating to the Seasoning or Preserving of Wood. R. Haddon, London. From S. E. Haskin, Avoca, U.S.A. Eng. Pat. 3875, March 5, 1889. *Sd.*

Wood is usually seasoned or "vulcanised" by being placed in a chamber, the air in which is heated by steam-coils. These being of great length, are very apt to leak, and the steam thus allowed to escape spoils the wood under treatment. The inventor therefore uses apparatus by which heated air, from which the moisture has been previously removed, is passed into the chamber. If the air, however, at a gradually increasing temperature be merely introduced, then at a certain point, the sap in the wood begins to boil and vaporise, thus damaging the quality of the fibre. In order to prevent this, the pressure in the chamber is increased *pari passu* with the temperature. As the wood is allowed to cool the temperature and pressure are again reduced simultaneously. The chamber is made of heavy riveted steel plates, and with removable cylinder heads. The wood is introduced on small trucks running on rails within the chamber. It is claimed that the process is much less expensive than the ordinary one, and also that the value of the seasoned article is increased. A drawing of the apparatus is given.—S. G. R.

X.—METALLURGY.

Aluminium. Sir H. E. Roscoe. Royal Institution Lecture, May 1889.

THE production of aluminium, previous to 1887, probably did not exceed 10,000 lb. per annum. The magnitude of the undertaking assumed by the Aluminium Company may be estimated, when we learn that they erected works having an annual producing capacity of 100,000 lb. of aluminium. The works now cover a space of nearly five acres. They are divided into five separate departments, viz., 1st, sodium; 2nd, chlorine; 3rd, chloride; 4th, aluminium; 5th, foundry; rolling, wire mills, &c.

1. *Manufacture of Sodium.* "Castner Process."

The vessels in which the charges of alkali and reducing material are heated are of egg-shaped pattern, about 18 in. in width at their widest part and about 3 ft. high, and are made in two portions, the lower one being actually in the form of a crucible, while the upper one is provided with an upright stem and a protruding hollow arm. This part of the apparatus is known as the cover. In commencing the operation, these covers are raised in the heated furnace through apertures provided in the floor of the heated chamber, and are then fastened in their place by an attachment adjusted to the stem; the hollow arm extends outside the furnace. Directly below each aperture in the bottom of the furnace are situated the hydraulic lifts, attached to the top of which are the platforms upon which are placed the crucibles to be raised into the furnace. Attached to the hydraulic lifts are the usual reversing valves for lowering or raising, and the platform is of such a size as, when raised, completely to fill the bottom aperture of the furnace. The charged crucible, being placed upon the platform, is raised into its position, the edges meeting those of the cover, forming an air-tight joint which prevents the escape of gas and vapour from the vessel during reduction, except by the hollow arm provided for this purpose. The natural expansion of the iron vessels is accommodated by the water-pressure in the hydraulic lifts, so that the joint of the cover and crucible are not disturbed until it is intended to lower the lift for the purpose of removing the crucible.

The length of time required for the first operation of reduction and distillation is about two hours. At the end of this time the crucibles are lowered, taken from the platforms by a large pair of tongs on wheels, carried to a dumping pit, and thrown on their side. The residue is

cleaned out, and the hot pot, being again gripped by the tongs, is taken back to the furnace. On its way, the charge of alkali and reducing material is thrown in. It is again placed on the lift and raised in position against the edges of the cover. The time consumed in making the charge is $1\frac{1}{2}$ minutes, and it only requires about seven minutes to draw, empty, recharge, and replace the five crucibles in each furnace. In this manner the crucibles retain the greater amount of their heat, so that the operation of reduction and distillation now only requires one hour and ten minutes. Each of the four furnaces, of five crucibles each, when in operation, are drawn alternately, so that the process is carried on night and day.

Attached to the protruding hollow arm from the cover are the condensers, which are of a peculiar pattern specially adapted to this process, being quite different from those formerly used. They are about 5 in. in diameter, and nearly 3 ft. long, and have a small opening in the bottom about 20 in. from the nozzle. The bottom of these condensers is so inclined that the metal condensed from the vapour issuing from the crucible during reduction flows down and out into a small pot placed directly below this opening. The uncondensed gases escape from the condenser at the further end, and burn with the characteristic sodium flame. The condensers are also provided with a small hinged door at the further end, by means of which the workmen from time to time may look in to observe how the distillation is progressing. Previous to drawing the crucibles from the furnace for the purpose of emptying and recharging, the small pots each containing the distilled metal (on an average about 6 lb.) are removed, and empty ones substituted.

The temperature of the furnaces are kept at 1,000° C., and the gas and air valves are carefully regulated so as to maintain as even a temperature as possible. A furnace in operation requires 250 lb. of caustic soda every one hour and ten minutes, and yields in the same time 30 lb. of sodium, and about 240 lb. of crude carbonate of soda. The residual carbonate, on treatment with lime in the usual manner, yields two-thirds of the original amount of caustic operated upon.

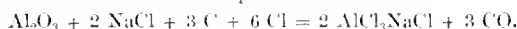
2. *Chlorine Manufacture.*—The usual method is employed. The gas is led into four gasometers, each of which is capable of holding 1,000 cu. ft. of gas, and is completely lined with lead, as are all connecting mains, &c.

3. *Manufacture of Double Chloride of Aluminium and Sodium.*—Twelve large regenerative gas furnaces are used for heating, and in each of these are fixed horizontal fire-clay retorts about 10 ft. in length, into which the mixture for making the double chloride is placed. These furnaces have been built in two rows, six on a side, the clear passageway down the centre of the building, which is about 250 ft. long, being 50 ft. in width. Above this central passage is the staging, carrying the large lead-mains for the supply of the chlorine coming from the gasometers. Opposite each retort, and attached to the main, are situated the regulating valves, connected with lead and earthenware pipes, for the regulation and passage of the chlorine to each retort. The valves are of peculiar design, and have been so constructed that the chlorine is made to pass through a certain depth of liquid, which not only by opposing a certain pressure allows a known quantity of gas to pass in a given time, but also prevents any return from the retort into the main.

The mixture for the retorts is made by grinding together hydrate of alumina, salt, and charcoal moistened with water, and by means of a pug mill the mass is forced out into solid cylindrical lengths; a workman with a large knife cuts the material into lengths of about 3 in. each. These are then piled on top of the large furnaces to dry. The retorts, when at the proper temperature, are charged by throwing in the balls until quite full, the fronts are then sealed up, and the charge allowed to remain undisturbed for about four hours, during which time the water of the alumina hydrate is completely expelled. At the end of this time the valves on the chlorine main are opened, and the gas is allowed to pass into the charged retorts. In the rear of each retort, and connected therewith by means of an earthenware pipe, are the condenser boxes which are built in brick. These boxes are provided with doors, and

also with earthenware pipes, connected with a small flue for carrying off the uncondensed vapours to the large chimney. At first the chlorine passed into each retort is all absorbed by the charge, and only carbonic oxide escapes into the open boxes, where it burns. After a certain time, however, dense fumes are evolved, and the boxes are then closed, while the connecting pipe between the box and the small flue serves to carry off the uncondensed vapours to the chimney.

The reaction which takes place is as follows:—



The chlorine is passed in for about 72 hours in varying quantity, the boxes at the back being opened from time to time by the workmen to ascertain the progress of the distillation. At the end of the time mentioned, the chlorine valves are closed and the boxes at the back of the furnace are thrown open. The crude double chloride, as distilled from the retorts, condenses in the connecting pipe and trickles down into the boxes, where it solidifies in large irregular masses. The yield from a bench of five retorts will average from 1,600 to 1,800 lb., which is not far from the theoretical quantity. After the removal of the crude chloride from the condenser boxes the retorts are opened at their charging end, and the residue is remixed in certain proportions with fresh material to be used over again. The furnace is immediately recharged and the same operations repeated, so that from each furnace upwards of 3,500 lb. of chloride are obtained weekly.

1. Aluminium. Reduction of the Double Chloride by Sodium.—This is effected in a large reverberatory furnace, having an inclined hearth about 6 ft. square, the inclination being towards the front of the furnace, through which are several openings at different heights. The pure chloride is ground together with cryolite in about the proportions of two to one, and is then carried to a staging erected above the reducing furnace. The sodium, in large slabs or blocks, is run through a machine similar to an ordinary tobacco-cutting machine, where it is cut into small thin slices; it is then transferred to the staging above the reducing furnace. Both materials are now thrown into a large revolving drum, when they become thoroughly mixed. The drum being opened and partially turned, the contents drop out into a car on a tramway directly below. The furnace having been raised to the desired temperature, the dampers of the furnace are all closed to prevent the access of air, the heating gas also being shut off. The car is then moved out on the roof of the furnace until it stands directly over the centre of the hearth. The furnace roof is provided with large hoppers, and through these openings the charge is introduced as quickly as possible. The reaction takes place almost immediately, and the whole charge quickly liquefies. At the end of a certain time the heating gas is again introduced and the charge kept at a moderate temperature for about two hours. At the end of this period the furnace is tapped by driving a bar through the lower opening, which has previously been stopped with a fire-clay plug, and the liquid metal run out in a silver stream into moulds placed below the opening. From each charge, composed of about 1,200 lb. of double chloride, 600 lb. of cryolite, and 350 lb. of sodium, about 115 to 120 lb. of aluminium is obtained. The composition of the metal, as shown by analysis, is 99.2 aluminium, 0.3 silicon, and 0.5 iron.

Eight or nine charges are laid on one side, and then melted down in the furnace to make a uniform quality, the liquid metal, after a good stirring, being drawn off into moulds. These large ingots, weighing about 60 lb. each, are sent to the casting shop, there to be melted and cast into the ordinary pigs, or other shapes, as may be required for the making of tubes, sheets, or wire, or else used directly for making alloys of either copper or iron.

The following table shows approximately the quantity of each material used in the production of one ton of aluminium:—

Metallic sodium	6,300 lb.
Double chloride	22,000 "
Cryolite	8,000 "
Coal	8 tons

To produce 6,300 lb. of sodium is required:—

Caustic soda	44,000 lb.
Carbide made from pitch, 12,000 lb. and iron turnings, 1,000 lb.	7,000 "
Crucible castings	2½ tons
Coal	75 "

For the production of 22,400 lb. double chloride is required:—

Common salt	8,000 lb.
Alumina hydrate	11,000 "
Chlorine gas	15,000 "
Coal	180 tons

For the production of 15,000 lb. of chlorine gas is required:—

Hydrochloric acid	180,000 lb.
Limestone dust	45,000 "
Lime	30,000 "
Loss of manganese	1,000 "

Properties of Aluminium.—After being cast it has about the hardness of pure silver, but may be sensibly hardened by hammering. Its tensile strength varies between 12 and 14 tons to the inch; ordinary cast iron being about 8 tons. Comparing the strength of aluminium in relation to its weight, it is equal to steel of 38 tons tensile strength. The fusibility of aluminium has been variously stated as being between that of zinc and silver, or between 600° and 1,000° C. The author's experience, that a small increase in the percentage of contained iron materially raised its point of fusion, was corroborated by Professor Carnelley, who found that a sample containing half per cent. of iron had a melting point of 700° C.; whereas sample containing 5 per cent. of iron does not melt at 700°, and only softens somewhat above that temperature, but undergoes incipient fusion at 730°.

Air, either wet or dry, has absolutely no effect on aluminium at the ordinary temperature, but this property is only possessed by a very pure quality of metal, and the pure metal in mass undergoes only slight oxidation, even at the melting point of platinum.

Leaf aluminium, when heated in a current of oxygen, burns with a brilliant bluish-white light. Heated in an atmosphere of chlorine it burns with a vivid light, producing aluminium chloride.

Alloys of Aluminium.—The most important alloys of aluminium are those made with copper. To arrive at perfection in making of these alloys, not only is it required that the aluminium used should be of good quality, but that only the best brands of Lake Superior copper should be used. The alloys all possess a good colour, polish well, keep their colour far better than all other copper alloys, are extremely malleable and ductile, can be worked either hot or cold, easily engraved, the higher grades have an elasticity exceeding steel, are easily cast into complicated objects, do not lose in remelting, and are possessed of great strength dependent on the purity and percentage of contained aluminium.

An important use of aluminium seems to be its employment in the iron industry, of which it promises shortly to become a valuable factor, owing to certain effects which it produces when present in the most minute proportions. Experiments are now being carried on at numerous iron and steel works in England, on the Continent, and in America. The results so far attained are greatly at variance, for whilst in the majority of cases the improvements made have encouraged the continuance of the trials, in others the result has not been satisfactory. On this point the author wishes to say to those who may contemplate making use of aluminium in this direction, that it would be advisable before trying their experiments to ascertain whether the aluminium alloy they may purchase actually contains any aluminium at all, for some of the so-called aluminium alloys contain little or no aluminium. Again, others contain such varying proportions of carbon, silicon, and other impurities as to render their use highly objectionable.

Aluminium added to molten iron and steel lowers their melting points, consequently increases the fluidity of the metal, and causes it to run easily into moulds and set

there, without entrapping air and other gases, which serve to form blow-holes and similar imperfections.

One of the most remarkable applications of this property which aluminium possesses of lowering the melting point of iron has been made use of by Nordenfelt in the production of castings of wrought iron.—F. S.

PATENTS.

A Method of sorting Minerals or other Bodies, and Apparatus therefor. G. Kilgour, London. Eng. Pat. 6348, April 28, 1888. 8d.

In place of the usual water-way with a running stream, a moving channel in still water is employed. The accompanying drawing illustrates the apparatus as a hand machine. A is a water tank; B a vertical spindle carrying a horizontal disc C with a portion of its centre cut away, and on which a spiral wall is built, producing a spiral channel D (Fig. 2),

Fig. 1.

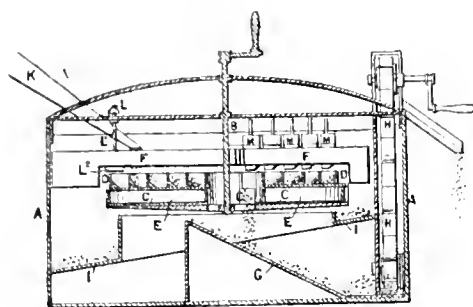
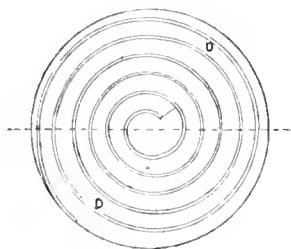


Fig. 2.



from the periphery to the centre of the disc. The crushed ore is fed through the shoot K into the channel at the periphery of the revolving disc, where it is washed by the still water, which is prevented from revolving with the disc by fixed blades F. The periphery travelling more quickly than the part nearer the centre, the ore on its introduction is first washed with the strongest stream motion, after which it is subjected to the gradually diminishing force of the same, with the result that the heavier particles of material separate and settle down in the channel from the periphery to the centre in the order of their specific gravities, and the lighter portions or tailings are carried right through and washed through the opening G. G is an inclined shoot, on to which the tailings fall and down which they gravitate to the side of the tank, whence they can be removed by any means or by the chain elevator H. I is an inclined shoot into which the heavy material is discharged and conveyed to the other side of the tank to be removed by any convenient means. L is a bell operated by a lever L' connected with a blade L'', and signals when sufficient deposit has accumulated in the channel D to require removal. The channel is cleared by reversing the disc and lowering the scrapers M sliding on radial arms F.

A larger range of velocity can be obtained by having one or more discs placed below the first one in such a position that the material from the centre of the upper falls into the periphery of the lower one. The bed of the channel may be horizontal, or may slope at any angle or as a curve, either upwards or downwards towards the centre, according as the force of gravity is required to add to or diminish the differential effect of the spiral. Many advantages are claimed for this apparatus, amongst which may be mentioned that the amount of water necessary is extremely small; that since the tailings sink through the water the float gold is not carried away with them, but is collected on the surface of the water, from which it can be removed by an occasional revolution of a blanket; and that a channel 340 ft. long and 1 ft. wide will be obtained by a disc only 20 ft. in diameter. The apparatus can also be used as an amalgamator for the treatment of auriferous crushed ore, in which case the disc is made of copper and amalgamated in the ordinary way. Other drawings than the above are given.—A. W.

Improvements in Apparatus or Plant for preventing Loss in the Smelting of Ores, Metals, or Compounds of Zinc or other Oxidisable Metallic Substances, and Ores or Wastes of them. F. Fenton, Batley, and R. J. Partridge, Grasmere, From J. Woolford, Brioude, France. Eng. Pat. 7257, May 16, 1888. 8d.

THE vapours or gaseous compounds of zinc or other metals from furnaces are condensed by the aid of water spray or steam intermixed with air in a series of chambers and pipes through which they are driven by means of three fans. Water is placed in some of the chambers, and the spray is produced by a jet of water pouring into each fan. A crude diagrammatic sketch is given.—A. W.

Improvements in the Pneumatic Process of Manufacturing Iron, Steel, and other Metals. R. P. Wilson, F. J. Wall, F. A. Thurston, T. L. Bibbins, and W. L. Flanagan, New York, U.S.A. Eng. Pat. 8925, June 19, 1888. 4d.

THE idea is to prevent loss of iron due to oxidation at the end of the process of refining by lessening the blast towards the finish and introducing into the converter above the molten metal the vapour or gas of a hydrocarbon. The hydrocarbon atmosphere reduces the oxide of iron formed by the blast to metal.—A. W.

Improvements in the Production of Metals of the Earths and Alkaline Earths. A. Feldmann, Linden, Prussia. Eng. Pat. 9783, July 5, 1888. 6d.

THE claim is—"the process of producing metals of the earths and alkaline earths, which consists in adding to a haloid salt of the said metals or to a compound thereof with a haloid alkali salt, an oxide of an earth, earth alkali or alkali metal, which is more highly electro-positive than the metal to be separated out, or in adding to an oxide of the earth or earth-alkali-metal, a haloid compound of one or more earth-alkaline earth or alkali metals which is, or are all, more highly electro-positive than the metal to be obtained, in melting the mass and decomposing the same by the electric current." As instances, magnesium may be obtained from its double chloride with potassium by employing oxide of calcium or sodium, while aluminium can be made from its double chloride with sodium by means of oxide of calcium. Again, magnesium can be produced from its oxide by introducing the latter into a bath of fluoride of calcium and chloride of sodium, and so on. Basic pots are employed for melting. The electrodes may be made of carbon, or if alloys are required, both the negative and positive electrodes may consist of the metal to be alloyed. "There are no by-products produced in the melt."—A. W.

Improvements in Coating Iron with Antimony. N. C. Cookson, Newcastle-on-Tyne. Eng. Pat. 4428, March 14, 1889. 6d.

THE difficulty of coating iron with antimony is overcome by first applying to the iron a coating of tin or zinc, and then dipping it into melted antimony or applying the same by any other suitable means.—A. W.

ERRATUM.

In May issue, page 398, second column, third line from bottom, for 2·01 read 0·01.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improvements in Storage Batteries. M. Immisch, London. Eng. Pat. 6907, May 9, 1888. 8d.

INSTEAD of using solid plates of the oxides of lead, the inventor clamps together strips of the active material between the teeth of leaden combs. Distance pieces of an insulating material are placed between the positive and negative plates.—B. T.

Improvements in or Relating to Electrical Fuses for Firing the Charge of Blast Holes and the Like. A. J. Boulton, London. From G. and C. Manet, Paris, France. Eng. Pat. 7408, May 18, 1888. 6d.

A PLATINUM wire of any convenient shape is placed inside the fuse and joined to wires connected with a source of electricity. The tube is then filled with detonating powder which can be ignited by the heat of the wire when the electric current passes through it.—B. T.

Improvements in Electric Batteries. H. Lahousse and Co. and C. Collé, Lille, France. Eng. Pat. 8965, June 18, 1888. 8d.

THIS battery is of the double-fluid type, the space between the outer cell and the porous pot being filled with granulated carbon packed round a carbon plate and sealed at the top with a layer of pitch; the top of the carbon plate and two pipes project through the pitch, one pipe serving as a means of supplying nitric acid to the cell and the other for the escape of air. The porous pot contains a zinc plate immersed in a solution composed of 35 grms. of bisulphate of mercury, 35 grms. of nitric acid, and 1 litre of water.

—B. T.

Improvements in the Form and Manufacture of the Frames, Plates, and Cells of Storage or Secondary Batteries. T. J. Haslam, jun., Dublin. Eng. Pat. 5095, March 25, 1889. 6d.

COMPRESSED beads or polygons of lead compounds are strung on rods of wood, bone, or other suitable material, the said rods being "strained" on frames of material unaffected by the electrolyte. This system of beads and rods forms the improved plate.—B. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

The Conversion of Oleic into Stearic Acid. P. De Wilde and A. Reychler. Bull. Soc. Chim. 1889, 295—296.

By heating oleic acid with 1 per cent. of iodine in sealed tubes to 270°—280° a mixture of fatty bodies results, containing 70 per cent. of stearic acid. This fatty acid can be separated by melting the contents of the tubes with tallow soap, boiling with acidulated water, and then distilling with superheated steam. One third of the iodine is obtained as hydriodic acid in the resulting liquors, but the remainder is difficult to recover, being retained in the tarry residue formed. Bromine acts similarly, yielding a solid acid melting at 51·5°, whilst with chlorine an acid melting at 31·5° results. The addition of colophony facilitates the reaction in each case. It is suggested that the unsaturated oleic acid first takes up iodine, that then hydriodic acid is given off, and this acts upon the oleic acid with the formation of stearic acid and regeneration of iodine.—C. A. K.

Walnut Oil. Thomas T. P. Bruce Warren. Chem. News, 59, 279.

THIS oil, obtained from the fully ripened nut of the *Juglans regia*, had many excellent properties, especially for mixing with artists' colours for fine-art work.

Walnut oil is largely used for adulterating olive oil, and to compensate for its high iodine absorption it is mixed with pure lard oil olein, which also retards the thickening effect due to oxidation. The marc left on expression of the oil is said to be largely used in the manufacture of chocolate. Many people seem to prefer walnut oil to olive oil for cooking purposes.

The value of this oil for out door work is demonstrated by the fact that a person who used it for painting the verandahs and jalousies of his house (near Como, Italy), some 20 years ago had not needed to repeat the operation. In this country, at least, walnut oil is beyond the reach of the general painter, and the pure oil is scarcely obtainable as a commercial article.

It was in examining the properties of this and other oils used as adulterants of olive oil that the author was obliged to prepare them, so as to be sure of getting them in a reliable condition as regards purity. The walnuts were harvested in the autumn of 1887, and kept in a dry airy room until the following March. The kernels had shrunk up, and contracted a disagreeable acid taste, so familiar with old olive oil in which this has been used as an adulterant. Most oxidised oils, especially cotton-seed oil, reveal a similar acid taste, but walnut oil has, in addition, an unmistakable increase in viscosity. The nuts were opened, and the kernels thrown into warm water, so as to loosen the epidermis; they were then rubbed in a coarse towel, so as to blanch them. The deoiled nuts were wiped dry, and rubbed to a smooth paste in a marble mortar. The paste was first digested in carbon bisulphide, then placed in a percolator and exhausted with the same solvent, which was evaporated off. The yield of oil was small; but probably, if the nuts had been left to fully ripen on the trees, without knocking them off, the yield might have been greater. It is by no means improbable that oxidation may have rendered a portion of the oil insoluble. The deoiled kernels gave a perfectly sweet, inodorous, and almost colourless oil, which rapidly thickened to an almost colourless, transparent, and perfectly elastic skin or film, not darkening or cracking easily by age. These are properties which, for fine-art painting, might be of great value in preserving the tinctorial purity and freshness of pigments.

Sulphur chloride gave a perfectly white product with the fresh oil, but when oxidised the product was very dark, almost black. The iodine absorption of the fresh oil thus obtained was very high, but fell rapidly by oxidation or blowing. A curious fact has been disclosed with reference to the oxidation of this and similar oils. If such an oil be mixed with lard oil, olive oil, or sperm oil, it thickens by oxidation, but is perfectly soluble. Such a mixture is largely

used in weaving or spinning. Commercial samples of linseed oil, when cold drawn, have a much higher iodine absorption, probably due to the same cause. Oils extracted by carbon bisulphide are very much higher than the same oils, especially if hot pressed.—W. S.

Californian Olive Oil. Chem. and Druggist, **34**, 1889, 791.

At a recent meeting of the Philadelphia College of Pharmacy a paper was read by Mr. Frank X. Moerk, in which Californian olive oil was compared with that of European origin. The samples of the American product were unquestionably genuine. In addition to finding that they were of a higher specific gravity (0.91717—0.91797) than the foreign oils, it was noticed that the reactions with acids were more intense and that the elaidin reaction was longer delayed. But the most remarkable fact was the extremely high percentage of free acids which the native oils contained. A good oil is generally expected to contain a mere fraction of 1 per cent. of free acids; but one sample of Californian contained as much as 8.33 per cent.; another (first pressing), 1.51; and a third (second pressing), 2.96 per cent. In the face of this observation the higher specific gravity is also remarkable, because free acids tend to lower that factor. Contrariness was further exemplified in the melting point of the free acids. Those from foreign oils melt at about 26° C., but the Californian acids went as low as 19° C. (the mean may be put down at 21° C.). The acids of the American oils at a temperature of 20° C. are viscid fluids containing in suspension the higher melting acids; the European oils are solid at this temperature. In addition to observing that the saponification equivalent of the American oil was higher (295 as compared with 292), there was also noticed a remarkable difference in the iodine absorption figures. The Californian oils absorbed 88 per cent. of iodine, while the foreign varies from 81 to 85 per cent. This is very probably due, the author thinks, to the presence of more olein than in the European oils, the melting point of the fatty acids also indicating this. There is another instance known, similar to this one, in which it has been proved that American fats differ in important respects from the same European fats—viz., lard. American lard has an iodine absorption of from 60 to 62 per cent., English lard from 51.5 to 62 per cent. From such results it would appear that climate and soil modify considerably the composition of the fats and oils, and for such variations due allowance must be made.—W. S.

PATENTS.

Improvements in the Manufacture of Soap. J. Jeyes, Plaistow. Eng. Pat. 8366, June 7, 1888. *Ad.*

To every 100 lb. fat employed for saponification, from 10 to 17 lb. of colourless and odourless mineral oil are added.—W. L. C.

Improvements in or connected with the Manufacture of Soap. C. A. Stitt, Edinburgh. Eng. Pat. 8604, June 12, 1888. *Ad.*

PARAFFIN oil, paraffin wax, or any mineral oil, is incorporated with the finished soap paste before it finally cools and hardens.—W. L. C.

Improvements in Candle-making Machines. J. M. Storrar, Glasgow. Eng. Pat. 8823, June 16, 1888. *Sd.*

This invention can be readily applied to existing machines, and has for its object the manufacture of candles whose outer layers are of different material from the inner core. This is accomplished by adding to the ordinary machine in which the moulds are fastened into a water-tight box, an annular mould which slides up and down in the ordinary one, and occupies the space to be eventually filled with the enamel or outer casing of the candle. Drawings are given.—W. L. C.

An Improvement in Cleaning and Polishing Compositions.

E. A. Ashley, Darlington. Eng. Pat. 9187, June 23, 1888. *Ad.*

GROUNDED flint, with or without barytes (sulphate of baryta) is incorporated with soap.—W. L. C.

An Improved Lubricating Composition. W. T. Hicks and J. Elliott, Middlesbrough. Eng. Pat. 9477, June 29, 1888. *Ad.*

To melted gutta-percha or caoutchouc, animal fat, pottery clay, and black lead are successively added, and the mixture is incorporated with a heat-absorbing material such as peat or turf, to prevent waste of the lubricant by overheating.—W. L. C.

An Improved Lubricating Compound. J. Annab, Orkney. Eng. Pat. 5028, March 22, 1889. *Ad.*

An emulsion of oil and water is produced by dissolving soft soap in the latter, prior to the addition of the oil.—W. L. C.

Improvements in the Treatment of Mineral Oils. T. H. Gray, Clapham Junction. Eng. Pat. 5132, March 25, 1889.

The oil is agitated with a solution of "chlorinated potash or soda," prepared by adding caustic alkali to chloride of lime solution.—W. L. C.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Waterproofing Fabrics. E. Döring, Dingl. Polyt. J. 1889, 185—192.

A CRITICAL estimate of those processes of which the technical utility is fully proved, the author remarking incidentally upon the large number of abortive patents and impracticable recipes which characterise the literature of this subject. The processes are divisible into two groups: (1) the fabrics are filled with a compound of a fatty acid and earthy base, produced by double decomposition upon the fabric; (2) they are impregnated with water-resisting substances, applied either in the melted state or dissolved in a suitable solvent. In the former, the usual practice is to pad with aluminium acetate, dry, and pass through soap solution. In preparing the acetate solution the author recommends the decomposition of aluminium sulphate with lead acetate. Complete decomposition of the sulphate is not essential, but the presence of free acid should be avoided. In washing the precipitate of lead sulphate the author recommends attention to the provisions in Bunsen's well-known article on the subject (*Annalen*, **148**, 269—293). The padding solution should be kept at 140°, preferably by means of a steam-jacket or worm. The addition to the soap solution of wax, resin and caoutchouc has important advantages, and the following details are given for the preparation of the mixture. The quantities of materials may be calculated per square metre of fabric to be treated as under: 30 grms. of tallow soap, 25 grms. of Japan wax, 1.5 gm. of crude caoutchouc, previously dissolved to a 10 per cent. solution in turpentine or camphor oil, and 1 gm. of oil varnish to 500 cc. of solution. The Japan wax is first melted, and the caoutchouc solution and varnish stirred in; next a hot saturated solution of "liver of sulphur," in the proportion of 50 per cent. upon the caoutchouc, is added, and after thorough mixture the whole is added to the boiling soap solution. The "liver of sulphur," in addition to "vulcanising" the caoutchouc, has an important action upon the alumina mordant, by pre-

epitimating the hydrate of alumina and thus opening it up to the attack of the soap. In cases where it is required to colour the soap-bath, those coal-tar colours which are soluble in fats should be used, and dissolved with the wax and caoutchouc.

For impregnating with such mixtures as *Oleum Rosci* and black wax—which the author recommends as the best preservative—a special machine is described, the essential feature of which is a vertical series of three hollow cast-iron cylinders or rollers, the lowest turning in the mixture to be applied to the cloth, the two upper ones heated internally by steam; the middle roller is driven, and the upper and lower roller are kept in contact with it by means of adjustable screws. There are in addition the usual “breadthing” and guide rollers. After impregnation the goods are freed from the more volatile constituents of the bath by steaming them at about 7 lb. pressure in a closed chamber. The excess of steam is caused to pass through a condensing worm and the volatilised oils thereby recovered. A special form of “steamer” is described.—C. F. C.

Red Lead and Peroxide of Lead. J. Löwe. *Dingl. Polyt. J.* **271**, 472—477.

MOST commercial red lead consists of a mixture of oxide of lead with pure red lead. A small proportion of carbonate of lead is also generally present, formed by exposure to air after manufacture. To remove the free oxide of lead from commercial red lead various substances have been recommended, such as a solution of sugar of lead, or cold dilute acetic or nitric acid. Sugar of lead does not remove the carbonate of lead, while in the case of acetic and nitric acids there is danger of peroxide of lead being separated. The author recommends the use of a 10—12 per cent. solution of nitrate of lead. 200—300 cc. are sufficient for 20 grms. of red lead. This solution removes not only the oxide of lead, but also the carbonate and any traces of metallic lead. The red lead should be first digested for a considerable time, and then boiled with the nitrate of lead solution. The percentage of free oxide of lead in the samples examined varied from 16—31 per cent. The purified red lead is brighter in colour than the original sample. Nine samples of purified red lead were examined as to the percentage of peroxide of lead obtained from them by digestion with dilute nitric acid. They yielded from 25.4—25.7 per cent. PbO_2 . This agrees with the results obtained by Mulder, Phillips, Houton-Labillardière and Pichon, and points to the formula Pb_3O_4 for red lead, instead of the usually accepted formula Pb_2O_3 , which requires 31.88 per cent. of PbO_2 . At the same time it is probably possible by long-continued burning to obtain Pb_3O_4 ; for Dumas found that a sample of red lead, after three burnings, contained 33.2 per cent. PbO_2 . In the formation of red lead, not only the temperature but also the duration of the heating is of importance. As long as free PbO is present, and the composition of the colour is Pb_3O_4 , there is much less danger of the red lead being spoiled, owing to the formation of Pb_2O_3 , than when the colour has the composition Pb_2O_3 . The suggestion that red lead is a mixture of Pb_2O_3 and Pb_3O_4 is not compatible with analytical results. It is pretty certain that both compounds exist, but a red lead containing free PbO seems to have the composition Pb_3O_4 .—H. T. P.

PATENTS.

Improvements in the Manufacture of Sulphide of Zinc for Pigment or other Purposes. G. J. Geary, Manchester. From A. Keiller, Gothenburg, Sweden. Eng. Pat. 5371, April 11, 1888. 6d.

A SATURATED solution of a zinc salt is mixed with a saturated solution of some inert sulphate such as that of potassium, sodium, magnesium or ammonium, and precipitated with sulphuretted hydrogen. The zinc sulphide is filtered off, dried and heated, when it is found to be a pigment possessed of more “body” than it has when prepared in the ordinary way. The filtrate can be then saturated with metallic zinc, zinc oxide or carbonate, and used over again.—B. B.

An Improved Liquid for Use in the Softening and Preserving of Seaweed for Decorative Purposes. A. R. Ensor, Skegness, Lincolnshire. Eng. Pat. 18,821, December 24, 1888. 4d.

THE inventor claims a solution containing 3 parts of bergamot, 6 of borax, 12 of ammonia, 14 of gelatin, 25 of glycerin, and 40 of methylated spirits, into which the seaweed after being washed in water is dipped and allowed to dry.—E. J. B.

An Improved Composition for Covering and Protecting Surfaces. R. Morris, Doncaster, and W. T. Gent, Misterton. Eng. Pat. 844, January 16, 1889. 6d.

MIXTURES of a resin (“such as the resin of commerce”) with a metallic oxide and gypsum in varying proportions, with or without the addition of pigments to give them any desired colour, are made, and applied to the surface to be coated, either by liquefying them by heat after they have been spread over it in fine powder, or by solution of the resin in “naphtha” and a little boiled oil.—B. B.

An Improved Anti-fouling Compound for Coating the Bottoms of Ships and other Vessels. R. Seabrook, Grimsby. Eng. Pat. 4637, March 16, 1889. 4d.

FIVE pounds of “flour of sulphur” are “immersed in” 10 gallons of coal-tar, and one gallon of “turpentine” is then added. The whole is kept for a month with occasional stirring, the “supernatant liquid” drawn off and black lead added in the proportion of 3 oz. to one gallon, stirring diligently. The product may be applied in any convenient way and is said to adhere to the vessel longer than compositions already in use.—B. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Oxidation of Gelatin with Potassium Permanganate, and the Relation of Gelatin to Albumen. R. Maly. *Monatsh. Chem.* **10**, 26—38.

WHEN the purest commercial gelatin (1 part) is dissolved in water, the solution gradually mixed with potassium permanganate (2 parts), and kept for 44 days at the ordinary temperature, it yields a mixture of very complicated acids analogous to the peroxy-proto acid obtained in a similar manner from albumen (*Monatsh. Chem.* March 1888). If, after filtering the manganese oxide, the solution be evaporated to dryness, the residue extracted with water, neutralised with acetic acid, and mixed with lead acetate, a copious white precipitate is produced, and the filtrate gives a further precipitate on adding mercuric chloride. The two precipitates contain the whole of the oxidised gelatin, and the filtrate does not show the biuret-reaction. When the precipitates are decomposed with sulphuric acid and sulphuretted hydrogen, respectively, acid syrups are obtained, from which, however, no crystalline compound can be isolated. Both syrups show the biuret-reaction, but do not give Millon's reaction, and no blackening occurs with potash and lead acetate. When heated, strongly acid vapours are evolved and the smell of burning gelatin is observed. When the acid syrup obtained from the lead precipitate is boiled for about 12 hours with excess of baryta, ammonia is evolved, and large quantities of barium oxalate, containing traces of the carbonate and phosphate, separate from the solution. No change takes place on further boiling, and a small portion of the solution, after freeing from baryta gives a dark blue colour with copper acetate, but does not show the biuret-reaction. If the whole be now filtered, mixed with a further quantity of baryta, and heated at 120°—190° for about 36 hours, an ammoniacal, tarry liquid is obtained. After filtering from small quantities of barium carbonate, ferric hydrate and organic substances, the solution is distilled, the distillate neutralised with hydrochloric acid

and again distilled. Pyrroline, and perhaps also traces of indole, were found in the distillate, and the residue contained ammonium chloride, a brown amorphous substance, perhaps pyrroline red, and a small quantity of a base which was probably aniline. The residue from the first distillation contained leucin, acetic acid, propionic acid, benzoic acid and glutamic acid. After isolating these compounds the mother-liquors were again heated with baryta, but no new product was obtained.

The acid syrup obtained from the mercury precipitate was also treated as described above. Ammonia, oxalic acid and pyrroline were obtained, but only traces of glutamic acid were isolated, and benzoic acid was entirely absent. A large quantity of propionic acid was produced, and the quantity of leucin obtained was much larger than in the case of the lead precipitate. The last-named product occurred either mixed or combined with an equivalent quantity of amido-valeric acid.

When gelatin is oxidised with a hot solution of potassium permanganate fatty acids (principally caproic), benzoic acid, and succinic acid are formed.

These results show that gelatin and albumen behave in the same way when treated as described above. The formation of isoglyceric acid in the case of albumen (loc. cit.), and its non-formation from gelatin, is, the author considers, of little importance, even if not due simply to slight differences in the conditions of the experiment. It has hitherto been generally supposed that albuminoids proper yield aromatic decomposition products (tyrosine, indole, phenol), whilst gelatinoids do not yield any such compounds. The author points out that this distinction cannot be maintained, as, although gelatin does not yield indole or tyrosine, it gives benzoic acid. This difference in behaviour shows no constitutional difference between albumen and gelatin, because oxyprotosulphonic acid (Maly, *Monatsh. Chem.* 1885, 91), which is simply oxidised albumen, does not yield tyrosine but benzoic acid when boiled with baryta under pressure. Again, albumen yields both indole and phenol; oxyprotosulphonic acid, on the other hand, gives neither compound. Gelatin behaves, therefore, exactly like oxidised albumen, and oxyprotosulphonic acid stands intermediate between gelatin and albumen.

All experiments on the decomposition of gelatin and albumen which have been made up to the present time show that there is no important and distinct difference between these two substances. Gelatin is as much an albuminoid as fibrin or casein, and a classification into gelatinoids and albuminoids cannot be upheld.—F. S. K.

PATENT.

A New or Improved Artificial Leather. N. F. E. Rapenud. Entreehaux, France. Eng. Pat. 8221, June 5, 1888. 64.

LEATHER refuse or cuttings is ground and made into a fibrous paste with which is mixed a glue or gelatinous compound containing fatty matter and glycerin. The paste may be spread and formed into plates by machinery, to be afterwards rolled and calendered. As exemplifying the composition, the following proportions may be taken:—leather refuse, 78–90 parts; gelatin, 4–8 parts; tallow, 1–2 parts; glycerin, 5–12 parts.—B. H.

XV.—AGRICULTURE, MANURES, Etc.

Propagation and Prevention of Smut in Oats and Barley. J. L. Jensen. J. Roy. Agric. Soc. Eng. 24, 397–415.

HAVING made a number of observations during the last two or three years on the disease known as "smut" on the oat and barley plants, the author is led to believe that its propagation takes place principally at the time of flowering, when the husk opens to allow the stamens to protrude, thus admitting the spores of the fungus. In one series of experiments in which oats were (1) dusted merely *outwardly* with the spores of *Restilago segetum*, (2) husk removed and spores dusted on the bare kernel, diseased plants were only

found in the latter crop, and that consequently, in order to prevent "smut," the *kernel* must be dressed with the preservative, and not merely the outside husk.

A series of experiments was made to determine the relative values of the different preservatives recommended for the prevention of smut—(1) sulphate of copper; (2) sulphate of copper, followed by quicklime; (3) sulphuric acid and water; (4) quicklime, subsequently followed by common salt, were tried, and, in addition, the effect of hot air, both dry and moist, and warm water. The results obtained showed that while the mineral preservatives all had a nearly perfect action so far as the prevention of smut is concerned, the crop suffered more or less from their application. Dry heat at 50°–51° had apparently no effect on the spores, moist heat destroyed the spores but damaged the crop also. Water at 51°–56° acted perfectly, both destroying the smut spores and leaving the seed corn uninjured. The author, after a yet more extended experience of the application of warm water, recommends it. The seed corn, placed in a basket lined with linen, is dipped into warm water at 55° four times, by which the temperature of the water is lowered so much that he recommends having a second vessel ready and the corn is rapidly dipped in the second vessel five or six times, after which it is cooled by pouring cold water over it, and it is then spread out on the floor to cool thoroughly.—J. W. L.

Society for the Promotion of Moor-Cultivation in Germany. Chem. Zeit. 19, 297–298.

VOX WANGENHEIM, in a long article on moor-cultivation, treats more especially of low-lying or submerged moors (Niederungsmoore) than of those moors which are above the surface of the water (Hochmoore). The former are cultivated in embankments covered with layers of soil alternating with channels for drainage (Moor-Damncultur). The kind of soil suitable for covering the embankments is a question of importance. Coarse river sand, almost free from clay, becomes very dry and cracks, so that seeds sown in it either perish or develop badly. Fine sand from moor subsoil remains moister than the coarse sand, and upon it hemp and flax grow very well, whereas peas half die off and half thrive, when the roots reach the moor. Meadow-marl, with 78 and 86 per cent. of calcium carbonate, has a somewhat similar effect; in the 86 per cent. soil the hemp grows better, but the peas and flax are not so good. Heavy marsh soil gives rise to good development, but where exposed to heat forms a hard crust which has to be broken up. Under suitable conditions all these soils may give good results. Sand permits of deep sowing, clay is appropriate for such crops as are sown in moister and cooler seasons of the year.

In the discussion which followed, calcareous sandy loam was recognised as of general utility. Intercepted drainage gives rise to mouldiness and should be prevented. All moors do not pay for sanding, those which are too submerged, for instance. Sanding is most effective on moors which suffer from frost, or are ferruginous and become readily dry. In sanding, 4 centimetres form too thin a layer, 8 cm. are about sufficient, but 11 cm. still better to ensure good and even crops. With regard to manuring, Fleischer's views are confirmed, and a moor not receiving any fertilising water, or fertile soil as covering, will yield 8,000 kilos. of hay per hectare for a dressing of 800 kilos. of kainite and 300 to 400 kilos. of basic slag per hectare. Systematic succession of crops is recommended for moor land.

For peat-moss litter the surface of high moors is very well adapted, which is not always the case with low moors, hence some manufacturers neglect to utilise suitable low-moor peat. The compression of the peat should be to about two-fifths or one-third the original bulk, sometimes it is not carried far enough and the finished product retains too much water. In order to obtain uniformity in the size of bales and convenience in estimating quantities of peat-moss, it is decided to make each 0.5 cubic metre, measuring 1 metre long; such a bale of good average-dry peat litter weighs 125 kilos. Its power of absorbing moisture and noxious odours, its disinfectant characteristics and the proportion of plant nutritives it contains, render it useful as

a general litter, as a packing material for perishable articles of food, and as a manure. As litter for horses, &c. it has been found, by some, lacking in uniformity and with too great absorptive power for moisture and noxious vapours; on the other hand, others speak highly of its beneficial influence on the growth and cutting qualities of the hoofs. Many prefer peat litter to straw litter, and think that if it could be obtained colourless its extended adoption would be even more certain.—D. A. L.

Potato Culture A. Girard. *Compt. Rend.* **108**, 412—415.

See under XVII., page 472.

XVI.—SUGAR, STARCH, GUM, Etc.

Improvements in the Manufacture of Starch, Dextrin, and Grape-Sugar. Dingl. Polyt. J. **271**, 512—515.

STARCH sugar of commerce mostly consists of a mixture of 64—66 per cent. of fermentable sugar, 18—20 per cent. of unfermentable organic matter, and 14—18 per cent. of water, and is considered almost useless for the preparation of wine and liqueurs and for brewing purposes; moreover, its employment for the manufacture of these products is illegal in Germany, Austro-Hungary, and in France. Although many attempts to obtain a purer product have been made during the last few years, the methods hitherto proposed have been found to be of no practical utility.

Seyberlich and Trampelach have recently worked out a process for preparing pure grape sugar on a commercial scale, which has been patented in most countries. The original experiments were made at the starch-sugar works owned by P. Brandenburg in Riga, 1,000 kilos. of air-dried starch being operated upon at a time. The process is, in its essential points, directed towards the method devised by Soxhlet (this Journal, 1882, 376). The patentees consider the purification of starch-sugar by means of methyl alcohol as practised by Soxhlet impracticable, on the ground of the high price of alcohol and its great volatility; moreover, the expenses incurred in evaporating vast quantities of liquors and the necessity of employing excessive quantities of charcoal, coupled with certain difficulties attending the subsequent crystallisation of the sugar, present great obstacles to the successful working of the process. The large consumption of charcoal is brought about by the fact that the saccharification is effected by means of sulphuric acid under pressure, the high temperature to which the mixture is exposed frequently giving rise to the formation of dark-coloured products, which require the use of excessive quantities of charcoal for the purpose of decolourisation. Seyberlich therefore made some trials to determine the effect of other acids. Hydrochloric acid being unsuitable, nitric acid was tried, the result being satisfactory in every respect. The saccharification was conducted in open vessels, one part of starch being mixed with two parts of water, and the mixture treated with 0.5 per cent. of nitric acid on the weight of air-dried starch.

For the preparation of the raw sugar the authors propose to make the starchy material into a milk with water, boil with nitric acid, neutralise the solution, then render it slightly alkaline, filter, evaporate to 35° B., cool to 18° C., and allow to crystallise in copper pans. The resulting sugar is then subjected to hydraulic pressure, the pressed cakes of raw sugar thus obtained containing 88 per cent. of real sugar, 10 per cent. of water, and 2 per cent. of impurities. The syrup is concentrated for crystallisation, and the final liquors (molasses) worked up for sugar after removal of the nitric acid and salts by means of sulphurous acid. The raw sugar is refined by dissolving it in water, bringing the solution to a density of 32° B. (measured hot), decolourising with charcoal (10 per cent. on the weight of raw sugar) at 80°—90°, and filter-pressing. The colourless sugar solution is then allowed to crystallise, and the product freed from the mother-liquors by pressing. The solution

is concentrated for the purpose of separating a further batch of crystals, whilst the final syrup is mixed with a fresh portion of raw sugar to be refined. By melting the sugar-cake and heating to boiling, then adding some crystals of anhydrous grape-sugar and allowing the mixture to cool, anhydrous grape-sugar is obtained. When this is broken up and sifted a crystallised product resembling cane-sugar is obtained. It contains 98 per cent. of sugar and 2 per cent. of water.—D. B.

Saccharification by means of Diastase. A. Reyehler. *Bull. Soc. Chim.* 1889, 286—295.

A SERIES of experiments are described on the saccharification of starch by means of solutions of gluten. As solvents, hydrochloric acid, acid sulphate of potassium, phosphoric acid, the acid phosphates of the alkalis, acetic, tartaric, lactic, and formic acids, were found most satisfactory, the solutions being obtained by treating fresh, well-washed and pressed gluten with the solvent at about 40° C. for 4—5 hours. These solutions do not coagulate on boiling; on addition of caustic potash drop by drop, a precipitate is formed, soluble in excess; mercuric chloride has no action and potassium ferrocyanide produces a precipitate soluble in acetic acid. With an alkaline solution of a copper salt a slight reduction takes place, probably due to the presence of a little saccharified starch; the solutions also give Lintner's reaction for diastase, viz., the blue colouration with hydrogen peroxide and tincture of guaiacum, but previous boiling or the addition of a concentrated solution of a base or of an acid prevents the formation of the colour. The resemblance of these solutions of gluten to diastase is borne out by their action on starch, which in the form of starch paste is converted by them at a temperature of 50°—60° into soluble products with a powerful reducing action. To effect the change the solution must be very dilute and very slightly acid; previous boiling prevents the action. In one experiment 2 grms. of starch (= 1.76 grms. of pure starch) dissolved in 250 grms. of water, were treated with 10 cc. of a solution, containing the gluten from 20 grms. of wheat flour dissolved in 130 cc. of a 1:1,000 solution of acid sodium phosphate, for 5 hours at 40°—50° C.; a liquid wort resulted capable of reducing 138 cc. of Soxhlet's solution of a copper salt in caustic potash; the complete saccharification of this quantity of starch by diastase would correspond to a reduction of 200 cc. of the solution. Albumen and gelatin under similar conditions only effect a slight saccharification of starch, whilst neither acid phosphate of soda, acetic acid nor hydrochloric acid in the dilute state employed for dissolving the gluten, have any solvent action on the starch. The vegetable albumen contained in wheat flour also acts like diastase. Solutions prepared by digesting wheat flour with acid phosphate of potassium are capable of converting starch into saccharine matter; this saccharification is aided by slightly acidifying the solution. Non-germinated barley also contains a constituent capable of saccharifying starch, and at a temperature of 50°—66° C. converts about two-thirds of the starch into soluble products. Here again the presence of small quantities of acid or of acid salts increases the action. The saccharification is best started at a temperature of 40°—45° C., and continued at 60°—66° C. A number of experiments with barley, malt and maize, as well as with mixtures of these, and employing solutions of acid sulphate of potassium, acid phosphate of potassium, acetic acid, and metaphosphoric acid are detailed. The saccharification of the starch of barley, maize, and wheat by the soluble ferments prepared as above forms the subject of a further series of experiments. The action is greatest in the case of barley, 50 to 86 per cent. of the contained starch being saccharified; the conversion is aided by the presence of potato starch.—C. A. K.

Saccharification by Diastase. L. Lindet. *Compt. Rend.* **108**, 453—456.

THE author cites experiments in confirmation of Payens' view that the secondary action of diastase upon the dextrins produced by the resolution of starch into maltose by dextrins is arrested by the accumulation of maltose in the solution,

and that during the alcoholic fermentation, as this maltose disappears, so the diastase continues its action on the dextrins until they disappear. O'Sullivan has attributed the saccharification of the dextrins during fermentation to the simultaneous action of diastase and yeast. The author, by using phenylhydrazine to precipitate the maltose from worts saccharified as far as possible by diastase, shows that in proportion as this precipitation takes place, the dextrins left in the solution undergo conversion into maltose.

—J. M. H. M.

PATENT.

Improvements in Apparatus for Use in Boiling and Evaporating Sugar and other Liquids. G. Fletcher, Litchurch, and C. A. Mathey, Demerara. Eng. Pat. 9183, June 23, 1888. 8d.

THE invention relates to vacuum pans, and consists, first, of a special arrangement of steam tubes which combine great efficiency in evaporating with special facilities for cleaning, and, secondly, of a special top or cover for the vacuum pan. The heating apparatus consists of two double series of horizontal tubes through which the steam circulates. For ease in cleaning operations, these sets of tubes are capable of being revolved on a horizontal axis into a vertical position. For the application of the special lid or cover the pan is made in two separate parts, the upper being large enough to slide loosely over the lower part in telescope fashion. Round the upper portion of the lower part is a copper trough into which the upper part of the pan loosely fits. The trough is filled with mercury, and when the pressure is reduced in the pan the mercury rises between the two telescoping parts of the pan. The lower part of the pan stands so high above the trough that at no diminution of pressure which is practically attained does the mercury rise high enough to get into the pan. Drawings are given.

—A. J. K.

XVII.—BREWING, WINES, SPIRITS, Etc.

Improvements in the Manufacture of Spirit. Dingl. Polyt. J. 271, 416—423.

ORDONNEAU (Rev. Univ. de la Dist. and Zeits. f. Spiritusind. 11, 183) has found the following substances in the first runnings of spirit made from molasses by fermentation with beer yeast:—Acetaldehyde, formic ether, isobutylaldehyde, acetic ether, and amylaldehyde. A small quantity of a body, heavier than water, and which gave the spirit a peculiar garlic-like odour, was also detected. The ill flavour of the spirit was due to the presence of valeraldehyde. The aldehydes are probably formed by a bacterial fermentation, during which the alcohols formed by the yeast are oxidised. This also explains the occurrence of the corresponding acids.

Yeast Poisons. H. Schultz (Zeits. f. Spiritusind. 11, 137).—Mercuric chloride in very dilute solution (1:500,000 to 1:700,000) considerably increases the activity of yeast for a shorter or longer time. Iodine (dissolved in potassium iodide) in all cases caused the fermentation to go on briskly from the beginning. The most favourable dilution was 1 in 100,000. Bromine has a similar effect when sufficiently dilute (1 in 300,000 to 1 in 400,000). Arsenious acid (1 in 40,000) has a favourable influence. Chromic acid (1 in 7,000 to 1 in 8,000) powerfully accelerates the initial activity of yeast. Salicylic acid (1 in 2,000 to 1 in 5,000) has likewise a favourable effect. Formic acid (1 in 300,000) temporarily increases yeast activity and causes fermentation to set in more quickly.

The Action of Acids on Yeast. Chapmann (Zeits. f. Spiritusind. 11, 232).—The quantity of sugar produced from starch-free yeast by the action of hydrochloric acid is

proportional to the concentration of the acid. The following percentages of sugar on the dry yeast were obtained:—

	Sugar.	Per Cent.
2 cc. of hydrochloric acid per 100 cc. of water.	2.6	
5 cc. " " " "	11.1	
10 cc. " " " "	16.3	
15 cc. " " " "	23.1	
20 cc. " " " "	24.9	
25 cc. " " " "	27.5	
30 cc. " " " "	29.3	

This sugar was produced almost entirely from the yeast cellulose.

Two Methods for the Removal of Pyridine Bases from Denaturated Spirit are described in the *Allgem. Zeits. f. Spirit. u. Presshefeind.* 9, 155.—According to W. Lang, such removal can be effected by shaking up the spirit with powdered zinc chloride; according to W. Kirchmann, by the addition of a solution of aluminium sulphate containing sufficient free sulphuric acid to permit of the formation of alum. In the first case, the pyridine is removed as zinc pyridine chloride, in the second, as pyridine alum.

—H. T. P.

Improvements in Brewing. Dingl. Polyt. J. 271, 461—472.

The Limit up to which Wild Yeasts may be Detected in Bottom Yeast. J. C. Holm and S. V. Poulsen (Zeits. f. d. ges. Brauwesen, 11, 381).—The experiments were made to determine the limits of temperature within which it is possible to work Hansen's spore-culture method. The yeasts examined were the Karlsberg bottom yeast, No. 2, and 18 other pure bottom yeasts. The wild yeasts added to these were *S. Pastorianus* I. and III. and *S. Ellipsoides*. The results showed that the 20 species of yeast tested by Hansen's method may be divided into two groups, of which one is best examined at 25° C. after 40 hours, and the other at 15° C. after 72 hours. In both cases a contamination with 1—1½ per cent. of wild yeast may be detected. Some members of the first group may also be analysed at 15° C.

Researches on the Physiology and Morphology of the Alcoholic Ferments. E. C. Hansen (Zeits. f. d. ges. Brauwesen, 11, 401).—The author's experiments were made with four different sugars: saccharose, maltose, lactose, and dextrose, and with nearly 40 species of yeasts, namely, with the six *Saccharomyces* described by Hansen in 1883, with *S. Marxianus*, *S. exiguus*, *S. membranifaciens*; 10 varieties of bottom yeast (*S. cerevisiae*), *Mycoforma cerevisiae*, *S. apiculatus*; seven varieties of Pasteur's *Torula*, *Monilia candida*, *Mucor erectus*, *M. spinosus*, *M. mucedo*, *M. racemosus*, and a few less known species of *Mucor*, and with *Oidium lactis*.

The results show that the *Saccharomyces* may be divided into two groups, according as they form invertin and produce alcoholic fermentation, or do not possess these properties. Only *S. membranifaciens* belongs to the latter class. All members of the first section form invertin in solutions of cane sugar and glucose, and produce active fermentation. Of the first class *S. Marxianus*, *exiguus*, and a few others do not ferment maltose, while the others do. Alcoholic ferments similar to yeast are next described (*Mycoforma cerevisiae*, *S. apiculatus*, *Torula*, *Monilia candida*). Like the *Saccharomyces* they all propagate by budding, but do not form endospores. Only one, *Monilia candida*, exerts a slight fermentative action on maltose. Many of them do not form invertin and have little or no fermentative action. A few varieties produce active fermentation in solutions of glucose and invert sugars, and as regards *Monilia candida*, the curious observation was made that it fermented cane sugar as such (without previous inversion). The *Mucors* are next considered. They also may be divided into two groups, according as they form invertin, or, as is mostly the case, do not form this ferment. Those members which exhibit a fermentative action also ferment maltose, if but slightly. Like the foregoing class, they differ considerably in fermentative power, and some cannot properly be considered as alcoholic ferments at all; to this latter class *Oidium lactis* belongs

As regards the industrial importance of the alcoholic ferments, the experiments show that only the genus *Saccharomyces* includes species which produce quick and active fermentation in solutions of maltose. In the manufacture of wine from grapes other organisms are available, since several of the *saccharomycetes*-like organisms produce fermentation in solutions of invert and grape sugars. The members of the genus *Mucor*, and also *Oidium lactis*, are of no industrial importance. As regards the behaviour of the four sugars towards the alcoholic ferments the following observations are made:—

1. There is nothing to show that invertin has any action on maltose; it must therefore be assumed that this sugar is directly fermentable, especially as a number of ferments which contain no invertin, such as *Monilia candida*, and all alcoholic ferments of the genus *Mucor*, except *M. racemosus*, have a fermentative action on maltose; *S. Maraschianus*, *exiguus*, &c., *S. apiculatus*, and the *Torulæ* do not ferment maltose. 2. Cane sugar is fermentable either without previous inversion (*Monilia candida*), or after inversion (most *Saccharomycetes*, a few species of *Torula*, and *Mucor racemosus*), *S. apiculatus*, a few *Torulæ*, and most of the *Mucors* have no action. 3. Dextrose is fermentable by all alcoholic ferments. 4. Lactose is fermented by only one species of ferment discovered by Duclaux in milk.

The Zymotechnical Analysis of the Micro-Organisms of the Air. E. C. Hansen (*Zeits. f. d. ges. Brauwesen*, 1888, 471).—By means of an aspirator a known volume of air is drawn through a small flask containing water, so that the organisms may be retained by the water. A "Miquel" flask is recommended for this purpose. Wort contained in small flasks is infected with this water. Hansen employs "Freudenreich" flasks, which are charged with about 15 cc. of sterilised wort. Only so much of the infected water must be added that the wort is not appreciably diluted. According to Hansen this method is suitable, not only for practical, but also for scientific purposes.—H. T. P.

Potato Culture. A. Girard. *Compt. Rend.* 108, 412—415.

THE alcoholic production of Germany is 4,000,000 hectolitres annually, three-fourths of which is obtained from the potato. France, whose distilleries produce only 2,000,000 hectolitres of alcohol, imports for the purpose 2,500,000 quintals of grain, chiefly maize, and appropriates 200,000 tonnes of sugar-beet, as well as 150,000 tonnes of beet molasses from the sugar refineries; the alcohol distilled from wine and cider amounts to only 100,000 hectolitres. In Germany, the cultivation of the potato has been so improved as to yield crops of 20,000—25,000 kilos. of tubers per hectare, with an average richness in starch of 17—18 per cent. In France, the crop seldom exceeds 10,000—11,000 kilos. per hectare, with a richness of 14—15 per cent. The author calculates that if by a proper system of cultivation crops of tubers can be grown in France, yielding 4,000 kilos. of dry starch per hectare, such crops are worth, to the distilleries, 800 fr. per hectare. By experiments extending over three years, with many different varieties of potatoes, and on two soils of very different richness, he has succeeded in 17 out of 29 trials in exceeding that yield. The best results were obtained with Richter's Imperator, which in 1888, a bad year for potatoes, yielded at one station 44,000, and at the other, 41,072 kilos. tubers per hectare, containing 18.4 and 19.5 per cent of starch respectively, equal to a yield of 8,096 and 8,000 kilos. dry starch per hectare.—J. M. H. M.

PATENTS.

Apparatus for Purifying Crude Spirit. W. S. Squire, London. Eng. Pat. 2735, February 23, 1888. 8d.

THIS invention has reference to an apparatus by means of which intimate admixture of the spirit with hydrocarbon oils and the subsequent separation may be effected continuously. The apparatus is somewhat like a filter-press, consisting of a series of chambers separated by channelled

plates or diaphragms. These plates are covered on both sides with filter paper supported on porous fabric. The tops and bottoms of each consecutive pair of plates are joined by means of passages which are connected to an injector nozzle that directs a stream tangentially into the chamber, thus causing its contents to rotate. Before starting the apparatus, all the lower filter-sheets are moistened with dilute spirit or water, and all the upper sheets with oil. Spirit is then pumped in at the top of the apparatus. When the chambers are partially filled, the inflow of spirit is stopped, and oil is pumped in at the bottom. The oil, in a finely-divided condition, floats up through the spirit, and takes up the impurities. Finally, the oil and spirit are separated, the oil passing through the upper filters which are soaked in oil, while the spirit passes through the bottom filters.—H. T. P.

Improvements in or Appertaining to the Clarifying of Beer, Wine, and other Fermented or Fermenting Liquids. A. G. Jericka, Gottlieben, and A. Eggmann, Ermatingen, Switzerland. Eng. Pat. 8522, June 11, 1888. 8d.

ACCORDING to this invention, turbid liquids are clarified by introducing into them porous blocks of baked clay or loam, or porous blocks of mineral of volcanic origin. These blocks can be used over and over again, and may be revived by calcination. A suitable shape is that of a hollow cylinder with corrugated surfaces. Particularly porous blocks may be obtained by mixing powdered burnt clay with moist clay or loam, and moulding and burning the mixture.—H. T. P.

Apparatus, Methods, and Arrangements adapted for Breweries, Distilleries, and other Installations for Charging Spaces or Chambers with Air free from Micro-organisms (Microbes) and their Germs, and preventing Air containing the same from penetrating therein and into Wort, and other Substances. K. Möller, Kupferhammer, Germany. Eng. Pat. 2110, February 6, 1889. 8d.

FOR the purpose of freeing air from germs, the inventor employs an apparatus, consisting of a number of conical filtering bags made of several layers of some closely-woven fabric. Each bag has placed in it a framework to prevent it from collapsing by air-pressure. The filters are placed in an outer case which is provided with an air outlet pipe. To this case is bolted a second case, also containing a number of filters which effect the preliminary cleansing of the air. This second case is fitted with air inlet and steam inlet pipes. In order to effect the preliminary sterilisation of the apparatus, steam is blown through it for about one hour. After this the filter is dried by passing a current of warm air through it. The outlet tap is provided with a test-cock, so that samples of the filtered air may be withdrawn and examined as to freedom from germs. To prevent the entrance of the outside air into the germ-free chambers, a slight excess of air-pressure must be maintained in them by forcing in filtered air. The chambers must be as air-tight as possible, and should be provided with valves to blow off at a certain pressure. The air supply pipe must be fitted with an arrangement to prevent the reflux of air when the pressure ceases. The air inlet and outlet pipes are provided with water closures so as to prevent the entrance of external air. The germ-free chambers are fitted with air-tight double doors, so arranged that the one can only be opened when the other is closed.

For filtering sterilised liquids an apparatus is employed, consisting of a number of filtering bags fixed inside a case which is fitted with an air-tight lid. This case is provided with inlet and outlet taps. The filters are cleaned by circulating boiling or sterilised water through the apparatus in an inverse direction. The apparatus is sterilised by blowing steam in at the liquid outlet.—H. T. P.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A)—CHEMISTRY OF FOOD.

On the Employment of Saccharine. P. de Clermont. Bull. Soc. Chim. 1889, 348—349.

THE author refers to some samples of cocoa containing saccharine instead of sugar which were presented to the Chemical Section of the Congress of the Swiss Society at Soleure by Schumacher-Kopp, the State chemist to the Canton of Lucerne. The analysis was as follows:—

	Per Cent.
Water (dried at 110°).....	3.89
Ash.....	6.45
Fatty matter.....	28.78
Phosphoric acid in the ash.....	16.88
Saccharine.....	6.76

This cocoa is much liked and used in Switzerland, and the author thinks it might with advantage be used by persons suffering from diabetes or obesity.

Numerous experiments have been made with it in the hospital at Lucerne, and no bad effects have been observed; on the contrary, in some cases its use has been attended with distinct advantages. The author thinks that the matter should be further studied, seeing that saccharine is prohibited in France but allowed in Switzerland, England, and other countries.—W. M.

So-called Congo Coffee. E. Fricke. Zeits. f. angew. Chem. 1889, 121—122.

THIS substance was obtained in a form resembling ordinary ground roasted coffee, but an infusion of it possessed an extremely astringent taste, and no caffeine or other crystallisable alkaloid could be found. A quantity of the natural bean was subsequently received, and this was found to be a species of *Phaseolus*, of shining black colour, and of such a size that 100 grms. contained 214 beans. The great difference in the percentage of woody fibre between the roasted material and the beans showed that a partial removal of the meal of the bean had been effected preliminary to the roasting process.—G. H. B.

PATENTS.

Improvement in the Treatment of Hide or Skin to obtain Gelatinous Matters. F. W. P. Swinborne and L. P. Swinborne, London. Eng. Pat. 9033, June 20, 1888. 8d.

ACCORDING to this invention hide or skin is thoroughly cleaved and then cut into thin shreds and dried. The shreds dry quickly and do not become tainted, so that they can be used for cooking purposes. If the hide has been limed or treated with a preservative, it must be well washed before drying. To obtain a superior product free from colouring matter and other impurities the hair and flesh sides of the skin are removed, and the middle portion only used. Instead of drying as above described the gelatinous matter is sometimes extracted from the middle portion with hot water, the solution being afterwards evaporated. Drawings are given showing the methods of cutting up and splitting the skin preferred by the inventors.—B. H.

Improvements in the Manufacture or Treatment of Gelatinous Substances. W. Gridley, London, and F. B. Pike, Streatham Hill. Eng. Pat. 2771, February 16, 1889. 4d.

THE object of this invention is the manufacture of a substitute for isinglass, called by the inventors "Isinglassine." To prepare it, the gelatinous material from calves' feet and other sources is thoroughly disintegrated and reduced to a pliable homogeneous mass. It is then passed between rollers to reduce the thickness, issuing from them in the form of white sheets or ribbons. After drying and pressing, the substance is cut into fine shreds by machinery, each pound being cut into about 125,000 shreds or staples.—B. H.

(B)—SANITARY CHEMISTRY.

The Purification of Sewage. Zeits. f. angew. Chem. 1889, 122—127 and 152—162.

A NOTICE of systems of sewage disposal at work in various continental cities compiled from official reports. The whole of the Berlin sewage is treated on the irrigation system, and to quote the main facts, the sewage of the year 1887—8 from 1,152,727 inhabitants amounted to 43,581,954 cubic metres, and was treated at a total cost of 0.526 mark per head of population. The average daily irrigation amounted to 3.77 litres per square metre of land, equal to a layer of sewage 3.8 mm. deep. Besides tables of general statistics relating to the system, the results of agricultural experiments on the irrigated land are referred to. The tables of analyses of the sewage and drainage waters give the number of germs present per cubic centimetre. The irrigation system was adopted in Breslau, as chemical treatment was too expensive. The cost is estimated at 1.25 marks annually per head. In Paris most of the sewage is sent into the Seine, but the adoption of a method of purification is now under consideration by the authorities. In Frankfurt the sewage is treated by chemical precipitation, and after clarification is sent into the river Main. Four subsidence reservoirs, each of 4,500 cubic metres capacity, are employed for the treatment of 18,000 cubic metres of sewage daily. The flow of treated sewage through these reservoirs is constant during eight days, at the end of which they are disconnected in rotation for removing the sludge, when the supernatant clear water is run off as far as possible, and the turbid water above the sludge proper is sent back to be mixed with the fresh untreated sewage. By this means the sludge is kept in as dense a form as possible, and is pumped into pits to drain. The reagents used are lime and sulphate of alumina, in quantities varying somewhat according to the state of the sewage. The cost is estimated at about 1 mark per head of population. At Wiesbaden the sewage is defecated by lime, and the drained sludge being in little demand as manure, is utilised for raising the level of the land near the works. In Essen the mode of treatment is by precipitation, at a cost of 0.62 mark per head. The writer concludes that the irrigation system is the most satisfactory where suitable land is available, otherwise chemical treatment is unavoidable.—G. H. B.

PATENTS.

Improvements in the Method or Process of and Apparatus for Purifying Sewage and other Impure Waters or Liquids. G. A. J. Schott, Bradford. From C. Lortzing, Berlin, Germany. Eng. Pat. 6070, April 24, 1888. 1s. 1d.

THIS specification describes a method of defecation of water-carried sewage by means of a mixture of quicklime, gypsum, and a metallic salt. The resulting sludge is settled out in a somewhat complex form of precipitating apparatus (described at length and illustrated in the specification) and then treated either with or without the use of steam or acid in filter-presses. The whole process and apparatus is covered by 26 claims.—C. C. H.

Improved Treatment of Materials for the Production of a Carbonised Body suitable for various Useful Purposes (Sanitary and other). E. Johnson, London. Eng. Pat. 6687, May 4, 1888. 6d.

GRANULATED dried ferruginous clay is mixed with an equal quantity of clean soot and tar, so as to form a thick mortar. The mixture is granulated and the whole carbonised in closed retorts, and thus rendered suitable for filtering purposes. If used as a deodorant or decoloriser, it is subjected to the action of pure oxygen in a closed receiver; if for disinfecting, chlorine is used instead of oxygen; and if for fertilising, soluble phosphates or other fertilisers may be added.—C. C. H.

Improvements in the Prevention of the Pollution of Rivers and Watercourses from Manufacturers' Polluted Waters and Waste, and for Clearing and Purifying ordinary River Waters for the Use of Manufacturers in their Business and for the Recovery of Expensive Materials used in certain Trades, as in Paper Mills, Dye Works, and others. W. Edwards, London. Eng. Pat. 8371, June 7, 1888. 8d.

A TANK is divided into separate compartments, each of which consists of an upper and a lower part. The upper portion is packed with a filtering material consisting of sand, coke, or gravel, resting on a perforated bottom and covered on top with cocoa-nut matting. The lower part of the tank forms a receptacle for filtered liquid and communicates through an opening controlled by a sluice with another chamber from which the liquid may be drawn by means of siphons or steam ejectors, and so an increased rate of filtration obtained.—C. C. H.

XIX.—PAPER, PASTEBOARD, Etc.

PATENTS.

Improvements in the Production and Manufacture of Paper having Waterproof, Non-conducting, and other Valuable Properties and Qualities. T. J. Pearce and M. W. Beardsley, Oakland, California. Eng. Pat. 3787, March 12, 1888. 6d.

THE INVENTORS saturate paper with "Maltha," which is the solid residue from the distillation of the heavier grades of petroleum.—E. J. B.

Process for Denitrating and Dyeing Pyroxilin. Le Vicomte Hilaire de Chardonnet, Besançon, France. Eng. Pat. 5270, April 9, 1888. 4d.

THE PROCESS consists in treating nitrocelluloses with nitric acid of a density of 1.32, whereby, in a few hours, they lose part of their nitrogen and become reduced below the state of the "tetranitrate," at the same time beginning to soften and being rendered more easy of treatment in dyeing and other operations.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Reduction of Tartaric Acid. M. Ballo. Ber. 22, 750—754.

IF one part of tartaric acid be heated on the water-bath with one-tenth part of crystallised sulphate of iron, a greyish yellow precipitate is formed. The mass, evaporated to crystallisation and extracted with alcohol, yields on evaporation of the alcoholic extract a residue which has acid properties. It combines with lime to form a lime salt. The author calls the acid *Iso-arabismic acid*. It may be isolated from the lime or lead salt by precipitating the base as oxalate or sulphide respectively. It has the composition $C_6H_8O_6$. It has no action on Fehling's solution, but turns the plane of polarisation to the right. It is a monobasic acid forming salts of the general formula $C_6H_7O_6M$. A second substance, *iso-arabismic hydrate*, is formed in this reaction, of the formula $C_6H_{12}O_6$. The greyish-yellow precipitate above mentioned is an organic compound containing 14.2 per cent. of iron. The object of the above research, as the author explains, is to show the possible action of iron in inducing organic change such as is ascribed to the iron present in chlorophyll.—J. B. C.

Constitution of the Cinchona Alkaloids. Z. H. Skraup. Monatsh. Chem. 10, 39—50.

THE author has recently shown that the "second half" of cinchonine contains a nucleus which is certainly not a quinoline ring but is in all probability a piperidine ring, and this view is in accordance with what is already known of the behaviour of cincholoipon and cincholoipic acid. Quinine, when oxidised with chromic acid, yields, as is already known, quinine acid, $C_{11}H_9NO_3$, and syrupy products which are analogous to those obtained from cinchonine and which can be separated into two portions by saturating the syrup with bases and extracting with alcohol. The portion insoluble in alcohol consists of salts of quinine acid, triarabopyridinic acid and an amorphous nitrogenous acid which hitherto could not be obtained in a pure state. The last-named acid can, however, be easily prepared in a crystalline condition by oxidising chitenine, $C_{19}H_{22}N_2O_4$, which, as the author has previously shown, is formed together with formic acid when quinine is carefully oxidised with potassium permanganate. Chitenine, prepared as previously described, when crystallised from alcohol, generally contains an impurity which can be removed by dissolving in warm ammonia, saturating the solution with carbonic anhydride, and repeating the process. It has no well-defined melting point, but generally melts at about 265° when heated slowly. It does not combine with phenylhydrazine, but it yields an amorphous yellowish-red acetyl-derivative. It is reduced when treated with sodium amalgam in dilute sulphuric acid solution yielding an amorphous base, the aqueous solutions of which are intensely yellow coloured. It yields an amorphous compound when treated with potash and ethyl iodide, and when heated with hydrobromic acid it is converted into the hydrobromide $C_{19}H_{22}N_2O_4 \cdot 2 HBr$.

Oxidation of Chitenine.—The most important product of the oxidation of this substance by chromic acid (about 25 per cent. of the chitenine employed) consists of cincholoipic acid, the isolation of which is described in detail. This acid is obtained in the form of a syrup which could not be induced to crystallise, but when agitated with a little warm hydrochloric acid and a crystal of cincholoipic acid hydrochloride (from cinchonine) thrown into the cold mixture, the hydrochloride, $C_{11}H_{13}NO_4HCl$, separates in well defined prisms or in small crystals according to the concentration of the solution; further quantities of the salt can be obtained from the mother-liquors by converting into the lead salt, purifying the latter by repeatedly precipitating with alcohol, decomposing with sulphuretted hydrogen, and treating the resulting syrupy acid as described above. The cincholoipic acid and the hydrochloride thus obtained are identical in chemical, physical, and also in optical properties with the corresponding compounds obtained from cinchonine. It was also proved that from the mixture of neutral compounds which are formed when quinine is oxidised with chromic acid a compound can be isolated which is identical with cincholoipon obtained by oxidising cinchonine.

If cincholoipic acid is heated for a short time on the water-bath it loses the power of crystallising, and is precipitated in an amorphous condition when alcohol is added to the aqueous solution; even after dissolving in hydrochloric acid the salt does not crystallise until after some weeks. This fact explains why in former experiments cincholoipic acid and its hydrochloride were not obtained in a crystalline condition.

Cincholoipic acid is best prepared as follows:—55 grms. of commercial quinine sulphate are dissolved in 30 grms. of concentrated sulphuric acid, the solution made up to 500 cc., and each 100 cc. is mixed in the cold with 380 cc. of a 4 per cent. solution of potassium permanganate. After filtering from the manganese oxide the filtrate and washings are evaporated to about 1½ litres; the concentrated solution of chitenine thus obtained is heated on the water-bath and a solution of 80 grms. of chromic acid and an equivalent quantity of sulphuric acid is gradually run in. When oxidation is at an end the whole is poured into excess of potash, boiled, filtered, the filtrate neutralised with sulphuric acid, and the potassium sulphate allowed to separate as completely as possible. The mother-liquors are mixed with a large volume of alcohol, concentrated sulphuric acid added,

and the whole vigorously shaken until the precipitate becomes colourless and crystalline. The alcohol is evaporated, the solution boiled with excess of lead carbonate, filtered, concentrated, and the residual lead salt precipitated three or four times from its aqueous solution with alcohol, decomposed with hydrogen sulphide and the filtrate acidified with hydrochloric acid and concentrated. On adding a crystal of the salt, cincholoipic acid (4—5 grms.) separates, and further quantities can be obtained from the mother-liquors, as well as from the lead salt which remains in solution after precipitating with alcohol. This method is also recommended for the preparation of cincholoipic acid from cinchonine.

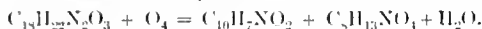
The author's investigations prove that the "second half" of quinine has the same constitution as that of cinchonine, so that the chemical difference between these two alkaloids is simply this, that quinine is a derivative of paramethoxyquinoline whilst cinchonine is a derivative of quinoline itself. The manner in which the two nuclei are joined together may, however, differ in the two alkaloids. The further investigation of cincholoipon and cincholoipic acid will be of importance in ascertaining the constitution of quinine.—F. S. K.

Constitution of the Cinchona Alkaloids.

H. Schnüderschütz, *Monatsh. Chem.* **10**, 51—64.

The isomeric alkaloids cinchonine and cinchonidine are very similar in properties and in their behaviour towards reagents. When carefully oxidised with potassium permanganate they both yield formic acid and are converted into cinchotenuine and cinchotenidine respectively; these two compounds have the composition $C_{17}H_{19}N_2O_3$, and both contain a hydrogen atom replaceable by the acetyl-group. Cinchonine and cinchonidine both yield cinchoninic acid when treated with chromic acid; this fact proves that both compounds are quinoline derivations, and that the hydroxyl-group must be situated in that portion of the molecule which is converted into cinchoninic acid. Comstock and Königs showed that the difference in constitution between these two alkaloids must be very slight, as they can be both made to yield one and the same cinchotenidine.

When cinchotenine or cinchotenidine is oxidised with chromic acid cincholoipic acid is obtained in a crystalline condition. An aqueous solution of cinchotenidine, prepared by oxidising cinchonidine with 4 per cent. potassium permanganate solution, was treated with chromic acid as described by Skraup (preceding abstract). Cinchoninic acid and an acid identical with cincholoipic acid from cinchonine were obtained, and as apparently no other product was formed the decomposition seems to take place in accordance with the equation—



The formation of cincholoipic acid is a further proof that the difference in constitution between cinchonine and cinchonidine is extremely slight, and that in addition to the points noticed above which these two alkaloids have in common, they both contain one and the same complex consisting of eight carbon atoms which, on oxidation, yields cincholoipic acid, and is, in all probability, a piperidine derivative. It may be that both alkaloids contain the same two constituent groups, and that their isomerism, if not purely physical, is due to some slight difference in the manner in which the two nuclei are combined together. If a compound identical with cincholoipon (from cinchonine) could be obtained from the nucleus in cinchonidine which is not oxidised to cinchoninic acid this view would be proved to be correct.—F. S. K.

Constitution of the Cinchona Alkaloids. J. Würstl. *Monatsh. Chem.* **10**, 65—72.

QUINIDINE, $C_{20}H_{21}N_3O_2$ (conquinine), is isomeric with quinine, and, like the latter, it forms salts which give fluorescent solutions. Skraup (*Annalen*, **199**, 340) has previously shown that quinine and quinidine are both oxidised by potassium permanganate, yielding formic acid and a base, $C_{19}H_{20}N_2O_4$.

This decomposition shows that one of the 20 carbon atoms is similarly situated in both alkaloids.

Quinine and its first oxidation product, chitenine, when treated with chromic acid, yield, as has been shown by Skraup, quinic acid and an acid syrup from which cincholoipic acid can be isolated.

The author treated an aqueous solution of chitenidine, prepared by oxidising quinidine sulphate with a 4 per cent. solution of potassium permanganate with chromic acid solution, as described by Skraup (preceding abstract), and obtained quinine acid and a cincholoipic acid identical with that formed from cinchonine, quinine, and cinchonidine. This fact proves that chitidine and quinine are both derived from a paramethoxyquinoline, and that the quinoline ring containing the methoxy-group is joined to the rest of the molecule in the same way as in quinine. In neither base can the hydroxyl-group be situated in that portion of the molecule which is oxidised to quinine acid, and both alkaloids contain the same complex, consisting of eight carbon atoms, to which the formation of cincholoipic acid is to be ascribed. The difference between the two alkaloids must, therefore, be due to a difference in constitution of the complex which does not yield quinic acid, and this difference, cannot be greater than that between cinchonine and cinchonidine.

In determining the relation between the four cinchona alkaloids, it will be of great importance to ascertain whether a compound analogous to cincholoipon (from cinchonine and quinine) can be obtained from cinchonidine and quinidine.—F. S. K.

Morphine. Skraup and Wiegmann. *Monatsh. Chem.* **10**, 101—114.

V. GERICHTEN, Schrötter, and O. Fischer have proved that morphine, $C_{17}H_{19}NO_3$, is a derivative of phenanthrene, $C_{15}H_{13}$, but the results of investigations on the decomposition of the alkyl-derivatives of morphine are very contradictory. v. Gerichten and Schrötter (*Ber.* **15**, 2179) observed that when methylmorphinemethylhydroxide is heated, a phenanthrene derivative, $C_{15}H_{13}O_2$, and methylethylpropylamine are obtained, a result which would seem to prove that the nitrogen atom was combined with a propyl-group. Hesse (*Annalen*, **222**, 232), on the other hand, found that methylmorphinemethylhydroxide yields trimethylamine, and not dimethylpropylamine, as was to be expected from v. Gerichten and Schrötter's investigations.

The authors found that when morphine is heated at a high temperature with alcoholic potash, sodium ethylate or sodium amylate, a volatile amine, and a phenol-like compound are obtained. When amyl alcohol is employed, considerable quantities of piperidine are often produced, owing to the presence of pyridine in the commercial amyl alcohol. The method which was found to give the largest yield of amine was the following:—Morphine is mixed with 10—15 times its weight of a 20 per cent. solution of alcoholic potash, and heated at 180° for 4—6 hours, the whole operation being carried out in absence of air. The dark-brown product is poured into dilute sulphuric acid, filtered from a light-brown flocculent substance, the filtrate saturated with soda, distilled with steam, and the distillate collected in hydrochloric acid of known strength.

The light-brown flocculent substance is very unstable, and rapidly darkens on exposure to the air. It is very difficult to purify, but it can be obtained in colourless microscopic crystalline flocks by repeated fractional precipitation (with water) from its solution in warm dilute alcoholic sodium hydrogen sulphite. It has the composition of a dihydroxy-morphine, $C_{17}H_{19}NO_5$, but all attempts to investigate this compound more fully were unsuccessful. When carefully oxidised with ferric chloride, it is converted into a red, unstable compound.

The quantity of the amine produced was, on the average, 40 per cent. of the morphine employed. It has the composition C_3H_7N , and was proved to be ethylmethylamine by direct comparison of the bases themselves and several of their salts, all of which were prepared and are fully described.

Ethylmethylamine, C_3H_9N , is a colourless liquid boiling at 34° – 35° . The *hydrochloride* is a colourless, hygroscopic crystalline compound melting at 133° . The *platinchloride* crystallises in needles melting at 208° ; the *aurochloride* melts at 179° – 180° .

The formation of ethylmethylamine shows that the nitrogen atom in morphine is directly combined with two alkyl-groups, so that it can only be combined with the phenanthrene complex with one affinity. Knorr's research (Ber. 22, 181, this Journal, 1889, 305), on the other hand, leads to the conclusion that the nitrogen atom is only combined with one alkyl-radicle. The formation of trimethylamine from methylmorphine-methylhydroxide could be explained by assuming that the ethyl-group is split off as ethylene, but it is difficult to understand how it is that Knorr obtained only dimethylamine from methylmorphine and not dimethylethylamine, as was to be expected from the authors' results. Some of the most important parts of this research were repeated, and it was found that ethylmethylamine is obtained, free from any considerable quantity of other amines, even when the alcohol employed is previously distilled over oxalic acid. This base is also produced when morphine or codeine is heated with methyl alcoholic potash. There can, therefore, be no doubt that morphine contains both a methyl- and an ethyl-group in direct combination with the nitrogen atom.

In the above experiments two samples of morphine, from different provinces, were examined, and both gave the characteristic reactions for this alkaloid. One sample was converted into morphinemethyl iodide and the product showed all the properties of this compound; in preparing other morphine derivatives the authors experienced considerable difficulties which at the time were attributed to chance, but whether such is really the case further investigations must decide.

Normal propylamine undergoes no change whatever when heated with alcoholic potash under the same conditions as those described above in decomposing morphine.—F. S. K.

Report on New Drugs and Fine Chemicals. Merck's Bull. 2, 13–20.

Acetyl-phenylhydrazine (C_6H_5)HN.NH(CO.CH₃). ("Pyrodine").—This body, first synthesised on a basis of theory by A. S. Liebmann, and as "Pyrodine," therapeutically examined by Dreschfeld (this Journal, 1888, 765), was first commended by the latter, but subsequently in communications to Liebreich, he added a caution as regards the toxic action of the drug. Lepin has since confirmed this latter observation and the need of caution required (Lyon méd. 1888, No. 80). Merck has now observed that the risks of toxic action reside in the fact that, as hitherto prepared, the substance is of variable nature, and that toxic action is due to impurities.

Pieric Acid.—This substance has been recently employed with success in the treatment of *Eczema impetiginosum*, by Cerasi (Gazzetta med. di Roma). Solutions of 0.3 to 0.6 per cent. strength are used.

Benzanilide, $C_6H_5NH.CO(C_6H_5)_2$.—A derivative of benzoic acid and aniline, just as acetanilide is of acetic acid and aniline. Its therapeutic properties are similar to those of acetanilide. E. Kahn (Wiener med. Wochenschrift, 1888, 1523) found it to be "a powerful and well-borne antipyretic." Febrile temperatures were reduced by some degrees within an hour, after a small dose as 0.2 gm.

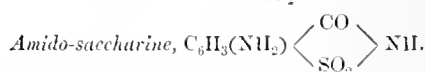
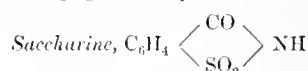
Curarine.—The active principle of curare (arrow poison). Prepared according to Böhm's method *curarine* appears as a yellowish-brown, amorphous, hygroscopic powder of intensely bitter taste. It is easily soluble in water and in alcohol, but insoluble in ether. It shows no perceptible alkaline reaction and forms no true salts, but decomposes on being heated with mineral acids, forming a crystalline derivative which has not yet been investigated. Concentrated sulphuric acid dissolves *curarine*, producing a crimson colour, which on addition of a little potassium bichromate, passes into a bluish tint. The strength of the preparation (*curarine*) may vary, just as in the case of curare, according to the origin of the crude drug from which it is prepared.

Lithium salicylate is pronounced by Vulpian to be of greater effect than sodium salicylate in gout and acute articular rheumatism. He maintains that the lithium salt is capable of consummating the action of the sodium salt.

Beta-naphthol.—Bouchard recommended this as a very slightly toxic but efficacious intestinal disinfectant. More recently, the experiments of Reverdin (Soc. Med. de la Suisse romande) have fully confirmed this, and also shown it to be an excellent surgical antiseptic. In surgical cases the naphthol is presented either in powder or in 10–15 per cent. wadding, which is prepared by sterilising cotton wadding at 130° C., and then impregnating it with an ethereal solution of beta-naphthol. Ruault has employed beta-naphthol water with good effect in ozæna. This solution is prepared by dissolving 125 parts by weight of the naphthol in 88 of alcohol and stirring 15 to 20 cc. of this into a quart of water.

"*Pyrofusine*."—This is the name of a peculiar ulmin-like substance extracted from various kinds of bituminous coal by treatment with alkaline solutions. In alkaline solution, a very strong antiseptic action is developed. P. F. Reinsch discovered this substance, and has applied it in his new process to the tanning of leather. The cellular structure of animal skins becomes so altered that an excellent leather is produced after a very brief immersion in a pyrofusine solution.

Amido-saccharine or *Paramidobenzoylsulphonic imide*.—This is a sweetening agent closely related to saccharine—

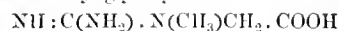


Its discoverer is A. Noyer. The amide is but little soluble in cold water, and a solution of it in hot water exhibits a deep blue fluorescence, and possesses an intense and persistent sweet taste.

Artificial Borneol, $C_{10}H_{18}O$, as obtained from rosin (colophony) by Armstrong and Fielden, is so far chemically undistinguishable from the native or true borneol or Borneo-camphor. Its alcoholic solution is, however, optically inactive, and this is the only property which serves to distinguish it from the natural product, the solution of which is dextro-rotatory. Borneol resembles the officinal or laurel camphor in its appearance, and consists of leafy white crystals. It is heavier than water, whilst common camphor is lighter. Its melting point is 199° C. In the case of frogs, it acted like laurel camphor in reducing the pulse-rate, but the pulse became fuller at the same time. In addition, however, R. Stockman finds, in the case of the artificial product, that a paralysis of the pneumo-gastric nerve is induced, not observed in that of the common camphor.

Butyl Chloral Hydrate, $C_4H_9Cl_3O$ + aq., or *Hydrate of Normal Trichlorobutylaldehyde*.—For some years after its discovery in 1870 was known as croton chloral hydrate. This is a misnomer, though still largely adopted, since it really applies to the substance of the formula $C_5H_9Cl_3O$ + aq. The subject of this note is a valuable anodyne in cases of special neuralgia, facial rheumatism, perioritis, &c. Liebreich prepares the composition recommended, so as to avoid the unpleasant taste of the butyl compound, as follows:—Butyl chloral hydrate 2–3–5 grms.; alcohol, 10 grms.; glycerol, 20 grms.; and distilled water, 120 grms.

Creatine.—Methyl-glycoeyamine—



in the anhydrous state forms an opaque, white, solid inodorous substance possessing a somewhat bitter acid taste. Its monohydrate crystallises in clear prisms, losing their water of crystallisation at 100° C. Creatine is soluble in about 70 parts of water, but almost insoluble in absolute alcohol. Creatine is one of those constituents of meat soups and extracts which impart appetising taste and stimulating action to the heart and muscular centres. Th. J. Mays has shown that creatine solutions as weak as 1:2,000 are

capable of re-animating a frog's heart which has been fatigued, and finally arrested by administration of sodium chloride. Robert (Chem. Zeit. 1888, 1662), as the result of experiment, recommends this principle as of undoubted value as an excitant of muscular action, in the case of the heart, digestive organs, and general muscular system.

Ethyl Bromide has gained renewed favour as an anæsthetic in light surgical practice, obstetrics, &c. Emphatic warning is given against substitution of *Ethylene bromide*, which has in several cases been erroneously supplied and administered. In the latter case, vomiting, great pallor, cerebral pain, and *tinnitus aurium* supervene. *Ethyl bromide* boils at 38° to 39° C., and when properly made is obtained by distillation of a mixture of potassium bromide, pure alcohol, and sulphuric acid, with purification of the crude product. *Bromide of Ethylene* boils at 131° C., and has no anæsthetic power whatever.

Lantaine is an alkaloid recently discovered by Boniza and Negrata (Chem. Centr. 1888, 1620) in the plant *Lantana brasiliensis*, called by the Peruvians "*Yerba Sagrada*." It acts similarly to quinine as an antipyretic, is well borne even by very weak stomachs, and proves of great efficacy in intermittent fevers in cases where quinine has been resisted.

Solanine.—This is a basic glucoside capable of forming true salts with acids, and also of being fractionated into a glucose and another substance of peculiar properties—"*Solanidine*." Solanine is contained in widely different species of the *Solanum* family, but is chiefly obtained from the sprouts of the potato (*Solanum tuberosum*). It forms colourless, lustrous, fine needles, melting at 235° C., is nearly insoluble in water, ether, and benzene; little soluble in cold, easily so in hot alcohol. Taste slightly bitter and pungent.

Solanine is an excellent neurotic sedative, more efficacious in long standing neuralgia, especially when neuritis is present, than either antifebrin or antipyrine. (Sardas, Bull. gén. thérap. 1888, May 30.) The solanine salts are easily soluble in water.

Urechites faberecta is the name of a plant found in Jamaica, containing two very poisonous glucosides, *Urechitin*, $C_{22}H_{42}O_{10}$, and *Urechitorin*, $C_{13}H_{26}O_5$. The former is obtained in the form of needles of intensely bitter taste and almost insoluble in water, but easily soluble in hot alcohol. Miniewicz (Dorpat, 1888) has recently isolated from the same plant an amorphous glucoside and an acid resin, both highly toxic. *Urechites* appears to be closely related in its effects to strophanthus, and is also an antidote to curare.

Viburnin, an extract from the bark of *Viburnum prunifolium* or "Black Haw," has been found of great value in certain uterine affections, especially by American physicians. Debrierte (Nouveaux remèdes, 1888, 396) has prepared the first precise report on the extract and his experiment with the active principle of the bark, *Viburnin*. There is room for still further research in view of the important results attained, with what must still be regarded as a crude product.—W. S.

PATENT.

Improvements in the Production of Iodine and Iodine Compounds. H. Suilliot and H. Raynaud, Paris. Eng. Pat. 9166, June 23, 1888. 6d.

THE solution of kelp, or any other liquid containing iodine in the form of iodides, is made alkaline by addition of sodium hydroxide, mixed with an excess of acetone, and a dilute solution of a hypochlorite is added gradually. Iodoform separates as a curdy precipitate, and the addition of the hypochlorite is continued until the formation of a precipitate ceases. Practically the whole of the iodine separates in the form of iodoform, from which it is recovered by any of the ordinary processes. Sulphides, sulphites, and thiosulphates reduce a certain quantity of hypochlorite, but other alkaline salts do not interfere. The hypochlorite may be replaced by any substance which will form a hypoiodite by reaction with an iodide.—C. H. B.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

PATENTS.

New or Improved Process for the Production of Coloured Photographs upon Glass and like Substances. A. E. Lottale, Balsall Heath, and F. Billing, Birmingham. Eng. Pat. 8518, June 11, 1888. 6d.

A glass plate is coated with a film of gelatin sensitised with a chromium compound as in the ordinary process of carbon printing. The film is exposed to light under a transparent positive image, and the chromium salts which remain soluble are removed by washing with water. The plate and film are then dried and afterwards immersed in a solution of some dye containing about 50 per cent. of glycerol. It is found that the dye attaches itself only to those parts of the film which have not been acted upon by light. The film is immersed in a solution of alum, then dried.

Gelatin films sensitised with ferric chloride and tartaric acid may also be used, and are dried at about 50° and exposed under a negative. In this case the dye solution is made by dissolving the dye in water or dilute alcohol, with or without admixture of glycerol, gum, or similar substances.—C. H. B.

Improvements in Apparatus for Producing and Discharging Currents for Washing Photographic Plates and Prints or other Analogous Purposes, capable of being attached for use upon or to any ordinary Vessel. W. Tylar, Birmingham. Eng. Pat. 9711, July 4, 1888. 8d.

THE apparatus consists essentially of a metal syphon which may be hung on the edge of any vessel. That limb of the syphon which is in the vessel is divided into two compartments, one of which is in communication with the discharging limb outside, whilst the other is connected with a water supply by means of which a current of water may be sent into the vessel under any desired pressure. The lower part of this feed pipe is provided with angular openings which send the water in different directions and thus promote constant circulation. Baffle plates may be used if necessary in order to still further divide the current. At the top of the syphon is a valve by means of which the current of water can be sent into the vessel down the feed pipe, or else down the discharge pipe. In order to start the syphon the water is first sent down the discharge pipe until all the air is drawn from the syphon, and if the valve is now turned and the water is sent along the feed pipe the syphon continues to act and draws off the surplus liquid from the vessel. Instead of dividing a limb of the syphon a separate feed pipe may be permanently attached to it. The inlet and outlet tubes may be closed with metal gauze, perforated plates, or any similar substance.—C. H. B.

Improved Apparatus for Washing Photographic Negatives and Prints. F. Bishop and D. Allan, London. Eng. Pat. 4103, March 8, 1889. 6d.

AN ordinary washing trough provided with the usual inlet and outlet tubes has standards attached to the ends or sides, and on these slides a rack in which the plates are held corner-wise in the ordinary manner. By means of clamping screws the rack can be adjusted at any height in the trough, and when the plates are completely washed the rack can be raised out of the water and is supported directly over the trough whilst the plates drain.—C. H. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENTS.

Improved Safety Smokeless Gunpowder. C. F. Hengst, Plumstead. Eng. Pat. 13,656, September 21, 1888. 6l.

This powder is produced by nitrating pulped straw, and after removal of all traces of acid, granulating the product with or without the addition of oxidising agents.—C. N. II.

Improvements in the Manufacture of Explosive Compounds. J. W. Skoghund, Stockholm, Sweden. Eng. Pat. 18,362, December 15, 1888. 6d.

This invention relates to the manufacture of explosive compounds, consisting of nitro-cellulose or trinitrophenol together with the radicle of carbonic, oxalic, or carbamic acids, in combination with ammonium, or another volatile radicle base, or hydroxyl.—C. N. II.

XXIII.—ANALYTICAL CHEMISTRY.

Action of Sulphurous Acid on Alkaline Hyposulphites. A Correction. A Villiers. Comp. Rend. 108, 402—403.

THE salt obtained by the action of sulphurous acid on hypsulphite (thiosulphate) of soda, and previously described by the author as having the formula $\text{Na}_2\text{S}_2\text{O}_4$, i.e., the sodium salt of a new acid, proves, on further examination, to be hydrated sodium tetrathionate, $\text{Na}_2\text{S}_4\text{O}_6 \cdot 2\text{H}_2\text{O}$. The salts formed in the reaction are therefore sodium trithionate and tetrathionate, $2\text{Na}_2\text{S}_2\text{O}_4 + 3\text{SO}_2 = \text{Na}_2\text{S}_3\text{O}_6 + \text{Na}_2\text{S}_4\text{O}_6$. —J. M. H. M.

The Free Caustic Alkali of Soap. J. A. Wilson. Chem. News, 59, 280.

THE author has already pointed out that there is a source of error in the spirit method, and this error is due to the simultaneous presence of free alkali and free fat or oil.

When high class soaps are analysed, containing no free glycerides, the spirit method gives very accurate results; but any analyst who has to deal with soaps of any quality, and made in the most imperfect manner, will find the alcohol process perplexing. Hence, the author has no hesitation in saying that the determination of free caustic alkali in some soaps is one of the *most difficult problems* met with in practice. The conditions necessary to ensure the stability of the soap (i.e., the decomposition into an acid soap and free caustic alkali) are just those conditions necessary to ensure the absolute saponification of the glycerides by the *free caustic alkali present*. To any expert in soap analysis, the presence of free alkali and glycerides in the sample simultaneously is easily seen; on the addition of alcohol with phenolphthalein the colour goes deep, then gradually fades and may disappear altogether.

The method depending on insolubility of soap in strong brine has been proved to give the most inaccurate results, whilst that depending on precipitation of the alkali by carbonic dioxide gas, the solvent for the soap being alcohol, gives the same conditions necessary for complete saponification, as stated above; hence, this process is of no use. It is necessary to bear these facts in mind in these days, when we hear so much about the absence of free alkali in certain soaps.

In using the alcohol process for determining free caustic alkali, it is necessary to use nearly, or, better, absolute alcohol, and to conduct the operation with the least possible access of air. Moreover, the alcohol should be used largely and in due regard to the percentage of water in the soap.

In these cases, on account of the presence of free fat, the alcohol process must be abandoned if good results are required, and it will be better to state the results in this form:—

Alkali in total, per cent. Alkali combined with fatty acids, per cent.

If the alkali existing as silicate and carbonate be very carefully determined, some idea may be gained of the alkali actually present as sodium hydrate. Supposing palm-nut or cocoa-nut oil to have been used in the fabrication of the soap, the determination of the Na_2O required to neutralise the fatty acids becomes quite inaccurate, owing to the solubility of the lower fatty acids; hence, another complication arises.

In order to show the differences between the above methods, a few analyses may be quoted:—

Nature of the Sample.	Alkali (Na_2O) by Titration.	Alkali by Titration of the Insoluble Fatty Acids.	Alkali by Alcohol Test.
	Per Cent.	Per Cent.	Per Cent.
1. Palm-oil soap, cold process	5.00	4.59	0.00
2. Highly watered soap from bone-fat.....	3.51	0.71	0.31
3. Palm-oil soap, similar to No. 1.....	5.61	5.39	0.00
4. Common soap for calico-printers.....	6.05	6.31	0.33
5. Soap from tallow and cocoa-nut oil.....	3.53	2.52	0.107
6. Washing soap sold in North of England.....	7.33	7.70	0.017

The article sold for calico-printers' use, known as soluble oil, which is made from castor oil, consisting therefore of the sodium salt of ricinoleic acid, is required to be as neutral as possible; hence some makers, after saponification, add hydrochloric acid to neutralise the excess of alkali, which of course is overstepped, and free fatty acid results. Its usual composition is—

	Per Cent.
Free fatty acid as ricinoleic acid	4.75
Total fatty acids.....	20.50
Total alkali.....	1.67

On decomposition of this soap with subsequent titration of the washed fatty acids the number of cc. of alkali used for neutralisation must be corrected by that required to neutralise the free fatty acids. Samples No. 1 and 3 in the table contained matured glycerides easily detected as previously mentioned. That the figure 0.31 per cent., corresponding to soap No. 2 is incorrect was proved by estimation of the carbonate and silicate in the soap. The last soap in the table actually gave results higher in the third column than in the total column.—W. S.

Determination of Lithium as Fluoride. A. Carnot. Bull. Soc. Chim. 1889, 280—286.

THE fluorides of potassium, caesium, and rubidium are readily soluble in water; the solubility of sodium fluoride in water is 1:25, whilst that of lithium fluoride is 1:800 at ordinary temperatures. In a mixture of equal volumes of water and ammonia the solubility of lithium fluoride is only 1:1,900, whilst in presence of a little ammonium fluoride the solubility is further decreased, being then 1:2,100 water, 1:3,000 a mixture of three volumes of water to one volume of ammonia, and 1:3,500 a mixture of equal volumes of ammonia and of water. The solubility of sodium fluoride in this last mixture and in presence of ammonium fluoride is 1:70.

The method proposed by the author for the determination of lithium and for its separation from sodium and potassium is based upon the slight solubility of its fluoride in presence of ammonia and ammonium fluoride. The solution containing the mixed salts of the three alkalis, in which the proportion of sodium plus potassium to lithium should not be greater than 10 or 15 to 1, is evaporated down to a few cc. in a weighed platinum dish and treated with fluoride of ammonium and an excess of ammonia. [The ammonium fluoride must be free from fluosilicate; to remove the latter dissolve the fluoride in water, add double the volume of ammonia, boil for a few seconds, allow to cool and filter off the separated silica. The solution can be kept for several days in a stoppered glass bottle.] The mixture is well agitated and allowed to stand for 24 hours, when a white gelatinous precipitate of lithium fluoride separates, which adheres partially to the dish. This is washed 2—3 times by decantation with water containing both ammonia and ammonium fluoride, and the washings filtered, the portion of the precipitate collected on the filter-paper being again washed with the above mixture. The filter is then dried, burned, the residue dissolved in dilute sulphuric acid, and the resulting solution added to the portion of the original precipitate in the platinum dish, the whole of the lithium being thus finally obtained and weighed in the form of sulphate. The solubility of the lithium fluoride in the ammoniacal mixture is allowed for, after measuring the volume of the filtrate (this ranges from 30—50 cc.), as follows:—7 cc. of the filtrate dissolve 0.002 gm. of lithium fluoride corresponding to 0.004 gm. of sulphate and to 0.001 gm. of metallic lithium. The separation of potassium and sodium can be effected in the filtrate from the lithium fluoride. The following results are given:—

Taken.			Found.	Calculated.
Li_2CO_3 .	Na_2CO_3 .	KNO_3 or KCl .	Li_2SO_4 .	Li_2SO_4 .
Grm.	Grm.	Grm.	Grm.	Grm.
0.109	0.300	0.300	0.148	0.1486
0.050	0.350	0.450	0.075	0.0743
0.030	0.120	0.060	0.045	0.0446
0.100	0.200	0.200	0.1475	0.1486

To apply the above method to the analysis of mineral waters containing lithium, the silica, iron, alkaline earths, and magnesium must first be removed and the lithium partially separated from the sodium and potassium by treating the mixed chlorides first with 90 per cent. alcohol and then with a mixture of 90 per cent. alcohol and ether. The resulting solution then contains the whole of the lithium together with a small proportion of the other alkalis and at times traces of magnesium as chlorides, and in this the lithium is separated as fluoride as above. If magnesium be present this will also be precipitated as fluoride. To determine its amount the resulting sulphates are dissolved and the magnesium precipitated as phosphate, the lithium being obtained by difference. As a check on the absence of sodium and potassium from the precipitate of fluoride, the weight of the sulphate should be about twice that of the fluoride (2.115 times exactly). Two mineral waters obtained from the neighbourhood of Beaune, in the department Côte-d'Or were found to contain 0.240 and 0.310 gm. of lithium per litre respectively.—C. A. K.

The Volumetric Determination of Carbon Dioxide in Carbonates. E. Jäger and G. Krüss. *Zeits. Anal. Chem.* **27**, 721—724.

A QUANTITY of the carbonate capable of yielding 40—50 cc. of gaseous carbon dioxide is decomposed in a 100 cc. flask by the addition of hydrochloric acid of 1.001 sp. gr. The stopper of the flask contains, besides a stop-cock funnel for the addition of the acid, a capillary tube bent twice at right angles, and connected with a Hempel burette. Before starting the decomposition, the flask is placed in a beaker

of water for two minutes to bring it to the temperature of the room; the acid is then gradually added, the pressure tube of the burette being meanwhile lowered so that the decomposition takes place under reduced pressure. As soon as the volume of gas in the measuring tube becomes constant, the decomposition is complete; the flask is then again placed in a beaker containing water for a few minutes, and the volume of gas read off. This volume, less the number of cc. of acid added, gives the volume of carbon dioxide found, which must be corrected for temperature and pressure. (1 cc. of CO_2 at 0 and 760 mm. = 0.0019663 gm.) An excess of acid should be avoided, so as to reduce the error due to absorption to a minimum. By surrounding the gas burette with a water jacket, the process may be rendered more accurate. Test analyses with sodium carbonate, and lecland spar are given in which the errors vary from 0.01 per cent. to 0.17 per cent. from the theoretical amount of carbon dioxide.—C. A. K.

Separation of Zinc and Cobalt. By H. Baubigny. *Compt. Rend.* **108**, 450—453.

CONSIDERING the completeness with which zinc can be separated from nickel by the action of hydrogen sulphide in a slightly acid solution (this Journal, 1889, 307), and also that cobalt salts are less easily converted into sulphide than those of nickel, the author has attempted the separation of zinc from cobalt by the same method. He finds, however, that in an acetic solution a little cobalt sulphide is always carried down with the zinc sulphide, giving the latter a green colour. With free sulphuric acid, in quantity about equivalent to the zinc and cobalt salts reckoned as sulphates, in a solution dilute enough to ensure entire precipitation of the zinc, better results are obtained. If the quantity of cobalt present be small, the separation is complete, and nearly so when very little zinc is present. With larger amounts of either metal the precipitated sulphides should be reconverted into sulphates, and the separation repeated.—J. M. H. M.

The Application of Pettenkofer's Reaction for Bile to the Detection of Free Acid in Aluminium Sulphate, Alum, &c. E. Egger. *Zeits. Anal. Chem.* **27**, 725—728.

THE author has reversed Pettenkofer's reaction, as modified by Mylius, for the detection of cholic acid by the blood-red colouration formed on the addition of furfuraldehyde and sulphuric acid, and finds that if a solution containing 0.00004 gm. of SO_3 be treated with two drops of a solution of furfuraldehyde (1 drop of aldehyde to 10 of water) and a little cholic acid, and the whole warmed in a porcelain dish on the water-bath, a distinct red colouration is formed. To test alum for free sulphuric acid the sample is first moistened with water and then treated with 25 cc. of a mixture of 2 parts of alcohol and 3 parts of ether in the cold for 24 hours, the resulting liquid filtered, and evaporated gently on the water-bath to about 1 cc., and then the cholic acid and furfuraldehyde added; 0.0032 gm. of free SO_3 in 20 grms. of alum, equal to 0.016 per cent., can be detected thus. The same limit of the reaction obtains with the presence of free acid in neutral potassium sulphate, magnesium sulphate and zinc sulphate; with aluminium sulphate, the limit is 0.030 per cent. of free sulphuric acid.

The author has also compared the delicacy of Jorissen's method (*Zeits. Anal. Chem.* **26**, 111) for the detection of free acid with the above. He finds that the addition of 0.0003 to 0.0004 gm. of free sulphuric acid (SO_3) to 3 cc. of acetic acid and 2 drops of Gurjun balsam are necessary in order to get a distinct blue colouration. With aluminium sulphate, zinc sulphate and alum, the pure substances, when added to the mixture of acetic acid and Gurjun balsam in the form of a coarsely-ground powder, give no colouration, but if they be ground very fine the characteristic blue colouration ensues in each case. Hydrochloric and phosphoric acids both give Pettenkofer's reaction with furfuraldehyde and cholic acid, but the test is far less delicate than with sulphuric acid; acetic and tartaric acid do not only give no reaction, but their presence decreases the delicacy of the test for sulphuric acid.—C. A. K.

Estimation of Total Organic Nitrogen in Water by the Kjeldahl Process. H. Leffmann and W. Beau. Amer. Chem. J. 11. (Reprint.)

THE following reagents must first of all be made up:—

Caustic soda solution: 100 grms. of caustic soda are dissolved in about a litre of water; this is boiled down to about half its bulk and then made up to a litre with water free from ammonia.

Sodium carbonate solution: 200 grms. of pure sodium carbonate are dissolved in a litre of water, and the solution boiled briskly until several hundred cc. have been evaporated.

In order to determine the ammoniacal nitrogen in a water, without distillation, 200 cc. are placed in a stoppered bottle, 2 cc. each of the solutions of sodium carbonate and caustic soda are added, the stopper inserted, the solutions mixed and allowed to stand for an hour or two. By this means the calcium and magnesium are removed, which would otherwise interfere with the colour reaction in Nesslerising. The clear liquid is then pipetted off, filtered through cotton-wool, and 100 cc. Nesslerised.

Total organic and ammoniacal nitrogen is estimated as follows: 500 cc. of the water are placed in a round-bottomed flask, 10 cc. of concentrated sulphuric acid added, and the mixture boiled down until the water is driven off and the acid is colourless or pale yellow. A little powdered potassium permanganate is then added until, on shaking, the liquid acquires a green colour, after which the flask is heated for a few minutes until the liquid becomes colourless. After cooling, 50 cc. of water are added, and then a slight excess of the caustic soda solution (about 150 cc. will be found necessary); 2 cc. of sodium carbonate solution are then added to ensure precipitation of the calcium and magnesium. The liquid is cooled by immersing the flask in cold water, then made up to 250 cc., transferred to a stoppered bottle and allowed to stand for about an hour, or until the greater portion of the precipitate has subsided. The clearer portion of the liquid is then pipetted off and filtered through cotton-wool. An aliquot portion of the filtrate is Nesslerised. For this the authors prefer to use 100 cc. made up to 200 cc. A blank experiment must be made to determine the amount of nitrogenous impurity in the reagents used. The method is stated to give exceedingly trustworthy results.—T. L. B.

Action of Ozone on Guaiacum Resin. N. Kowalewsky. Centralbl. f. d. med. Wissensch. 27, 65.

GUAIACUM resin gives not merely one blue oxidation product, but a whole series of coloured products. Paper soaked in tincture of guaiacum shows the colours well, the different colours appearing in succession. On the dry paper ozone has to all appearances no action, but, if paper, which has been exposed dry to ozone for a couple of minutes, be afterwards moistened, it takes the colouration. This property it retains for a quarter of an hour or more after exposure to the ozone. Water through which ozone has been passed has no action on the paper.

Exactly similar reactions are shown with iodine.—T. L. B.

On the Determination of Glycerol by Oxidation with Potassium Permanganate in Acid Solution. H. Grünwald. Zeits. f. angew. Chem. 1889, 34—35.

THE author has tested the method of Planchon (this Journal, 1888, 779), and has obtained satisfactory results by absorbing the evolved carbonic acid in caustic potash solution, instead of the soda-lime recommended by Planchon.—G. H. B.

On the Adulteration of Lard with Cotton-seed Oil. A. Binjard and G. Wallbauer. Zeits. f. angew. Chem. 1889, 119—121.

THE authors' work was undertaken in connexion with an official inquiry into the state of purity of American lard in the wholesale market. Out of 42 samples examined, 34 were adulterated with cotton-seed oil in proportions varying from 19 to 53 per cent. The colour tests used for the qualitative examination were the Bechli-Hehner silver nitrate test and Labiche's reaction (this Journal, 1888, 135 and 404). The amount of cotton-seed oil present was estimated by means of Hübl's iodine method.—G. H. B.

New Books.

THE USES OF PLANTS. A Manual of Economic Botany, with special reference to Vegetable Products introduced during the last fifty years. By G. S. BOULGER, F.L.S., F.G.S., Professor of Botany at the City of London College, &c. London: Roper & Drowley, 11, Ludgate Hill. 1889.

SMALL 8vo volume, bound in cloth and containing 192 pages of subject-matter, four additionally devoted to a systematic synoptical index and 14 to a general index. The practical character of the work appears in the contents, arranged as follows:—INTRODUCTION—i. Economic Botany more than fifty years ago. ii. The Progress of Economic Botany in England during the last fifty years (1837—1887). PART I.—FOODS, FOOD-STUFFS, AND FOOD-ADJUNCTS. Section 1. Starches and Bread-Stuffs. (2.) Sugars. (3.) Pulse. (4.) Roots and Tubers. (5.) "Vegetables." (6.) Fruits. (7.) Nuts. (8.) Food-Adjuncts: (a) Alcoholic. (b) Condiments. (c.) Flavours. (d.) Alkaloids. II.—MATERIA MEDICA. III.—OILS AND OIL SEEDS, &c. IV.—GUMS, RESINS, &c. Section 1. Gums. 2. Resins. 3. Caoutchoucs and Guttas. V.—DYES AND TANNING MATERIALS. VI.—FIBRES AND PAPER MATERIALS. VII.—TIMBER AND OTHER WOODS. VIII.—AGRICULTURAL PLANTS. IX.—MISCELLANEOUS PRODUCTS.

CHEMICAL LECTURE NOTES. By PETER T. AUSTEN, PH.D., F.C.S., Professor of General and Applied Chemistry, Rutgers College and the New Jersey State Scientific School, New York: John Wiley and Sons, 15, Astor Place. 1888.

THIS is a small book containing a collection of chemical notes and observations on certain topics which, as experience has shown the author, cause the student more or less trouble. The work is written in a conversational style, the effort being evidently not only to teach the elements of chemistry and chemical physics, but to train the reasoning faculties and powers of expression in language. The style is at times somewhat racy; for example, under the heading of the "Classification of the Sciences," the opening sentence runs thus:—"In all attempts at classification there will occur between the various classes tracts of No-man's Land of greater or less dimensions, and these not seldom give rise to squabbles between those who wish to rule them." "The reason of this is that Nature does not deal with classes." "Chemistry and Physics are distinguishable for a time, but soon a field is reached that belongs to both." The text of this little work covers 96 pages; there is a Table of Contents, but no alphabetical index; indeed the character of the book does not demand it. Under the heading, "The Chemical Factor in Human Progress," some interesting and simple accounts are given of certain applications of chemistry to the industrial, medical, and sanitary arts.

FABRICATION ET CONTROLE DES CHAUX HYDRAULIQUES ET DES CEMENTS. Théorie et Pratique. Influences réciproques et simultanées des différentes opérations et de la Composition sur la Solidification. Énergie. Thermodynamique. Thermochimie. Par H. BONNANIE, Conducteur des Ponts et Chaussées, &c., &c. Paris: Gauthier-Villars et Fils, Imprimeurs-Libraires du Bureau des Longitudes de l'École Polytechnique. Quai des Grands-Augustins, 55. 1888. London: H. Grevel & Co., 33, King Street, Covent Garden.

OCTAVO volume in paper cover, containing 276 pages of subject-matter with which 22 wood engravings and diagrams are interspersed. There is no alphabetical index, but the work commences with a full and carefully arranged Table of Contents. The author in his preface emphasises the importance and value he believes may be found in his work

for constructors of bridges and permanent ways, military engineers, and railroad companies. The matter in this book is subdivided as follows:—**CHAP. I.** Historical, with various theories and considerations. **II.** Manufacture of Hydraulic Limes and Cements. **III.** Roasting: The relationship between the roasting, the initial attraction, and the final resistance. **IV.** Preparation of mortars and cements, and the various theories in connexion therewith, Le Châtelier's theory. The general theory of Hydraulicity. **APPENDIX.** Modern Theories. Energy: Notions relating to the Mechanical Theory of Heat; Equilibrium between Heat and Chemical Affinity. Dissociation. Principles of Mechanical Chemistry.

HISTOIRE SCIENTIFIQUE ET INDUSTRIELLE DU NOIR D'ANILINE. Par E. NOELTING, Directeur de l'École de Chimie de Mulhouse. Mulhouse: H. Stuckelberger, Libraire-Éditeur. (C. Detloff's Buchhandlung.) 1889.

This work, large 8vo form, bound as a pamphlet, appears to be devoted in the first place to dealing with the scientific and historic development of Aniline-black, and thereafter to the critical examination in the light of historic development, of the claims of M. Grawitz to patent rights, which, if granted, would give him the monopoly of this industry in France. Amongst the various distinguished opinions on this subject appended is that of Prof. A. W. Hofmann. The work contains a short preface, 169 pages of subject-matter, and at the end a concise Table of Contents.

DAS FURFURAN UND SEINE DERIVATE. Von Dr. ADOLF BENDER. Berlin: S.W. R. Gaertner's Verlagshandlung, Hermann Heyfelder. Schönebergerstrasse, 26. London: H. Grevel and Co., 33, King Street, Covent Garden.

PAMPHLET. 8vo size, the tabulated contents of which are announced as having been taken from a prize essay on the "Derivatives of Indole, Pyrrol, Furfuran, and Thiophen." The problem to be solved in this essay appears to have been the most rational mode of classification and arrangement of the members of the group referred to, with their principal derivatives. The method followed is foreshadowed in the "Vorbemerkungen." Then follows a complete index of reference on the literature of the subject, followed by 11 pages of text dealing with the occurrence and chemical development of Furfuran and thereafter with that of its derivatives in directions A, B, and C. The tabulated list follows, covering 71 pages, and arranged according to the scheme aforesaid. The grouping embraces the following items, represented in the columns of the table:—Name; Origin; Appearance; Melting Point; Boiling Point; Odour; Solubility in Water, Alcohol, Ether, &c.; Reactions; Remarks.

Trade Report.

(From Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

RUSSIA.

Classification of Articles in Customs Tariff.

Note.—Pound = 36 lbs. avoirdupois. Rouble = 3s. 2d.

The following decisions have been given by the Russian Customs authorities:—

Extract of hops and lupuline (trituated hops) generally.—Section 48, point 2. Duty, 2 roubles gold per pound.

Hydrofluoric acid imported in gutta-percha vessels, together with the vessels containing the acid.—Section 140. Duty, 2 roubles 40 copecks gold per pound.

Purified glycerin.—Section 141, point 3. Duty, 65 copecks gold per pound.

FRANCE.

Modification of Customs Duty on Collodion.

By a recent decision of the French Customs authorities, the *ad valorem* duty of 5 per cent. formerly levied on collodion as a chemical product not distinguished, has been converted to the specific rate of 15 francs per 100 kilos.

BELGIUM.

Imposition of an Import Duty on Saccharine.

The *Moniteur Belge* for the 22nd May publishes the text of a law of the Belgian Government imposing an import duty on saccharine. The following is a translation of the law in question:—

Art. 1. The import duty on saccharine or benzoic sulphinaide is fixed at 140 francs per kilogramme. Soluble saccharine, in a solid or liquid state, and all products containing more than one-half per cent. of saccharine, are subject to the same duty.

Art. 2. Products prepared with the aid of saccharine, other than those indicated in the preceding article, are assimilated, for the application of import duties, to products prepared with the aid of sugar. The classification of them is determined according to the sweetening power of saccharine compared with that of sugar.

Art. 3. The Government is empowered to establish on the manufacture of saccharine an excise duty not exceeding the import duty, and to take the necessary steps to secure the collection of this tax and the inspection of the factories.

THE NETHERLANDS.

Classification of Articles in Customs Tariff.

The following decisions affecting the classification of articles in the Netherlands Customs Tariff have recently been given by the Netherlands Customs authorities:—

Turpentine varnish is included in the category of colours prepared in oil, and pays therefore 5 per cent. *ad valorem*, whether prepared with turpentine or oil of turpentine.

Tariff Classification of Sulphonal.

According to a recent decision of the Netherlands Customs authorities, sulphonal is subject to an import duty of 1 florin 30 cents per kilogramme.

Modification of Import Duties on Vinegar.

A law of the 4th May last has fixed the import duties on vinegars as follows:—

Vinegar, including pyroligneous acid and acetic acid, crystallised or liquid:—

Containing, per litre, less than 100 grammes of acetic acid, not mixed with water, 3 florins per hectolitre.

Containing, per litre, 100 grammes of acetic acid, not mixed with water, 3 florins 50 cents per hectolitre.

Containing a larger quantity of acetic acid, in proportion to the above duties.

SPAIN.

Prohibition of the Import of Saccharine as an Article of Food.

According to the *Deutsches Handels-Archiv* a decree, dated the 3rd April last, has been issued, providing that the imports of saccharine for purposes of food, as well as of all substances which contain saccharine in any quantity and serving for similar purposes, is prohibited.

ITALY.

Classification of Articles in Customs Tariff.

Note.—Lire = $9\frac{5}{16}$ d. Quintal = 220·4 lb. avoirdupois.

The following decisions have recently been given by the Italian Customs authorities:—

Chloride of Metilene (? Methyl) and effervescent carbonate of lithine (prob. lithia).—Category 62. Duty, 120 lire per quintal.

Creoline (an antiseptic).—Category 61. Duty, 10 lire per quintal.

Anticryptogamic powder (composed of sulphur, with the addition of sulphate of lime and sulphate of copper, substituted for sulphur in the treatment of diseases of the vine).—Category 248. Duty, 1·10 lire per quintal.

SWITZERLAND.

Classification of Drying Oils.

Drying oils are taken out of Category 39.

AUSTRIA-HUNGARY.

Classification of Articles in Customs Tariff.

The following decisions affecting the classification of articles in the Austro-Hungarian Customs Tariff have recently been given by the Austro-Hungarian Customs authorities:—

Chemical products, such as toluidine, sulphu-naphthylamic acid and its salts, polysulphuric acid and its salts, are classified under Category 322 of the tariff, and pay 1·50 florins per 100 kilogrammes.

GREECE.

Alterations in Customs Tariff.

Note.—Oke = 2·8 lb. avoirdupois. Lepta = $9\frac{2}{10}$ d.

A despatch, dated the 30th April last, has been received at the Foreign Office from Sir E. Monson, Her Majesty's Minister at Athens, enclosing translation of a law just gazetted, making certain modifications in the Customs Tariff of Greece. The following is an extract from the translation in question:—

The following alterations shall be made in the Customs Tariff:—

1. The words "chalk in general" shall be struck off from the text of alinea c of Class 61.

2. An alinea marked f shall be added to this class (61), which shall be as follows:—

"Chalk in general, 2 lepta per oke."

3. An alinea marked b shall be added to Class 94, which shall be as follows:—

"Starch from potatoes of a bitter taste, 5 lepta per oke."

4. The words "in general, namely" in alinea c of Class 103, shall be substituted by the word "refined."

5. An alinea d shall be added to the above-mentioned class to the following effect:—

"Unrefined acids (for market) 10 lepta per oke."

UNITED STATES.

Recent Customs Decisions.

The following decisions affecting the classification of articles in the Customs Tariff and the application of the Customs law of the United States, have recently been given by the United States Customs authorities:—

In assessing the dutiable weight of imported rape-seed oil, which is subject to duty at the rate of 10 cents per gallon under T. I. 28, the standard of $7\frac{1}{2}$ pounds to the gallon is to be taken.

An article found on examination to be the elementary substance known as potassium, the metallic base of potash, is dutiable under paragraph 215 (T. I.), new, as a metal unwrought, and not free by assimilation to sodium.

So-called "ammonia-alkali" found on examination to be soda ash, is dutiable as such under paragraph 71 of the indexed tariff at the rate of a quarter of a cent per pound.

On the exportation of an article known as the "solid ingredient of rackarock," made by the Rand Drill Company of New York, from imported chlorate of potash, and packed in sacks or earthenware, there shall be allowed a drawback of the duty paid on a quantity of the imported chlorate used in the manufacture equal to the net weight of the exported prepared chlorate, less the legal retention of 10 per cent.

Savin, sage, and santal-wood oils are classified under T. I. 92, at the rate of 25 per cent. *ad valorem*; so-called preparations of coal-tar which are really chemical compounds, whereof coal-tar is not a constituent, and which are not wholly derived from coal-tar, nor sold as coal-tar preparations similar in general characteristics to salol, are dutiable as above; lactucarium, which is the juice of the lactucarium plant, inspissated by mechanical means, and used exclusively as a medicine, is dutiable under T. I. 93.

An article found upon chemical analysis to be a chemical salt known as "alpha-naphthylamine-mono-sulphonated soda salt" is dutiable under paragraph 92, for chemical salts or compounds not specially enumerated or provided for, at the rate of 25 per cent. *ad valorem*.

ARGENTINE CUSTOMS LAW FOR 1889.

The following are extracted from the text of the Customs Law of the Argentine Republic for the year 1889:—

Art. 1. All goods of foreign origin, and imported for consumption, will pay a duty of 25 per cent. *ad valorem*.

The following articles are excepted and will pay as follows:—

- a. 50 per cent. on gunpowder, munitions, and perfumery.
- b. 45 per cent. on matches (except wax).
- c. 10 per cent. on all kinds of paper.
- d. 5 per cent. on rough common salt, sulphuric acid, and sulphate of lime.
- e. The following specific duties are hereby imposed:—

Note.—Peso = 4s. 2d.

	Ps.
Alcohol in casks, fine, at 30° strength. per litre	0·15
Petroleum..... " "	0·25
Stearine or glycerin candles..... per kilo.	0·15
Stearine candles..... " "	0·12
Wax matches..... " "	0·50

Art. 2. The following articles are admitted free:—Powder for blasting, raw sulphur, sheep dip, and drugs.

Art. 3. All Argentine products or manufactured articles are free of export duty.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

THE SALE OF COCOANUT BUTTER IN SAXONY.

Mr. G. Strachey, Her Majesty's Chargé d'Affaires at Dresden, in a despatch to the Foreign Office, dated the 11th May last, with reference to the sale of cocoanut butter in Saxony, says:—

"The local sanitary police decided some time since that the regulations of the margarine law were applicable to cocoanut butter. On the complaint of some Mannheim makers of the article, the provincial authorities quashed this decision as illegal.

"They ruled that the cocoanut butter, proving on analysis to be in the nature of a pure vegetable fat, was not a preparation similar to animal butter in the sense of the margarine law. This substance might, therefore, lawfully bear the designation of cocoanut butter, and could be sold without restriction."

PETROLEUM WELLS IN VENEZUELA.

See Board of Trade Journal for June, p. 662.

OUR TRADE WITH SERBIA.

Our commercial treaty with Serbia has entered upon its last year of life, and as to our future trade with that country much will depend upon the terms which the Serbian Government will be prepared to accord us under new agreements. Austria-Hungary has hitherto held Serbia in her grip, but it is not likely that she will be induced to make the monopoly of her powerful neighbour absolute. Foreign capital may meanwhile, our Consul at Nisch says, find profitable employment in aiding to develop the rich natural resources of the country, such as vines and minerals, upon the future of which the purchasing power of Serbia will most largely depend. There is no scope yet for the employment of large capitals in any purely commercial undertakings.

It is suggested that with a view to the encouragement of British trade with the Balkan States a general British import agency should be established. This agency would have for its first object the convincing Servians of the superior durability, practical utility, and real cheapness of British goods; and although it would have many difficulties to encounter, it would, it is believed, ultimately get the better of German manufactures, which are turned out at the same price as ours, but which pay a higher transport freight to Serbia than the British articles coming by sea. The cheapness of the sea route would especially benefit British trade in big orders.—*Pall Mall Gazette*.

MISCELLANEOUS TRADE NOTICES.

EXPORT OF ALCOHOL FROM RUSSIA.

The Russian *Grajdanine*, basing its remarks on the latest publications of the Russian excise department, points out that the export of Russian alcohol is increasing year by year. The maximum attained in 1887 was three times the average of the export of the last 10 years (2,616,222 vedros per annum); the average of the export of the last five years is 56 per cent. lower than that of 1887, which itself is 5.2 per cent. higher than that of 1886. The quantity exported is equivalent to 19.8 per cent. of the entire alcohol manufactured in Russia in the course of the year. Two-thirds of the total quantity exported (6½ million vedros) were supplied by Poland and the Baltic Provinces.

ZINC PRODUCTION IN SILESIA.

The Belgian *Bulletin du Musée Commercial* publishes some interesting statistics with regard to the production of zinc in Europe and in the United States during the years 1880 to 1888. These figures draw attention to the important place occupied in this industry by the province of Silesia. The production of zinc in 1880 was 208,690 tons in Europe and 23,239 tons in the United States. In 1888 the figures were 267,005 tons in Europe and 50,000 tons in the United States. Of the divisions of the world, Silesia took the second place in zinc production, with 83,375 tons in 1888, as against 64,459 tons during 1880. Belgium, in 1888, produced 133,245 tons (but part of the Rhine Province was included in this amount); the United States, 50,000 tons; and then followed Great Britain with 26,633 tons; France and Spain, with 16,140 tons; Austria, with 3,827 tons; and finally Poland, with 3,785 tons.

METAL PRODUCTION IN AUSTRIA-HUNGARY.

According to *Genie Civil*, since the moment when Hungary secured the economical and industrial autonomy from Austria, the progress of her iron manufactures has been steadily marked. The total production, which in 1886, before the dual control had been effected, was only 106,720 tons, reached the figure of 234,667 tons in 1888, and, therefore, has more than doubled. It is the chain of the Carpathian Mountains, forming a vast girdle around the great plain of the Danube, which furnishes Hungary with

iron ore, abundant in quantity and of an excellent quality; and it is in the region north of those mountains (in the districts of Gömör, Zips, Abauj, Torna, and Ziptan) that very rapid progress has recently been made.

Although the forests are still abundant, the large blast furnaces burning Silesian coal begin more and more to take the place of the little charcoal blast furnaces. Mr. Wedding, of Berlin, who is well known for his numerous treatises on the properties of iron and steel, draws attention to this new condition of things in a recent article in *Stahl und Eisen*, as one to which the notice of metallurgists ought to be particularly drawn. This paper gives particulars, of an unusual fulness and accuracy, on the comparative *roulement* of the old and new wood and coke furnaces, comparing, in particular, the manufacture of Bessemer steel at the Diosgyör factory, which belongs to the Hungarian State, with that of Martin steel at the same factory, and in those at Brezowa and at Saljo Tarjan. It appears that in Hungary the superiority of the Martin steel over the Bessemer steel is universally recognised.

A JAPANESE CEMENT.

There is a probability, says the *Japan Gazette*, that the day of foreign cement in Japan is past. A Yokohama cement manufacturer and dealer has discovered a stone called *mekura* in Noto district which possesses remarkable qualities as a cement material. If the stated results of his tests be correct they are very good. It is said that the cement will bear a weight of 400 lb. to 500 lb. per square *sun* (about 1½ inch). Foreign cement is sold at about 4.70 dols. per barrel, while the estimated sale price of the cement under notice is about 2.50 dols.

AGRICULTURE IN CANADA.

The following remarks are taken from the report of the Select Standing Committee on Agriculture and Colonisation, presented to the Dominion House of Commons on the 27th April last:—

Professor Saunders, director of Government experimental farms, was examined by the Committee, and he stated that the results of numerous experiments had shown that the wheat called "Ladoga" ripens fully 10 days earlier than the "Red Fyfe." There appears, however, to have been considerable difference in the opinion expressed by the different bodies of experts to which the wheat was submitted, as to its quality, the same samples having been graded variously as "hard wheat," "soft wheat," and "No. 1 hard."

Mr. Saunders having stated that a series of careful experiments had been made by the chemist of the central experimental farm, which demonstrated that the Ladoga was superior in gluten to the Red Fyfe, while reports from bakers, and specimens of bread shown, proved that the flour produced from it was strong in bread-making qualities, even more so than that from Red Fyfe, the colour of the bread, however, being a shade less white.

The remarks made by Mr. Saunders on the subject of the barley product of the Dominion and the importance for Canadian farmers of growing varieties suitable for malting purposes in England, cannot be too carefully considered by them. He showed that we were in danger, from two causes, of a lessened demand for Canadian four and six rowed varieties in the United States markets, which had hitherto taken such large quantities; and, on the other hand, that the importation into England, for malting purposes, reached the quantity of 35,000,000 bushels a year, and for which much higher prices are paid than our farmers have hitherto obtained. It has, therefore, become a matter of prime importance for Canadian farmers to produce varieties to suit the English market. The kind used in England is the two-rowed, the four and six rowed being not at all saleable there for malting purposes. Mr. Saunders stated that a large number of samples of the very best varieties of the two-rowed had been distributed among farmers in different parts of the Dominion.

Mr. Saunders stated that 913 seed-germinating tests had been made during the year, of which 216 were of frozen wheat, 20 of frozen oats, and 19 of frozen barley.

These tests showed that the vitality of frozen wheat varied from 21 to 99 per cent.; frozen barley, 14 to 99 per cent.; and frozen oats from 2 to 94 per cent. The conclusion arrived at was that it was most unwise for farmers to sow anything but good seed, unless driven to it by absolute necessity, the rule being the same in vegetable as in animal life, from which it followed that a good constitution of seed was necessary in plant life to produce a good result.

OLIVE OIL.

Spanish olive oil having had a very low reputation, some producers have of late been trying hard to improve its quality, and fit it for table use. Some of the Seville growers are now making an excellent oil which commands a ready sale at more than double the price heretofore obtained. As the cost of making good oil is by no means double that of making bad, there is likelihood of other makers following this profitable example.—*Industries*.

A NEW LUBRICANT.

A Berlin correspondent says that mustard-seed oil has long been used in Germany as a condiment, and is principally manufactured at Ilversgehofen, near Erfurt. Now, however, there has been a new use found for this substance. As it only begins to solidify at a temperature of 9° to 10° C., and, moreover, forms no fatty acid which could affect metals, it has recently been employed as a lubricant for machinery. According to experiments made by Professor G. Hermann, Aix-la-Chapelle, its lubricating power is as 263 to 168 as compared with olive oil, while it is more than double that of naphtha. In order to prevent the workmen from using the mustard-seed oil for any but lubricating purposes it is denaturalised through the agency of a small quantity of petroleum.—*Ironmonger*.

ALCOHOL AND WATER TANNINS.

M. Adrian was recently consulted by the Custom House officials in regard to the possibility of distinguishing water tannins from alcohol tannins, the second alone being liable to duty. On making experiments to elucidate the question, he has found that when tannins prepared with water are exhausted with ether, the liquors evaporated and the residue redissolved in alcohol, the spirituous solution will, on being mixed with water, afford no precipitate. Alcohol tannins, on the contrary, even when made with weak spirit, contain resinous and fatty matters which, under the conditions described, will give an appreciable precipitate.—*Chemist and Druggist*.

THE ZINC INDUSTRY ON THE INCREASE.

The active demand which has sprung up for zinc during the last few years has led to a greatly increased production of that metal, which is now largely used for galvanising iron and many other purposes. The quantity of zinc produced in Europe and the United States increased year by year from 1880 to 1888, except during the period between 1885 and 1886, when there was a slight diminution, especially as regards Great Britain. The production, which in 1880 amounted to 208,005 tons in Europe and to 23,239 tons in the United States, had risen in 1888 to 267,005 and 50,000 tons respectively. The largest quantity is produced in Belgium and the Rhineland; these districts jointly represent about 134,000 tons, and after these come Silesia, with about 84,000 tons. Next in order comes the United States, contributing 50,000 tons, as already indicated, followed by Great Britain with about 27,000 tons. The zinc works of France and Spain show a turn-out of some 16,000 tons, while the Austrian and Polish yield barely exceeds 7,600 tons.—*Ironmonger*.

A GREAT IRON-ORE DEPOSIT.

A Canadian contemporary states:—"The iron-ore deposit at St. George's Bay, Newfoundland, has excited the wonder of the experts who have visited it. Doctor Stevens, mining expert from New York, has inspected the property and found the visible width of the deposit to be 171 feet, the distance beyond not being ascertainable as the deposit is

hidden by moss and shrubbery. The length of the deposit has not been determined, but it may be described as a mountain of magnetic ore of the purest quality, free from sulphur and phosphorus, and just suitable for the manufacture of steel. Analyses by Professor Pike give an average percentage of 90.3 per cent. of magnetic iron. The samples were taken from the surface, and the solid vein will undoubtedly give still higher results. A deep gulch cuts through this mountain of ore, exposing the lode, which can be worked on either side—in fact, quarried out—at a cost of not over 20 c. a ton. From the bottom of the gulch to the top of the mountain, 750 feet, thousands of tons of ore, estimated at from 300,000 to 400,000 tons, are exposed, which can be mined without the aid of explosives. This magnificent deposit of ore is close to a fine harbour, with which it may be connected by a short tramway. Coal has been discovered close by, which adds immensely to the value of the property, and we are safe in predicting that in a few years St. George's Bay will be the seat of extensive steel and iron works. The property has been bonded to an American syndicate."—*Ironmonger*.

THE UTILISATION OF WASTE PICKLE.

The Corporation of West Bromwich have been discussing the question of the disposal of the spent "pickle" from the galvanising works of Messrs. Ash and Lacy. An application had been made by the firm to run the pickle into the sewers, but the sewerage committee had come to the conclusion that the pickle, in its raw state, was very injurious both to brick and iron sewers. The committee were also satisfied that the treatment of the pickle with limestone only partially neutralised the acid, but did not precipitate or remove iron from the liquid. The only method the committee had seen in use was the mixing of a quantity of milk of lime with the pickle, which was said to neutralise the acid and precipitate the iron. The committee could not recommend that Messrs. Ash and Lacy should connect with the sewers at present, but proposed that they should furnish a sample of the effluent they proposed to discharge to an eminent chemist, who should advise as to the results of a process to which it was to be subjected as regarded acid, iron, and any other ingredients which might prove prejudicial or injurious to the sewers. The council agreed with the conclusions of the committee. Proceedings are to be taken against a Wolverhampton firm of galvanisers for turning sulphuric acid into the borough sewers.—*Chemist and Druggist*.

THE MANUFACTURE OF PICRIC ACID AT REDDESH.

The magistrates have decided to grant the application of Messrs. Charles Lowe and Co. to be permitted to manufacture picric acid at their works on condition that a lock-up shed should be erected expressly for the purpose of storing the red lead, the key to be kept by some responsible person. Mr. Yates, on behalf of Mr. Lowe, assented to the condition imposed.—*Chemist and Druggist*.

THE RUSSIAN PETROLEUM TRADE.

A St. Petersburg correspondent says that the Russian petroleum trade is assuming vaster proportions every year, and the total exportation of naphtha from the Black Sea and overland amounted last year to nearly 35,000,000 pounds, as against 19,000,000 in 1887, and 15,000,000 in 1886. Russian petroleum now finds favour in many markets which were formerly exclusively supplied with American products, and, it is stated, the sales of the Russo-German Naphtha Company rose last year to 541,500 centners, as against 323,000 centners in 1887. During the first quarter of the present year Italy imported 35,715 double centners of Russian oil, or fully 18,000 double centners more than during the corresponding period of 1888.—*Ironmonger*.

INDIGO-GROWING IN THE UNITED STATES.

Efforts are being made, says the *O. P. & D. Reporter*, to again interest South Carolina planters and capitalists in the cultivation and manufacture of indigo, which was an important article of commerce in the Southern States before

Great Britain's relations with the American colonies were severed. The industry then thrived because the Southern manufacturers were given a bounty of 6d. on every lb. put upon the market; but the subsequent civil strifes seem to have discouraged the continuation of extensive indigo operations, and since then the cultivation has been confined principally to Florida, where the plant grows luxuriantly, and where the dyeing material is still prepared on a small scale for local use. Correspondence has passed between parties in Georgia and St. Paul relative to the advisability of reviving the industry in the South, and some figures have been presented which give a glowing account of prospective profits. The practical details to govern the new scheme come from an ex-manager of two indigo factories in the East Indies, who is now in the States, and desires to co-operate in such an undertaking.

AUSTRIAN PETROLEUM WELLS.

The success of the petroleum borings in Galicia are indicative soon that the Austro-Hungarian Empire will be totally independent of a foreign supply of oil. Formerly there was a tendency to speak slightly of Galician oil deposits owing to the fact that a large proportion of the wells were dug by hand. Of late years the American method of drilling has been introduced, and many Galicians have become accomplished drillers. In the Lodyna district wells of a profitable character have been bored. Galician wells have not the copiousness of Russian, but a readier market exists for the oil, and the demand for Lodyna petroleum is such that it is sold at a high rate long in advance of appearing on the surface. The oil belt of Lodyna is five miles long and intersected by a railway, thereby enabling the oil to be sent to the refineries at a trifling expense. A few years ago all the refineries in Galicia did not produce 1,000,000 gallons of refined oil, but now their production exceeds 6,000,000 gallons. The Austrian Government takes great interest in the development of the petroleum industry, and has adopted a protective policy which has already succeeded in establishing the Galician oil trade on a firm basis. In consequence of this and of such successes as the recent borings at Lodyna, where wells have been struck giving a profit of 500 or 600 per cent., the financial and commercial world in Austria has been deeply moved, and petroleum has caused much excitement.—*Engineering and Mining Journal*.

THE ROTHAMSTEAD TRUST.

Sir J. B. Lawes, Bart., having endowed the Rothamstead Agricultural Experimental Station with the sum of 100,000*l.*, for the purpose of carrying on the investigations after his death, has now appointed the trustees, who met at Rothamstead and elected the following officers:—Dr. John Evans (treasurer to the Royal Society), chairman; Sir John Thorold, deputy chairman; Dr. Hugo Müller, treasurer; and Mr. Herbert Cox, secretary. The trustees were conducted over the experiments by Sir J. B. Lawes and Mr. C. B. Lawes, and afterwards discussed the steps to be taken for working the trust.—*Standard*.

PLATING WITH COBALT.

Among the exhibits at the Royal Society's soirée on Wednesday, June 19th, were fine samples of plating with metallic cobalt, done at the Technical College at Finsbury. The cobalt has a better colour than nickel, can be applied to any of the common metals and to steel, and does not flake from to which it has been applied.—*Standard*.

REGULATIONS FOR WITHDRAWAL OF ALCOHOL FROM BOND FOR SCIENTIFIC PURPOSES OR FOR THE USE OF THE UNITED STATES.

Internal Revenue Manual, 1888, 280.

Section 3297 of the Revised Statutes, as amended by Act of May 3, 1878, provides that the Secretary of the Treasury is authorised to grant permits to scientific institutions or colleges of learning to withdraw alcohol in specified quantities from bond without payment of the internal revenue tax on the same (average, 1.70 dols. per United States gallon of 231 cub. in., of 95 per cent. strength absolute alcohol), or on the spirits from which the alcohol has been distilled, for the sole purpose of preserving specimens of anatomy, physiology, or natural history belonging to such institution, or for use in its chemical laboratory.

Alcohol may be withdrawn from bond under the above provisions of law, on application of the president or curator of the institution in which the same is to be used, to the Secretary of the Treasury, transmitted through the collector of internal revenue of the district in which the alcohol is located.

For full instructions in regard to this subject, and also as to the withdrawal of distilled spirits from warehouse free of tax for the use of the United States, see [Treasury] Department Circular, No. 2, dated January 2, 1886, and Treasury Department Circular dated March 26, 1889.

DUTY FREE SPIRITS FOR SCIENTIFIC USE.

The kinds and quantities of spirits withdrawn for scientific purposes and for the use of the United States, free of tax, extracted from the report of Commissioner of Internal Revenue 1888, are given in the following table:—

CLASS OF SPIRIT WITHDRAWN.

	Year ended 30th June.	
	1887.	1888.
	U. S. Gallons.	U. S. Gallons.
Whisky, Bourbon.....	492	631
„ Rye	729	854
Alcohol	18,673	21,271
Cologne spirits.....	1,373	2,858
Total quantity	21,165	25,614

The different colleges and schools, especially those of medicine, are availing themselves more and more of the provisions of the law and regulations, while on the other hand, the manufacturing druggists are using less grain alcohol for their extractions every year. The employment of a refined wood alcohol is increasing among the latter, where the extraction of the drug by alcohol is only a step in the manufacture.

THE IMPORTS AND EXPORTS OF DRUGS AND CHEMICALS.

IMPORTS (QUANTITIES).

Principal Articles.		1884.	1885.	1886.	1887.	1888.
Alkali	Cwt.	66,893	68,503	78,154	64,753	56,793
Brimstone	"	747,398	720,048	636,396	661,158	773,480
Drugs:						
Bark, Peruvian	"	165,791	128,104	145,367	143,177	144,820
Opium	Lb.	490,675	710,099	521,124	654,122	587,565
Dyeing or tanning stuffs:						
Bark	Cwt.	433,136	356,828	390,798	346,566	339,691
Cochineal, granilla, and dust	"	14,766	14,228	14,941	10,089	7,674
Cutch and gambier	Tons	32,219	26,312	28,352	27,361	28,543
Dyes obtained from coal tar	Value £	554,880	487,459	569,750	542,806	568,962
Indigo	Cwt.	104,423	94,314	85,308	76,700	78,128
Madder, madder root, garancine, and munjeet	"	23,208	24,721	21,395	19,347	14,204
Safflower	"	1,794	715	1,394	710	1,623
Shumach	Tons	11,794	11,157	13,083	13,038	12,050
Valonia	"	34,447	29,487	34,227	29,678	31,871
Dye-woods:						
Logwood	"	68,626	68,549	55,598	48,720	62,306
Unenumerated	"	22,629	26,001	22,466	24,807	17,232
Galls	Cwt.	37,307	83,268	36,222	26,164	36,944
Gum:						
Arabic	"	57,529	93,532	75,591	46,405	77,728
Kowrie	"	62,378	82,566	44,724	55,144	66,000
Lac, seed, shell, stick, and dye	"	112,479	119,511	107,261	110,778	103,183
Of other sorts	"	98,232	104,889	88,317	101,835	110,594
Isinglass	"	8,356	6,412	5,952	7,023	6,824
Oil:						
Train or blubber, and sperm	Tons	17,489	18,380	15,854	17,698	16,871
Animal	Cwt.	95,811	121,498	113,482	140,467	129,283
Cocoa-nut	"	244,399	185,496	156,775	180,792	194,025
Olive	Tons	17,213	24,227	20,664	20,789	18,535
Palm	Cwt.	811,012	905,459	1,004,419	968,227	953,799
Seed	Tons	12,528	12,940	16,315	15,508	16,257
Turpentine	Cwt.	462,639	308,323	294,451	359,202	359,070
Chemical, essential, and perfumed	Lb.	795,043	805,597	813,405	973,557	936,946
Paraffin	Gallons	175,206	232,067	273,847	327,110	348,019
Petroleum	"	52,675,789	73,873,641	71,125,736	77,390,435	94,401,285
Quicksilver	Lb.	4,877,748	4,136,519	4,422,478	4,590,907	5,533,110
Rosin	Cwt.	1,475,955	1,322,354	1,168,355	1,086,121	1,310,425

IMPORTS (VALUES).

Principal Articles.	1884.	1885.	1886.	1887.	1888.
Alkali	£ 70,175	£ 59,841	£ 55,828	£ 46,847	£ 50,687
Brimstone	109,694	188,573	157,919	157,188	173,425
Drugs:					
Bark, Peruvian	905,199	874,332	801,353	661,682	551,568
Opium	341,371	456,134	307,666	422,920	365,518
Unenumerated	786,506	789,822	669,979	616,165	888,241

IMPORTS (VALUES).—continued.

Principal Articles.	1884.	1885.	1886.	1887.	1888.
Dyeing or tanning stuffs:	£	£	£	£	£
Bark.....	196,845	147,912	173,079	117,107	131,976
Cochineal, granilla, and dust.....	84,081	85,380	95,688	62,750	50,272
Cutch and gambier.....	821,018	563,565	651,218	661,597	705,779
Dyes obtained from coal tar.....	554,880	487,159	509,750	542,806	568,962
Indigo.....	2,483,931	2,119,840	1,907,555	1,673,067	1,702,232
Madder, madder root, garancine, and munjeet.....	31,070	36,858	26,812	24,177	18,497
Safflower.....	7,109	2,907	5,934	3,122	6,283
Shumach.....	165,631	162,951	178,464	156,720	135,410
Valonia.....	521,621	465,112	483,911	424,574	455,044
Substances and extracts unenumerated.....	791,861	752,259	698,705	737,701	739,822
Dyewoods:					
Logwood.....	381,950	374,373	290,714	265,213	366,131
Unenumerated.....	117,203	167,153	125,177	149,772	90,030
Galls.....	87,413	118,908	98,036	72,212	105,188
Gum:					
Arabic.....	174,102	326,908	295,464	213,477	312,493
Kowrie.....	182,693	258,244	133,056	179,462	177,822
Lac, seed, shell, stick, and dye.....	462,372	383,102	305,856	287,618	271,406
Of other sorts.....	321,608	360,969	311,969	374,247	380,293
Isinglass.....	120,500	88,379	80,307	101,033	87,156
Oil:					
Train or blubber, and sperm.....	530,805	520,412	361,947	373,275	323,680
Animal.....	194,636	229,971	188,120	246,960	225,835
Cocoa-nut.....	306,288	276,224	214,346	248,218	245,867
Olive.....	715,964	981,348	791,245	758,348	672,614
Palm.....	1,408,753	1,217,816	1,050,459	943,126	945,896
Seed.....	388,148	368,130	306,126	374,120	412,438
Turpentine.....	500,533	387,927	391,870	472,016	517,901
Chemical, essential, and perfumed.....	210,241	183,488	191,346	215,882	194,700
Paraffin.....	348,753	414,026	421,522	451,728	448,234
Petroleum.....	1,711,313	2,289,525	2,091,276	2,103,599	2,565,598
Quicksilver.....	333,918	326,959	369,779	439,208	616,499

EXPORTS (QUANTITIES).

Principal Articles.	1884.	1885.	1886.	1887.	1888.
Alkali..... Cwt.	6,562,400	6,661,800	6,212,800	6,161,900	6,343,000
Oil, seed..... Tons	61,212	66,295	70,476	75,098	78,008
Soap..... Cwt.	476,438	402,112	426,904	452,761	499,868

EXPORTS (VALUES).

Principal Articles.	1884.	1885.	1886.	1887.	1888.
Alkali.....	£ 2,089,609	£ 1,955,790	£ 1,788,078	£ 1,712,771	£ 1,638,770
Chemical products or preparations (<i>see also</i>) Dye-stuffs.....	1,463,794	1,448,817	1,492,574	1,692,651	1,931,904
Dye-stuffs.....	639,230	496,757	483,466	490,264	468,767
Medicines, drugs, and medicinal preparations.....	893,184	842,725	814,213	869,083	932,154
Oil, seed.....	1,466,014	1,531,747	1,502,346	1,567,646	1,593,912
Soap.....	547,613	472,438	446,710	452,244	482,399

EXPORTS OF FOREIGN AND COLONIAL PRODUCE (QUANTITIES).

Principal Articles.		1884.	1885.	1886.	1887.	1888.
Drugs:						
Bark, Peruvian	Cwt.	102,938	112,440	117,991	131,379	123,792
Opium	Lb.	471,377	425,196	368,107	353,137	335,397
Dyeing or tanning stuffs:						
Cochineal	Cwt.	11,292	12,260	11,303	8,114	6,168
Cutch and gambier	Tons	11,063	8,995	10,193	9,631	9,379
Indigo	Cwt.	70,770	70,626	54,081	53,085	51,129
Unenumerated	"	84,935	71,119	69,125	74,482	83,838
Dye-woods: Logwood and all other sorts	Tons	6,793	7,180	8,345	7,607	5,102
Gum:						
Arabic	Cwt.	39,237	59,858	43,319	42,122	44,915
Kowrie	"	27,178	19,612	25,184	17,574	19,023
Lac, seed, shell, stick, and dye	"	62,056	73,132	72,197	67,678	73,577
Of other sorts	"	56,045	57,030	52,080	56,923	59,287
Quicksilver	Lb.	3,934,616	3,661,683	4,956,020	4,685,678	3,534,907

EXPORTS OF FOREIGN AND COLONIAL PRODUCE (VALUES).

Principal Articles.		1884.	1885.	1886.	1887.	1888.
	£		£	£	£	£
Chemical manufactures and products		216,740	248,640	159,178	284,192	303,125
Drugs:						
Bark, Peruvian		679,336	621,511	547,794	481,636	343,913
Opium		371,225	299,272	215,868	240,808	331,475
Unenumerated		434,174	379,605	363,398	384,740	366,566
Dyeing or tanning stuffs:						
Cochineal		64,434	81,807	79,749	51,713	35,263
Cutch and gambier		292,749	266,161	256,097	251,457	249,710
Indigo		1,708,150	1,543,578	1,170,299	1,178,879	1,084,000
Unenumerated		139,074	109,958	91,021	103,870	142,960
Dyewoods: logwood and all other sorts		47,591	48,677	52,995	48,845	47,751
Gum:						
Arabic		128,243	186,591	174,180	168,373	192,293
Kowrie		80,211	56,344	74,357	57,738	55,021
Lac, seed, shell, stick, and dye		236,375	244,058	208,268	179,424	200,657
Of other sorts		179,897	193,624	177,271	195,761	192,881
Oil:						
Cocoa-nut		274,768	168,692	138,270	117,287	158,029
Olive		197,255	132,877	110,604	114,653	118,554
Palm		616,966	547,027	511,785	506,699	692,297
Quicksilver		285,817	287,208	414,687	439,386	367,572

—Chemist and Druggist.

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ended 31st May.	
	1888.	1889.
	£	£
Metals.....	2,019,775	1,691,075
Chemicals, dyestuffs, and tanning materials.....	636,715	810,562
Oils.....	457,561	438,509
Raw materials for non-textile industries.....	2,630,933	3,293,306
Total value of all imports.....	30,370,775	34,802,437

SUMMARY OF EXPORTS.

	Month ended 31st May.	
	1888.	1889.
	£	£
Metals (other than machinery)	3,320,494	3,020,679
Chemicals and medicines	637,899	697,892
Miscellaneous articles.....	2,727,569	2,812,386
Total value of all exports.....	19,276,225	20,335,738

IMPORTS OF METALS.

	Month ended 31st May.	
	1888.	1889.
	£	£
Copper ore	93,693	83,762
„ regulus and precipitate.....	431,080	230,427
„ unwrought and part wrought	377,272	151,106
Iron and steel:—		
Iron ore.....	194,436	256,100
„ bar, angle, bolt, and rod	46,777	64,169
Steel, unwrought	8,418	10,407
Lead, pig and sheet	124,309	165,222
Pyrites of iron or copper	101,484	95,538
Quicksilver	30,480	14,204
Tin	286,254	222,703
Zinc	116,983	50,964
Other metals	205,580	349,833
Total value of metals.....	2,019,775	1,691,075

IMPORTS OF CHEMICALS.

	Month ended 31st May.	
	1888.	1889.
	£	£
Alkali	4,040	3,642
Bark (for tanners' or dyers' use)	17,005	30,771
Brimstone	17,281	12,737
Chemical products unenumerated....	140,785	144,984
Cochineal.....	1,630	3,372
Cutch and gambier	49,304	43,367
Dyes (coal tar):—		
Aniline	23,061	20,102
Alizarine	25,674	29,092
Other coal tar dyes	1,347	1,989
Indigo.....	66,732	59,294
Madder, garancine, and munjeet	1,701	1,758
Nitrate of soda.....	125,812	177,942
Nitrate of potash	28,606	26,622
Valonia	20,965	47,292
Other articles.....	111,760	207,598
Total value of chemicals	636,715	810,562

IMPORTS OF OILS.

	Month ended 31st May.	
	1888.	1889.
	£	£
Cocunut	25,117	2,632
Olive	101,572	66,017
Palm	61,132	87,934
Petroleum	134,899	131,625
Seed of all kinds	48,124	40,838
Train, blubber, and sperm	22,991	36,802
Turpentine	2,038	6,122
Other articles.....	61,688	63,539
Total value of oils.....	457,561	438,509

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES.

	Month ended 31st May.	
	1888.	1889.
	£	£
Bark, Peruvian	77,588	34,846
Bristles.....	27,309	38,568
Caoutchouc	146,257	154,526
Gum arabic.....	36,447	21,512

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES—*continued*.

	Month ended 31st May.	
	1888.	1889.
	£	£
Gum, lac, seed, shell, &c.	32,443	21,039
Gutta-percha	25,462	43,456
Hides, raw, dry	232,376	182,792
„ „ wet	108,707	120,591
Ivory, teeth, &c.	23,598	9,293
Manures, guano	13,115	11,745
„ bones	23,196	20,908
Paraffin	37,262	36,098
Paper materials:—		
Linen and cotton rags	46,249	35,292
Esparto and other fibres	65,057	93,670
Pulp of wood	64,992	55,185
Rosin	15,483	19,130
Tallow and stearine	89,792	196,901
Tar	1,746	1,552
Wood and timber:—		
Hewn	310,665	450,896
Sawn, split, planed, &c.	407,205	837,254
Staves	52,635	70,141
Mahogany	39,523	34,815
Other articles	813,886	802,996
Total value of raw materials for non-textile industries	2,690,993	3,293,306

Besides the above, drugs to the value of 69,518*l.* were imported during the month, as against 67,001*l.* in 1888.

EXPORTS OF METALS OTHER THAN MACHINERY.

	Month ended 31st May.	
	1888.	1889.
	£	£
Copper, unwrought	66,904	142,194
„ wrought	33,080	74,296
„ mixed or yellow metal	29,384	43,676
Hardware and cutlery	282,600	250,195
Iron and steel	2,496,959	2,579,585
Lead	91,202	110,019
Plate and plated and gilt wares	30,958	34,828
Telegraphic wires, &c.	67,905	86,926
Tin	60,024	54,365
Zinc	5,759	15,292
Other articles	143,661	185,625
Total value of metals	3,320,494	3,620,679

EXPORTS OF CHEMICALS.

	Month ended 31st May.	
	1888.	1889.
	£	£
Alkali	161,219	132,942
Bleaching materials	49,079	50,962
Manures (chemical)	146,836	163,208
Medicines	88,647	93,283
Other articles	132,118	257,437
Total value of chemicals ...	637,899	697,892

EXPORTS OF MISCELLANEOUS ARTICLES.*

	Month ended 31st May.	
	1888.	1889.
	£	£
Gunpowder	38,522	30,182
Candles	16,987	17,069
Caoutchouc manufactures	94,300	93,674
Cement	116,070	125,782
Earthenware and porcelain	186,981	184,909
Red pottery and stoneware	9,321	18,614
Glass, plate	21,644	20,923
„ flint	24,236	23,005
„ bottles	34,827	49,239
„ other kinds	14,296	12,447
Leather, unwrought	120,403	116,495
„ wrought	25,347	27,965
Seed oil	150,413	154,149
Oil and floor cloth	66,300	82,664
Painters' colours and materials	131,469	137,910
Paper of all kinds	155,321	154,784
Rags (for paper)	36,935	41,171
Soap	47,114	42,017
Total value of miscellaneous articles exported	2,727,569	2,812,386

* Only articles of chemical interest are given in this table, hence the items and total do not agree.

STATISTICS.

MINERAL PRODUCTION OF CANADA IN 1888.

Through the courtesy of Mr. E. Coste, in charge of Mineral Statistics Division of the Geological Survey of Canada, we are enabled to give herewith a statement of the mineral production of Canada in 1888.

These figures show nominally a considerable increase in the value of Canadian mineral products from 12,959,073 *dols.* in 1887 to 16,500,000 *dols.* in 1888; but in reality 1,847,102 *dols.* of this increase is in a miscellaneous item not included in last year's returns.

The chief items show but little improvement. Of asbestos, the production declined 169 tons; that of building stone increased nearly 164,000 cubic yards. The production of cement has declined 19,000 barrels, and is very small, which is rather surprising, for Canada contains some very good cement rock.

The coal production has increased from 2,368,041 net tons in 1887 to 2,658,134 tons in 1888. And the output of coke, which is still very small, increased from 32,000 to 45,000 tons. These features are encouraging, though, considering the magnificent coal deposits of Nova Scotia, are but a very small part of what they should be.

Copper naturally felt the boom in the market, and increased from 3,260,424 pounds in 1887 to 5,562,864 pounds in 1888.

The production of gold has declined more than 3,000 ounces, and silver has scarcely increased.

The production of lead in ore has increased from about 100 tons to 337 tons; a ridiculously small amount, but one which will probably be increased hereafter by silver lead mines in British Columbia.

The production of sulphuric acid has increased $1\frac{3}{4}$ million pounds.

On the whole, this summary shows that Canada still lags far behind in the industrial race, notwithstanding its rich natural resources, which are very little known outside of or even in Canada, and comparatively very little enterprise is shown in Canada in their development.

Mexico, on our southern border, is developing its natural resources with much greater energy than Canada, and is attracting the capital that naturally would go north were attention directed to the natural resources of the country, and were inducements offered for its investment there.

THE MINERAL PRODUCTION OF CANADA IN 1888.

Name of Product.	Quantity. ¹	Value. ²
		Dols.
Antimony ore (exports). Tons	352	6,891
Arsenic..... "	30	1,200
Asbestos ³ "	4,104	255,007
*Bricks..... Thousands	165,265	1,033,721
*Building stone..... Cubic Yds.	387,164	561,197
Cement..... Barrels	50,608	35,593
*Charcoal..... Bushels	233,618	15,703
Coal..... Tons	2,658,134	5,259,832
Coke ⁴ "	45,373	134,181
Copper ⁵ Lbs.	5,562,864	667,543
*Fertilisers..... Tons	518	21,000
*Glass..... "	..	150,000
Gold ⁶ Oz.	58,557	1,058,610
Granite..... Tons	19,172	63,846
Graphite..... "	170	4,200
Grindstones..... "	4,936	12,159

* Some returns yet to be received.

¹ Quantity marketed, except when otherwise specified. The tons are of 2,000 pounds.

² Market value, less charges of transport from point of production.

³ There was no production from Ontario this year, but there was an increase of 185 tons from the mines of the Eastern townships.

⁴ Oven coke; all the production of Nova Scotia.

⁵ Copper contents of Capelton ores at 12 cents per pound at the mine.

⁶ Nova Scotia gold is calculated at 19.50 dols. per ounce, and that from British Columbia at 17 dols.

THE MINERAL PRODUCTION OF CANADA IN 1888— *continued.*

Name of Product.	Quantity.	Value.
		Dols.
Gypsum ⁷ Tons	175,887	179,393
*Iron ⁸ "	49,962	1,442,974
Iron ore..... "	44,410	139,393
Lead (fine, contained in ore)..... Lbs.	674,500	27,472
*Lime..... Bushels	2,213,464	339,541
Limestone for iron flux.. Tons	15,577	14,712
Manganese ore ⁹ "	1,782	47,243
*Marble and serpentine.. "	215	3,110
Mica..... Lbs.	29,025	30,207
Mineral paints..... Tons	4,197	14,759
Mineral water..... Gals.	124,850	11,456
Miscellaneous clay products..... "	..	350,370
Petroleum ¹⁰ Barrels	695,201	716,057
Phosphate ¹¹ Tons	22,485	242,285
Pig iron..... "	18,191	226,443
Platinum..... Oz.	1,200	4,800
Pyrites..... Tons	51,764	232,038
Salt..... "	44,581	143,804
Sand and gravel (exports) .. "	260,929	38,398
Silver ¹² "	..	368,396
Slate..... Tons	5,314	90,689
Soapstone..... "	140	280
Steel..... "	9,508	470,819
Sulphuric acid..... Lbs.	7,143,210	97,755
Tiles..... Thousands	7,518	114,057
Whiting..... Tons	209	240
Estimated value of mineral products not returned (principally rolled iron and glass)..... "	..	1,847,102
Total..... "	..	16,500,000

* Some returns yet to be received.

⁷ Production of New Brunswick and Ontario, plus Nova Scotia exports.

⁸ This includes four rolling mills, one forge and the Londonderry Iron Works. Returns have not yet been received from six similar works, thus rendering the statement very incomplete. The total manufactures of iron will, however, be much larger than those of last year.

⁹ New Brunswick production plus Nova Scotia exports.

¹⁰ These figures are calculated from the inspection returns at 100 gallons crude for 38 gallons refined oil, and are computed at 1.903 dols. per barrel of 35 imperial gallons. The barrel of refined oil inspected was assumed to be 42 imperial gallons.

¹¹ Direct returns. The production is divided as follows:—

Ottawa County mines, 20,396 tons; Ontario mines, 2,089 tons; total, 22,485.

The exports as per Customs Department returns were 18,776 tons, valued at 208,609 dols.

¹² Exports plus silver contained in Capelton ores.

—*Engineering and Mining Journal.*

INCREASED CONSUMPTION OF COPPER.

The lower price of copper has told both upon the supplies and deliveries to the trade in England and France during May. While the supplies have fallen, the deliveries have very materially increased, and the stocks are less by over

7,000 tons. Messrs. H. R. Merton and Co.'s statistics give the following figures for the current year:—

Month.	Stock.	Price of G.M.B.	Supplies.	Deliveries.
	Tons.	£ s.	Tons.	Tons.
January.....	109,528	77 10	9,716	4,293
February.....	118,140	78 0	10,009	1,397
March.....	124,876	39 5	11,135	4,399
April.....	124,447	37 15	8,080	8,509
May.....	117,420	41 0	6,837	13,864

—*Pall Mall Gazette.*

COST OF COAL PRODUCTION IN GERMANY AND FRANCE.

The following translation from *L'Echo des Mines et Metallurgie* gives the results of an investigation by M. Amedée Marteau, published in the Belgian *Moniteur des Interests Materiels*, of the comparative cost of the production of coal in France and Germany:—

The conclusion from this comparison is that Germany profits by a double advantage in the production of coal—first, from less costly manual labour, and secondly, from the nature of the beds, which permit the workmen to produce annually much more than the French workman, this second point having an influence over the former.

The extraction of coal in Germany, which only amounted to 33,396,400 tons in 1872, exceeded 58,000,000 tons in 1886, for a value of 300,720,000 marks. The price per ton amounts, therefore, to 5·18 marks, while it was 5·25 in 1880 and 8·88 in 1872. For lignite, the same progress is seen. From 9,018,000 tons for 24,496,000 marks in 1872, the extraction rose in 1886 to 15,617,000 tons for 40,270,000 marks. The price per ton fell consequently from 3·27 to 2·58 marks. The total extraction of fuel in Germany in 1886 amounted to about 73,500,000 tons, with a value of 340,977,000 marks. In Germany prices were 6·50 francs for coal and 3·25 francs for lignite, against 12·83 francs for coal in France, or 100 per cent. above the German price. Take, first, the difference of annual production per man. In 1860 it amounted in Germany to 160 tons, in 1870 to 229 tons, and in 1886 to 290 tons, or 130 tons more than in 1860. Therefore, about 250,000 men were employed to produce the 73,637,000 tons of coal and lignite in Germany in 1886. This makes, in round numbers, 294½ tons per man per year. It will be remarked that this high average is only obtained thanks to lignite, the average extraction of which is 555 tons, while for coal it was only 274 tons; but as in France no distinction is made in the kinds of fuel, it is preferable to calculate on the total production rather than on each particular branch. The average figure of production per man and per annum for coal in Germany is 274 tons; but this figure in the mines of Westphalia, which are by far the most considerable, since they engage more than 100,000 men, is 287 tons—almost the general average for the whole.

In France it needed 109,426 men in 1884 to produce 20,024,000 tons of coal, or about 190 tons per man per year.

With reference to wages, the following are the particulars for Germany in 1886:—

	Proportion of Numbers for each kind.	Annual Wages.	Average Daily Wages.
	Per Cent.	Francs.	Francs.
Colliers.....	54	1'148	3'80
Repairs, &c.	24	'828	2'77
Day labourers.....	19	'902	2'90
Children.....	3	'460	1'32
Total and average.	100	1,097'5	3'32

In France the maximum wages is 4·12 francs, and the average wages 3·83 francs, the annual average being 1,007·5 francs in Germany and 1,073 francs in France. It will be seen that the difference is 65·50 francs per annum and 0·51 franc per day. Taking account of these two elements to appreciate the difference in the cost of manual labour per ton of fuel, it will be seen that in Germany a miner produces 290 tons per annum for 1,007·5 francs, and a French miner 190 tons for 1,073 francs. It follows that the cost of manual labour per ton of coal extracted is 3·65 francs in France, against 3·50 francs in Germany, or an advantage of 2·15 francs per ton in favour of the latter country.

The principal coal basins of Germany, those of the Ruhr and Silesia, are of remarkable regularity. The working of a series of beds of average thickness is generally possible without gobbing, and almost without timbering. There are actually reckoned 74 workable beds, only considering those as such which have a thickness of more than 50 centimetres (19·68 ins.), forming a total thickness of 70 metres (230 ft.) of coal.—*Engineering and Mining Journal.*

QUICKSILVER.

	IMPORTS.			
	1889.	1888.	1887.	1886.
	Bottles.	Bottles.	Bottles.	Bottles.
May.....	1,857	4,236	4,200	10,436
January—May.	35,877	48,238	39,177	40,635
	EXPORTS.			
	1889.	1888.	1887.	1886.
May.....	6,200	11,916	4,054	5,556
January—May.	31,774	22,260	24,432	33,340
Average Price:	£ s. d.	£ s. d.	£ s. d.	£ s. d.
May.....	8 2 6	7 0 0	6 13 6	6 5 6

—*Alcr. S. Pickering.*

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

7987. C. Le Fevre, jun. Carrying off superfluous vapours from furnaces and coppers. May 14.

8169. Solvay and Co. Multiple-acting distilling apparatus for caustifying liquors and separating the gases therefrom. Date applied for under Patents Act, 1883, sec. 103, 19 October 1888, being date of application in Belgium.

8173. A. Fryer. Improvements in the treatment of solutions or liquids for the purpose of concentration or evaporation, and in apparatus therefor. May 16.

8184. J. J. Hicks. Improvements in brewers' and other thermometers. May 16.

8252. J. J. Bodmer and G. R. Bodmer. Apparatus for the manufacture of compressed blocks. May 17.

8342. G. Olberg. Rotating furnaces. May 20.
 8596. J. G. Chapman. See Class XVI.
 8687. E. F. Varaldi. Vacuum pumps. May 24.
 8738. J. H. Parkinson. Improvements in and apparatus for isolating or separating gases of different liquefying points, which are mechanically mixed. May 27.
 8872. W. L. Wise.—From Solvay and Co., Belgium. Apparatus for the methodical and continuous treatment of pulverulent matters by fluids. May 28.
 8882. W. P. Branson and H. W. Neild. See Class XVIII.—A.
 8898. W. B. Wright. See Class II.
 8928. F. N. Mackay.—From J. Baxter and J. Muter. Improvements in filtering and in filter presses. May 28.
 9041. D. B. Morison. Apparatus for heating or evaporating liquids. May 31.
 9111. W. Buckwell. "Kilns and other furnaces by the conducting and utilisation of the carbonic acid gas and like products of combustion, and the apparatus therefor." June 1.
 9118. S. Berghelm. Improvements in crucibles for smelting ores, metals, glass, and other substances. June 1.
 9200. A. Keddle. Improvements relating to thermometers. Complete Specification. June 3.
 9204. J. E. Warren. Means or apparatus for use in filtering. Complete Specification. June 4.
 9321. F. M. Maynard. See Class XVII.
 9354. F. J. Brougham.—From S. Jönsson. Centrifugal separating machines. June 4.
 9375. G. King. Fastenings for retort lids. June 4.
 9759. F. Rybicka and R. Langer. Centrifugal saturating or soaking machines. June 13.
 9850. J. Brown and G. Johnston. Vacuum drying apparatus. June 15.

COMPLETE SPECIFICATIONS ACCEPTED.*

1888.

4698. W. Bergh. Centrifugal fluid-separating machines. May 22.
 8561. The Gas Patents Syndicate.—From J. B. Archer. Kilns for firing bricks, &c. June 12.
 9916. G. A. Godillot. Furnaces for burning granular or pulverulent fuel, vegetable matter, and combustible liquids. May 22.
 11,357. M. Negro. Filter for any process of filtering. June 12.
 11,485. W. R. Watson and R. A. Robertson. Apparatus for evaporating, concentrating, and distilling liquids. May 29.
 12,357. R. A. Robertson. Centrifugal apparatus applicable for filtration. June 12.
 13,005. W. H. Grindley and W. S. Hensley. Pyrometers. June 5.
 14,599. S. Binks.—From J. Binks. Apparatus to prevent incrustation in boilers. June 19.
 16,793. J. Laidlaw. Oscillating centrifugal machines. June 12.
 16,791. J. Laidlaw. Centrifugal machines. June 12.

1889.

5559. H. Bergner. Centrifugal separating machines. May 29.
 6938. J. C. Felner and C. Ziegler. Travelling platforms, beds, or trucks for kilns or ovens for drying, burning, baking, &c. June 5.
 7149. C. Salomon. Drying, desiccating, and roasting apparatus. June 12.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

7996. G. Moir. Improved method and apparatus for the more economical use of fuel and the consumption of smoke, more applicable to boiler and other furnaces. May 14.
 8010. A. Myall.—From J. H. Lancaster, United States. Improvements in artificial fuel. May 14.
 8179. A. Runge. A new or improved charging trough for gas retorts, and apparatus for raising and operating the same. Complete Specification. May 16.
 8192. J. von Langer and L. Cooper. Process for generating gases known as water-gas and producer-gas. Complete Specification. May 16.
 8263. S. B. Darwin. Improvements in compounds to be used for manufacturing illuminating gas, the prevention of stoppages in ascension pipes, and the deposition of naphthalene. May 17.
 8281. J. E. Bedford. The purification of water-gas. May 18.
 8292. W. P. Thompson.—From W. Pope Hazard, United States. Improvements in apparatus for supplying hydrogen gas to furnaces. May 18.
 8519. V. B. D. Cooper. Improvements in the manufacture of gas for heating and other purposes. Complete Specification. May 22.
 8714. J. A. Norberg. Consuming smoke from furnaces. May 27.
 8724. W. R. Hutton. Improvements in the making of char or coke from coal, and obtaining tar and ammonia water and mixed gases therefrom. May 27.
 8832. H. Williams. Improvements in apparatus employed in the manufacture of water-gas for heating and lighting purposes. May 28.
 8892. G. Hatton and R. Lythgoe. Improvements in gas producers and other furnaces. May 29.
 8898. W. B. Wright. Improvements in means for feeding fluid fuel to furnaces, particularly applicable to the furnaces of brick kilns. Complete Specification. May 29.
 8993. S. W. Wilkinson. A process first for producing a clean gaseous fuel to be used in the evaporation of brine, and secondly for recovering the ammonia formed during the production of said gaseous fuel. May 30.
 9026. J. G. Irwin and A. Isaacs. A new and improved means of and apparatus for inducing incandescence for illuminating and other purposes. May 31.
 9061. B. van Steenberg. Improvements relating to the manufacture of water-gas, and to apparatus therefor. Complete Specification. May 31.
 9173. R. Simon and F. Wertenbruch. A new or improved method for the production of water-gas, and apparatus therefor. June 3.
 9279. B. Loomis. An improved process of and apparatus for manufacturing heating and illuminating gas. June 4.
 9288. W. Clark. Improvements in and relating to machines or apparatus for manufacturing gas. Complete Specification. June 4.
 9327. S. Fox and E. Blass. Improvements in the manufacture of water-gas and in apparatus therefor. June 4.
 9402. C. Deakin. Improvements in the production of lighting and heating gases. June 6.
 9454. G. Love. Improved apparatus for generating and consuming combustible gas. June 7.
 9535. G. Hatton and F. W. Harbord. Improvements in the manufacture of water-gas, and apparatus employed therein. June 8.
 9553. J. Armour and H. Armour. Improvements in and connected with stills for refining mineral oils. June 8.
 9619. G. Hatton and F. W. Harbord. Improvements in the manufacture of water-gas, and in apparatus for its production and use. June 11.

9621. H. Aitken. Improvements in making gas from coal or other bituminous or combustible substances. June 11.

9625. C. E. Miles. Improvements in the production of illuminating gas. June 11.

9626. C. E. Miles. Improved means and apparatus for the manufacture of producer or generator gas. June 11.

9783. A. Nickson and W. Black. Improvements in distilling shale, coal, or other oil and tar-yielding minerals, and in retorts therefor. June 14.

9868. A. Middleton, C. E. Fraser, and H. M. Carter. Improvements in artificial fuel. June 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

8560. The Gas Patents Syndicate, Limited. — From J. B. Archer. Fuel gas burners. June 19.

9893. J. Jones. Vertical or inclined retorts for distilling shale, coal, &c. June 12.

10,186. A. Campbell and W. Boyd. Purifying coal-gas and other gaseous or liquid products of destructive distillation, partly applicable in the alkali manufacture. June 5.

11,294. L. Mond and G. Eschellmann. Obtaining inert gases. June 19.

11,443. J. Elliott. Gas-producing apparatus in which the carbonisation is continuous. June 12.

13,913. H. C. Webb. An inconsumable lamp wick. June 5.

14,878. J. King. Apparatus for taking off the gas from gas retorts and delivering it to hydraulic mains, and preventing the tar or liquors which condense in the ascension pipes from returning to the retorts. May 22.

1889.

2664. J. O. Spong. Means and apparatus for enriching and purifying the flame of coal-gas. May 29.

4807. W. J. Taylor. Firing furnaces and converting solid fuel into gaseous fuel, and apparatus therefor. May 29.

4969. P. Tarrington and D. S. McDonald. Portable apparatus for manufacturing gas. May 22.

6920. C. Kreissig and O. Seim. Producing an increased light effect of gas, paraffin, and other flames. May 29.

7152. H. J. Allison. — From A. G. N. Vermilya. Process and apparatus for generating heat. June 19.

7653. C. Dubois. Obtaining useful products from the residues of gas purification, and apparatus therefor. June 12.

7854. C. P. Armstrong. — From G. Jaunez. Apparatus for manufacturing carburetted air gas. June 19.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATION.

9371. F. C. Ostertag. — From L. Ferrario, Italy. Improvements in the process of and apparatus for treating heavy hydrocarbons. June 4.

COMPLETE SPECIFICATION ACCEPTED.

1888.

10,186. A. Campbell and W. Boyd. See Class II.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

7977. S. Pitt. — From L. Casella and Co., Germany. The production of new bluish-black colouring matters. May 13.

8156. H. H. Lake. — From A. Leonhardt and Co., Germany, through Wirth and Co. Improvements in the manufacture of amido-phenols. May 16.

8264. H. H. Lake. — From A. Leonhardt and Co., Germany, through Wirth and Co. Improvements in the production of blue-black colouring matters. May 17.

8299. B. Willcox. — From The Farbenfabriken vorm. F. Bayer and Co., Germany. Improvements in or connected with the manufacture of azo-colouring matters for printing and dyeing. May 18.

8373. J. Y. Johnson. — From The Badische Anilin und Soda Fabrik, Germany. Improvements in preparing colouring matters of the oxyketone group suitable for dyeing and printing with the aid of mordants. May 20.

8548. E. de Pass. — From Messrs. Ewer and Pick, Germany. Process for producing azo-colouring matters from dehydrothiopatoluidine of 191° C. melting point, and from its homologue dehydrothiometaxyldine. May 23.

8673. B. Willcox. — From The Farbenfabriken vorm. F. Bayer and Co., Germany. Improvements in the manufacture of colouring matter and of leuco-bases employed therein. May 24.

8726. W. G. Thompson. The production of new azo-tetrazo-nitro- and nitroso compounds. May 27.

8732. W. G. Thompson. The production of compounds produced by the action of oxidising agents on phenols, naphthylamine, and on sulpho acids. May 27.

8750. B. Willcox. — From The Farbenfabriken vorm. F. Bayer and Co., Germany. Improvements in the manufacture of basic colouring matter. May 27.

9076. F. X. Best and R. Rice. An improved method of preparing dyes. May 31.

9384. H. D. Kendall. Improvements in the production of colouring matter from coal-tar products. Complete Specification. June 6.

9427. J. Y. Johnson. — From The Badische Anilin und Soda Fabrik, Germany. Improvements in preparing colouring matters of the oxyketone group, suitable for dyeing and printing with the aid of mordants. June 6.

9428. J. Y. Johnson. — From The Badische Anilin und Soda Fabrik. Improvements in preparing colouring matters of the oxyketone group, suitable for dyeing and printing with the aid of mordants. June 6.

9429. J. Y. Johnson. — From the Badische Anilin und Soda Fabrik. Improvements in the production of coloured compounds of gallacetophenone within or upon animal and vegetable fibres. June 6.

9489. F. Petersen. Improvements in the manufacture or production of colouring matters suitable for dyeing and printing. June 7.

9612. J. Y. Johnson. — From F. von Heyden, Germany. A new or improved manufacture of beta-naphthol carbon acid. June 11.

9642. O. Imray. — From The Farbwerke Vormal's Meister, Lucius, und Brüning, Germany. Production of oxysulphonic acids and naphthalin. June 11.

9643. O. Imray. — From The Farbwerke Vormal's Meister, Lucius, und Brüning. Improvements in the production of colouring matters from oxysulphonates of naphthalin. June 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

10,314. J. Y. Johnson. — From The Badische Anilin und Soda Fabrik. Manufacture of methylene blue and allied colouring matters. May 22.

10,653. C. D. Abel. — From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of brown colouring matters which dye cotton without the use of a mordant. May 22.

10,845. H. H. Lake.—From K. Ochler. Manufacture of colouring matters. May 29.

13,798. O. Inray.—From G. C. Zimmer. Manufacture of colouring matters. June 12.

14,836. W. G. Thompson and W. H. Claus. Production of new colouring matters. May 22.

1889.

4565. H. H. Leigh.—From R. G. Williams. Colouring matters. June 12.

7587. A. Bang.—From Dahl and Co. Production of azo-colouring matters from diamidodibenzylbenzidin and diamidodibenzyltolidine. June 12.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

8106. V. Schevelin and P. Mindovsky. Process for the treatment of vegetable fibres by means of acid, neutral, and alkaline residues of naphtha manufacture, or specially prepared substances analogous to such residues. May 15.

9236. J. Palmer. A new and improved system of retting all gummy fibres. June 4.

9534. T. Rivett. Improvements in gassing yarns. June 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

10,633. W. Hitchcock-Spencer. Apparatus for treatment of rhea or China grass and other vegetable fibres. June 5.

1889.

5582. A. W. Montgomery. Treatment of sisal hemp. June 5.

6836. S. Cooper and T. Cooper, jun. Apparatus employed in the manufacture of wood wool. June 5.

7315. J. T. Pearson. Means and apparatus for humidifying fibrous substances. June 12.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

7948. E. M. H. Andreoli. See Class XI.

8107. V. Schevelin and P. Mindovsky. Process for cleansing and bleaching fibrous substances, and for fixing organic colouring matters thereon by means of acid and alkaline residues of naphtha manufacture or of specially prepared substances analogous thereto. May 15.

8237. T. Parkinson. Improvements in the methods of mordanting by drying cotton yarns and similar substances, and in the apparatus therefor. May 17.

8477. D. Walker and R. Walker (The Middleton Paper Staining Co.). Improvements in the method of and in means for printing designs in several colours at one operation upon paper, cloth, and other similar materials and fabrics. May 22.

9149. S. Mason, jun. Improvements in apparatus for dyeing and otherwise treating wool. June 3.

9254. J. Frost. Certain improvements in dyeing or colouring hair, wool, silk, fur and other animal or vegetable fibres in the raw or manufactured state. June 4.

9432. G. A. Greeven. Improvements in impregnating, washing, and dyeing yarn in hanks or skeins, and in the means or apparatus employed therein. June 7.

9692. A. Graemiger, W. T. Whitehead, S. Mason, jun., and E. A. Leigh. Improvements in machines for dyeing, bleaching, and otherwise treating yarn in cop or other compact form. June 12.

9836. W. E. Heys.—From C. Vandermeirssche, France. Improvements in the method of and apparatus for dyeing and similarly treating yarns and textile materials in all stages of preparation. June 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

9044. C. Dratz and H. Dratz. Dyeing or painting on fabrics, and apparatus therefor. May 29.

11,452. J. C. Mewburn.—From La Société Leblois, Picéni et Cie. Bleaching, dyeing, &c. textile materials, and apparatus therefor. June 5.

11,806. E. Sutcliffe and G. E. Sutcliffe. Dyeing aniline black. June 5.

12,670. H. E. Hounsell.—From G. A. Conant. Bluing paper. June 12.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

8045. H. E. Newton.—From L. O'Brien. See Class X.

8177. E. Hermite, E. J. Paterson, and C. F. Cooper. Manufacture of bleaching and disinfecting liquor. May 16.

8537. A. J. Boulton.—From P. J. McMahon, United States. Improvements in or relating to the manufacture of anhydrous ammonia. May 22.

8741. W. P. Thompson.—From P. Magnier, France. Improvements in the manufacture of picric acid and certain alkaline or alkaline-earth picrates. May 27.

8779. J. J. Alsberge. Process for the manufacture of chlorine, which may be employed in combination either with the ammonia-soda process or with the Leblanc soda process. May 27.

8841. C. A. Burghardt. Improvements in the manufacture of nitrate of ammonium and of a resulting by-product. May 28.

8862. W. Thorp. Improvements in the method of and apparatus for condensing or absorbing and utilising sulphuric and sulphurous acid fumes. May 28.

8993. S. W. Wilkinson. See Class II.

9225. T. Turner. Improvements in the treatment of waste pickle from galvanising works. June 4.

9283. H. Goldschmidt. Improvements in extraction and use of metallic precipitates. June 4.

9680. A. G. Greenway. Improvements in the utilisation of waste acids or pickles formed in galvanising iron and called by him the "ammonium-sulphide process." June 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

9835. R. Weiss. Manufacture of acetic acid and by-products. June 5.

10,186. A. Campbell and W. Boyd. See Class II.

10,187. A. Campbell and W. Boyd. Obtaining chlorine from hydrochloric acid or chlorides, and regenerating the peroxide of manganese used. June 5.

10,193. G. H. Bolton, J. R. Wyld, and H. Auer. Manufacture of permanganates and chlorates. June 5.

10,322. J. Hargreaves. Treatment of sulphuretted hydrogen to obtain sulphur, and apparatus therefor. June 5.

11,731. C. N. Hake. Manufacture of nitrate of ammonia. June 19.

16,247. H. J. Kirkman. Utilisation of waste pickle from tinning and galvanising works where hydrochloric acid is used for pickling. May 29.

17,183. J. B. Thompson. Reduction of hydrogen sulphide for the production of sulphur therefrom. May 29.

1889.

5221. M. Cannon. Manufacture of acetic acid. June 5.

6443. E. Augé. Manufacture of soda alum. May 22.

6710. W. P. Thompson.—From J. A. Bradburn. Manufacturing caustic soda or caustic potash. May 29.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

7919. R. T. Grocott. Improvements in apparatus for making certain articles of pottery ware, such as electric lamp roses, switches, fuse blocks, and the like. May 13.

8049. T. Davidson. Improvements in pressed glass dishes and in their manufacture. May 14.

8166. J. McMillan. Apparatus for making bottles or other articles having a narrow orifice in glass, crystal, or similar molten metals, with a certain modification of same for making similar articles in clay, stone, flint, or china ware. May 16.

8403. W. J. Blenko. Improved process and apparatus for producing sheet glass with or without ripples or design or designs upon one surface. Complete Specification. May 21.

8511. E. Bassy. Improved compounds for the manufacture of bricks, tiles, and pottery goods in general, also in compounds or combination of ingredients for the manufacture of white enamel or opaque colours as a surfacing body or glaze to said bricks or articles. May 22.

8597. J. Stiel. A weather- and acid-proof enamel for building materials and the like, and a method of producing the enamel. Complete Specification. May 23.

8760. A. Drummond. Improvements in apparatus for manufacturing corrugated, ribbed, or other glass having designs or patterns upon the surface. May 27.

9147. J. W. Homer. Improved means or apparatus for withdrawing molten glass or molten metal from furnaces. June 3.

9148. F. E. Grosse. An improved process for manufacturing antique irising mother-of-pearl like blown, rolled, or pressed window glass. Complete Specification. June 3.

9257. H. T. Holloway and H. Holloway. Improvements in tile linings to walls and other upright partitions. June 4.

9645. H. J. Allison.—From C. C. Gilman, United States. Improvements in the manufacture of porous earthenware. Complete Specification. June 11.

9841. F. C. Clare. Improvements in the manufacture of terra-cotta porcelain castor bowls, knobs, and hands. June 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

11,016. H. J. Haddan.—From the Josephine Glass Works, Germany. Manufacture of red glass. June 12.

15,300. G. R. Grant. Pictures or decorative plaques formed largely of glass. June 19.

1889.

6393. P. Simson. Manufacture of plate glass. May 29.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

8042. A. Schöfer. A new or improved continuous lime and cement kiln or furnace. Complete Specification. May 14.

8145. G. P. Gildea. An improved method of making cement from chalk marls and argillaceous limestones, and of utilising poor clays for the purpose of making cement, and apparatus therefor. May 16.

8309. R. Stone. Improvements in the manufacture of fireproof plastic materials, applicable to various purposes. May 18.

8428. M. May. A process for producing artificial polished or ground stone. May 21.

8795. A. N. Ford. The manufacture of improved materials for roofing and other purposes, and of a composition therefor. May 27.

8922. J. Clarke. Improvements in or relating to kilns for burning bricks or the like. May 29.

9166. E. Nunan. Improved base for plastering and other purposes. June 11.

9843. J. Hadfield, A. J. Hadfield, and J. W. Hadfield. Improvements in the manufacture of asphalt, and in the apparatus used therefor. June 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

9986. F. W. S. Stokes. Continuous manufacture of cement. June 5.

1889.

2844. A. C. Ponton, B. L. Mosely, and C. Chambers. Manufacture of artificial stone. May 29.

4175. E. Münjah. Producing useful materials from greenstone, diabase, and other varieties of hornblende. May 29.

5190. St. G. T. C. Bryan. Treatment of slag to make it suitable for pavements, walls, &c. May 29.

6584. G. R. King. Compounds to restrain the setting of plaster, &c. June 5.

8042. A. Schofer. See application above. June 19.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

7971. J. T. Blomfield and W. D. Bohm. Improvements in the separation of metals and substances contained in same. May 13.

8038. H. H. Lake.—From E. Thomson, United States. Improvements relating to the welding, soldering, or brazing of metals, and to apparatus therefor. Complete Specification. May 14.

8045. H. E. Newton.—From L. O'Brien, New South Wales. A new or improved process for making metallic sulphates in solution. Complete Specification. May 14.

8057. The Alkaline Reduction Syndicate, Lim., and A. B. Cunningham. Improvements in the production of sodium, and in apparatus therefor. May 14.

8297. F. Bachschmid. Improvements in inlaying metals. May 18.

8438. T. Slater. An improved method of coating wrought or cast iron with a metallic alloy made especially for the purpose intended, the said alloy being applicable to various articles where brass is now used. May 21.

8150. W. Sowerby. Improvements in the treatment of iron, steel, and other metals in the making of cylinders, shafts, ingots, and other articles for effecting the consolidation thereof. May 21.

8492. J. Riley. Improvements in the manufacture of steel or steel-like compounds. May 22.

8543. T. Twynam. Improvements in effecting the re-carburisation of steel or ingot iron. May 22.

8605. G. C. Fricker. Preparing metallic sheets for coating with other metals. May 23.

8608. R. L. Cousins. A process and apparatus for extracting precious metals from ores or quartz. May 23.

8630. A. Crosbie. The recovery of tin from tin plate, scrap, &c. May 24.

8678. M. R. Conley and J. H. Lancaster. Improvements in apparatus for deoxygenising, dephosphorising, desulphurising, and treating iron and other ores, and for collecting and burning the fumes and gases therefrom. May 24.

8789. M. Crawford. Improvements in means for effecting the separation of particles of different specific gravities, more especially intended for the separation of gold and other metals from crushed or divided ores. May 27.

8822. E. Matheson. An improved process of manufacturing pots or crucibles of wrought iron or other malleable metals. May 28.

8856. H. H. Lake.—From C. M. Ball, S. Norton, and A. T. Porter, United States. Improvements relating to the separation of magnetic ores from phosphorus and other impurities, and to apparatus therefor. Complete Specification. May 28.

8883. C. A. Doremus. Process for removing calcium, magnesium, and other metals from aqueous solutions. Complete Specification. May 28.

8943. T. Twynam. Improvements in the manufacture of ingot iron and steel. May 29.

9006. E. A. Cowper. Improvements in the manufacture of Bessemer steel. May 30.

9140. G. Hatton. Improvements in the manufacture of iron and steel, and in apparatus employed therein. June 3.

9147. J. W. Horner. See Class VIII.

9187. H. H. Chandler. An improved flux for coating iron or steel with copper and for welding copper. Complete Specification. June 3.

9206. J. T. King.—From W. R. Jones, United States. Improvements in the manufacture of iron and steel, and in apparatus therefor. Complete Specification. June 4.

9289. W. F. M. McCarty, W. H. Ashton, and H. D. Walbridge. Improvements in and relating to a process of and apparatus for producing steel direct from the ore. Complete Specification. June 4.

9301. J. Gill. Improvements in blast furnaces. June 4.

9358. R. E. Green. Improvements in the production of alloys of aluminium. June 4.

9472. E. W. T. Jones. Improvements in preparing surfaces of iron and steel for receiving a coating of metal or alloy, such as spelter, tin, or terne metal. June 7.

9476. A. A. Lockwood and H. Chappel. Improvements in the treatment of auriferous and argentiferous materials, and in apparatus therefor. Complete Specification. June 7.

9592. S. Alley. Improvements in apparatus for treating metallic ores or compounds with chemicals. June 11.

9632. T. Parker. Improvements in and in connexion with pickling and preparing iron for galvanising. June 11.

9646. A. J. Boulton.—From J. M. Dufort and V. E. J. Dufort, France. Improvements in the manufacture of articles in cast metal with a coating of other metal. Complete Specification. June 11.

9784. W. White. Improvement in the distillation of sodium and potassium and their alloy. June 14.

9821. J. Shears. The extraction of metals from ores and slags and the debris from smelting works and other manufacturing works. June 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

8095. B. H. Thwaite. Producing solid steel castings, and apparatus therefor. June 12.

8303. W. F. Donkin.—From R. Donkin. Amalgamation of gold and other ores, and apparatus therefor. May 29.

8332. W. P. Thompson.—From H. F. Julian. Treatment of ores for the extraction and recovery of gold and silver, and apparatus therefor. June 12.

8747. L. Q. Brin. Producing aluminium bronze and other alloys of aluminium. May 22.

9391. W. G. Forster. Manufacture of sodium and potassium. May 29.

9457. G. Theodossieff. Tempering or hardening steel or iron. May 29.

10,266. J. A. Stephan and R. Southerton. Manufacture of aluminium and its alloys. May 29.

11,691. T. Andrews. Apparatus for consolidating small iron or steel scrap. June 12.

17,623. H. J. Kirkman. Utilisation of flux skimmings from galvanising works. June 19.

17,909. A. J. Boulton.—From W. Ross and H. D. Bush. Upsetting of metals, and apparatus therefor. May 29.

1889.

1602. M. Johnson, W. E. Field, and J. S. Berman. Amalgams, and method of applying same in the amalgamation of gold and silver. June 19.

2722. E. L'Homme. Metallic alloys. June 12.

5669. C. M. Hall. Production of aluminium. June 5.

5670. C. M. Hall. Production of aluminium and alloys thereof. June 5.

6070. S. McCloud. Manufacture of bars and rounds of steel and iron, and apparatus therefor. May 29.

7132. L. Imperatori. Manufacture of compressed compound blocks of substances containing iron and of carbonaceous matter, and the use of such blocks in the production of cast steel and ingot iron. June 5.

7181. E. Walsh, jun. Method and apparatus for condensing zinc vapours and collecting the metallic zinc therefrom. June 5.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

7948. E. M. H. Andreoli. Improvements in bleaching paper pulp by electrolysis. Complete Specification. May 13.

8476. T. Parker. Improvements in the method of cleansing iron for galvanisation and similar purposes. May 22.

8552. G. Nahusen. An improved process for the electrolytic separation of aluminium, aluminium alloys, and magnesium from solutions of their salts. May 23.

8709. E. H. M. Andreoli. Amalgamating gold by electricity and mechanical motion. May 27.

8855. T. Harris and H. F. de Bathe Cameron. Improvements in secondary batteries or accumulators. May 28.

8925. C. Wells. Improvements in electric batteries. May 29.

8986. D. Urquhart, W. Bates, and F. Wynne. Improvements in secondary batteries. May 30.

9093. A. Jung. Improvements in storage batteries. June 1.

9153. D. J. Arnold and H. B. Coryell. An improved dry galvanic battery. Complete Specification. June 3.

9183. M. Sussmann. An improved exciting liquid for electric batteries. June 3.

9237. G. E. Dorman. Improvements in dynamo-electric generators and motors. June 4.

9659. A. H. Norman. Improvements in and connected with electric batteries. June 11.

9667. G. Wilkinson. Improvements in apparatus for the generation of electricity. June 12.

9681. R. Tatham. Improvements in electrical storage or secondary batteries. June 12.

9828. W. J. S. Barber-Starkey. Improvements in secondary voltaic batteries. June 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

8161. C. C. Nichols, for the London Electric Bleaching Co. Bleaching paper-pulp by electricity. June 12.

11,569. H. Pieper. Secondary and other electric batteries. June 19.

19,061. A. Cornwell. Materials to be used in galvanic batteries. May 22.

1889.

6112. P. A. Newton.—From W. Main. Secondary batteries. May 22.

6119. J. J. Shedlock and R. Me-stern. Thermo-electric batteries. May 22.

6865. G. E. Heyl. Secondary batteries. May 29.

7002. T. H. Hicks. Secondary or storage batteries. June 5.

7356. C. Maltby-Newton. Galvanic or primary batteries. June 12.

7619. W. J. Starkey Barber-Starkey. Electric batteries. June 12.

7647. S. S. Wheeler. Electric motors and dynamo-electric machines. June 12.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

8196. R. O. Unglaub. Improved apparatus for rectifying glycerin. Complete Specification. May 16.

8567. J. Taylor. An improvement in the manufacture of soap powder. May 23.

8740. W. P. Thompson.—From A. Schumacker and C. Tschiffeli, France. Improvements in or appertaining to presses for extracting oil or other liquids from seeds or the like. May 27.

9201. J. Snowden. Improvements relating to toilet and cleansing soaps. June 3.

9207. J. C. S. McLay and J. A. Fisher. Improvements in the manufacture of cleansing and polishing materials. June 4.

9382. E. Cuvelier. A new or improved process for crushing and extracting oil or liquids from oleaginous seeds and other like materials, and apparatus therefor. Complete Specification. June 4.

9400. T. R. Weston. An improvement in the manufacture of soap and similar substances. June 6.

9410. A. H. Parker. Improved cleansing, scouring, and bleaching compound for wool and other fabrics, also applicable to cleansing purposes generally. June 6.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

9123. T. S. Steen. Manufacture of soap. May 29.

10,296. M. V. Brisset. Purification of fatty acids, and apparatus therefor. June 5.

11,505. C. Weigelt. See Class XV.

1889.

4190. C. Hervieux and V. Bédard. Composition for use as axle grease. May 22.

4651. H. C. Foulsham. An improved soap powder. May 22.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

8362. T. S. Steen. An improvement in the manufacture of blacking for boots, shoes, and other leather articles. May 20.

8513. T. Hughes. An improved means for the protection of ships' bottoms, as also the inside of the vessels and other submerged substances, also for roofing structures and buildings and for inside decorations. May 22.

8910. W. Walker, J. Sloan, and E. W. Bell. Improvements in anti-fouling and anti-corrosive compositions. May 29.

9184. E. Mourlot. An improved varnish. June 3.

9436. J. Fleming. An improved paint. June 7.

9442. M. Williams and J. Ascough. Improvements in the manufacture of blue colouring matter for laundry bleaching and other purposes. June 7.

9565. H. Noerdlinger. An improvement in the manufacture of oil varnish. June 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

10,192. J. Eastman. Preservative material for iron, steel, or other structures, and the bottoms of vessels, and process of manufacturing it and other products from gas tar. June 19.

10,301. E. Oates. Varnish-removing compound. May 29.

10,365. E. Oates. Paint-removing compound. May 29.

10,757. F. Wendling. New paint for stones, plaster, &c. June 5.

11,398. P. Brentini. Compound for removing paint. June 12.

11,579. S. B. Beswick. Varnish for cleaning and preserving harness. June 12.

1889.

1282. J. B. Hannay. Making a white pigment of lead, and apparatus therefor. May 29.

1434. J. B. Hannay. Purifying sulphate of lead. June 5.

5380. G. R. B. Kempton. Sapphire crystal blue for laundry purposes. June 5.

5792. L. E. Andés. An enamel or paint having disinfecting properties. May 22.

6581. G. Hand Smith. Treatment of gum copals, gum resins, and other gums for the manufacture of varnishes and other solutions. June 5.

7379. W. Smartt. Production of vulcanised india-rubber and analogous materials. June 12.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

8191. J. Kristen. Improvements in the process of and means for dyeing hides. May 16.

8194. H. B. Bury, J. Bury, and J. I. Davies. A process for removing grease from sheep and lamb pelts before fleshing and splitting. May 16.

8590. R. North and W. Ellis. Improvements in apparatus for "grounding" chamois and other leathers. May 23.

9776. B. Nicholson and T. Palmer. Improvements in and apparatus or means for the tanning of hides, skins, or other leather goods. June 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

10,362. P. Puech. Process for unhairing skins. June 5.

1889.

5671. C. W. Cooper. Process and apparatus for treating hides, skins, or scraps in liquids. May 22.

5672. C. W. Cooper. Method of treating hides, skins, or scraps in liquids. May 22.

XV.—AGRICULTURE AND MANURES.

APPLICATIONS.

8782. A. Booty. An improved manurial composition or stimulant for plants, bulbs, trees, and other vegetable produce. May 27.

9087. J. W. Lodge. An improved process and means to be employed for partially destroying and mixing night-soil and other refuse, and for converting the same into manure suitable for grass land and arable purposes. June 1.

COMPLETE SPECIFICATION ACCEPTED.

1888.

11,505. C. Weigelt. Preparation of manures from fish, &c., and extraction of oil therefrom. May 22.

XVI.—SUGARS, STARCHES, GUMS, ETC.

APPLICATIONS.

8052. C. Steffen. Apparatus for refining loaf sugar in the moulds. Complete Specification. May 14.

8596. J. G. Chapman. Improvements in and connected with apparatus for evaporating and concentrating saccharine or other solutions. May 23.

8622. C. Steffen. An improved apparatus for producing white sugar. Complete Specification. May 24.

9021. J. Foster. Improvements in and relating to the drawing off and condensing of the vapour from sugar pans, and apparatus therefor. May 30.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

9320. A. H. J. Bergé. The acid saccharification of amylaceous substances. May 29.

1889.

7131. H. A. Hughes. Process and apparatus for obtaining sugar liquor from sugar cane, or for obtaining extract. June 19.

8052. C. Steffen. See application above. June 19.

XVII.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

7964. R. Haddan.—From J. C. Severino, Spain. A method of manufacturing a novel liqueur or beverage. Complete Specification. May 13.

8277. J. Leslie. The application of oxygen in the distillation of alcoholic liquids. May 18.

8343. L. A. Enzinger. An improvement in apparatus for sterilising fermented alcoholic liquors. May 20.

8686. M. Bauman, T. Sederl, and F. Wirk. Improvements in malt-kilns and kilns for drying similar materials. May 24.

8839. C. Huelser.—From J. Kuntze. A new or improved apparatus for pneumatic malting. May 28.

8992. W. W. Mutter and W. Dawson. Improvements in or relating to distillers' safes. May 30.

9181. E. Luck. Improvement in and apparatus for the purification of alcohol or alcoholic liquors. June 3.

9276. A. Gough, sen. Improvements in the apparatus for the making and drying of malt. June 4.

9280. S. Hirschler. An improved apparatus for agitating or turning over malt and other like substances. June 4.

9321. F. M. Maynard. An improved valve and fittings for the better regulation of the flow of steam or liquids for various purposes, especially designed for use with brewers' and distillers' attenuators, &c. June 4.

9629. J. D. Paul. A new method of preserving beer. June 11.

9660. J. Phillipi. A new or improved process of and apparatus for pasteurising, cooling, and aerating beer or other fermented or fermentable liquids, and filling the same into casks. June 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

8116. E. Wilson. Drying and curing malt, hops, &c. by an improved apparatus. June 5.

9964. Baron S. Stempel and N. Warcuzoff. Purification of alcohol. May 22.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

8882. W. P. Branson and H. W. Neild. Improvements in evaporating or condensing milk and other liquids. May 28.

8945. J. L. Johnston. Further improvements in the preparation and combination of animal substances with vegetable substances for use in food. May 28.

8963. T. Williams. Improved means for smoke-curing fish and flesh foods, and in fuel compounds for the purpose. May 29.

9226. B. Johnson. An improved mode of preserving fruit. June 4.

9303. T. D. Coustas. Improvements in preserves and condiments. June 4.

9348. E. J. T. Digby. Improvements in the preparation and manufacture of an alimentary compound. June 4.

9861. C. Heinemann. The manufacture of a malt product called "wheat coffee." June 15.

9881. A. Richardson. Improvements in the preservation of milk in bottles. June 15.

B.—Sanitary Chemistry.

8088. C. H. Beloe and F. Candy. Improvements in and connected with the purification and filtration of sewage and other foul liquids. May 15.

8294. H. R. Newton. Improved means for filtration and disposal of sewage and other offensive liquids. May 18.

8725. A. K. Brown. Improvements in or connected with apparatus for softening, purifying, clarifying, and filtering water and other liquids. May 27.

9763. G. Brownen and J. Gamgee. Improvements in bleaching, disinfecting, purifying, and preserving substances, and apparatus therefor. June 13.

9777. B. Nicholson and T. Palmer. Improvements in and apparatus for the treatment of sewage, faecal matter, foul waters, or the like, for the purification or deodorising thereof, and the obtaining of products therefrom. June 13.

9793. J. Croft and J. F. Yeadon. Improvements in the method of purifying water and extracting sludge and other refuse therefrom. June 14.

C.—Disinfectants.

8177. E. Hermite, E. J. Paterson, and C. F. Cooper. See Class VII.

8527. W. Black and W. L. Remoldson. Improvements in the manufacture or preparation of disinfectants or antiseptics. May 22.

9165. A. H. Allen and W. W. Staveley. Improvements in the production and application of the metallic compounds of phenoloids. June 3.

9256. J. Shaw. Purifying sewer-gas, and ventilating sewers, drains, and water-closets, &c.—a deodoriser. June 4.

COMPLETE SPECIFICATIONS ACCEPTED.

B.—Sanitary Chemistry.

1888.

8491. J. Price. Expelling liquid from and compressing sewage sludge and other semi-fluid or plastic substances. May 22.

C.—Disinfectants.

1889.

4387. H. Oppenheim. Tablets for disinfecting, antiseptic, medical, bleaching, and laundry purposes, and as an insecticide. May 29.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

7948. E. M. H. Andreoli. See Class XI.

8509. F. Favier, jun. Improvements in machinery for refining and finishing half-stuff in paper making, and in hydrostatic balances for changing the contents of the pulp reservoirs. Complete Specification. May 22.

8514. F. J. Fawcus. Improvements in the manufacture of paper. May 22.

8903. J. Groome. Improvements in machines used for reducing or pulping materials used in the manufacture of paper. Complete Specification. May 29.

8946. J. Husnik. Improvements in the production of semi-transparent marks or designs on or in paper by means of gelatin relief printing. Complete Specification. May 29.

9313. G. F. Gregory. Making paper for taking press copies untearable. June 4.

9694. F. J. Cheesebrough. From H. Pataky and W. Pataky, Germany. Manufacture of wood pulp. Complete Specification. June 12.

COMPLETE SPECIFICATION ACCEPTED.

1889.

2702. E. C. de Mejer and T. Greenwood. Manufacturing artificial stucco-work. May 29.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

8085. H. W. Jones. Improvements in the production of developers for photographic use. May 15.

8899. T. Thorns. Rendering albumenised and sensitised photographic paper free from smell. May 29.

9012. A. H. Cros. Improvements in colour photography. Complete Specification. Date applied for under Patents Act, 1883, sec. 103, 8 November 1888, being date of application in France.

9520. J. H. Smith. The delivery and regular distribution of gelatino-bromide of silver or other emulsion, or viscous liquid upon glass, paper, or other plane surface. June 8.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

8718. Sir F. A. Abel and J. Dewar. Manufacture of explosives. May 27.

9361. A. V. Newton.—From A. Nobel. Improvements in the preparation of explosive compounds. June 4.

9433. W. B. McGavin. Improvements in explosive compounds. June 7.

COMPLETE SPECIFICATION ACCEPTED.

1888.

11,751. C. Lamm. Protecting and preserving explosives. June 19.

THE JOURNAL

OF THE

Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 7.—VOL. VIII.]

JULY 31, 1889.

[Non-Members 30/- per annum; Members
21/- per Set of extra or back numbers;
Single Copies (Members only) 2 6.

The Society of Chemical Industry.

ASSISTED BY THE FOLLOWING STAFF OF

Abstractors:

Past Presidents:

Sir H. E. Roscoe, M.P., LL.D., V.P.R.S.	1881—1882.
Sir Frederick Abel, C.B., D.C.L., F.R.S.	1882—1883.
Walter Weldon, F.R.S.	1883—1884.
W. H. Perkin, Ph.D., F.R.S.	1884—1885.
E. K. Muspratt	1885—1886.
David Howard	1886—1887.
Prof. James Dewar, F.R.S.	1887—1888.
Ludwig Mond	1888—1889.

T. L. Bailey, Ph.D.
G. H. Beckett.
D. Bendix.
E. Bentz.
E. E. Berry.
E. J. Bevan.
Bertram Blount.
Arthur G. Bloxam.
C. H. Bothamley.
E. G. Clayton.
Julius B. Cohen, Ph.D.
C. F. Cross.
A. R. Davis.
W. W. Haldane Gee, B.Sc.
C. Napier Hake.
S. Hamburger, Ph.D.
Oswald Hamilton.
John Heron.
Bertram Hunt.
C. C. Hutchinson.
D. E. Jones, B.Sc.
W. E. Kay.
A. J. King, B.Sc.

F. S. Kipping, D.Sc.
Chas. A. Koln, Ph.D.
F. W. T. Krohn.
T. A. Lawson, Ph.D.
J. Walter Leather, Ph.D.
A. Liebmann, Ph.D.
D. A. Louis.
W. Macnab.
J. M. H. Munro, D.Sc.
H. S. Pattinson, Ph.D.
H. T. Penternmann.
S. G. Rawson, D.Sc.
A. Rée, Ph.D.
F. W. Renaut.
Edward Simpson.
A. J. Smith, B.Sc.
Oscar J. Steinhart, Ph.D.
A. L. Stern, B.Sc.
A. Studer, Ph.D.
Bertram Thomas.
Eustace Thomas.
V. H. Veley, M.A.
R. Lloyd Whiteley.
A. Wingham.

COUNCIL FOR YEAR ENDING JULY, 1890.

President: Sir Lowthian Bell, Bart., F.R.S.

Vice-Presidents:

R. Forbes Carpenter.	S. H. Johnson.
Prof. F. Clowes, D.Sc.	Ludwig Mond.
Sir J. Neilson Cuthbertson.	Dr. Hugo Muller, F.R.S.
Prof. James Dewar, F.R.S.	Dr. W. H. Perkin, F.R.S.
Jas. Duncan.	Dr. Edw. Schmuck, F.R.S.
Dr. John Evans, F.R.S.	Prof. W. A. Tilden, F.R.S.

Ordinary Members of Council:

L. Archbutt.	B. E. R. Newlands.
S. B. Boulton.	Jno. Pattinson.
Jno. Brock.	Jno. Spiller.
Jno. Calderwood.	E. C. C. Stanford.
Alexander M. Chance.	J. C. Stevenson, M.P.
A. E. Fletcher.	A. Norman Tate.

With the Chairmen and Secretaries of Sections.

Honorary Treasurer:

E. Rider Cook, East London Soapworks, Bow, E.

Honorary Foreign Secretary:

Dr. Ferdinand Hirtner.

General Secretary: Charles G. Cresswell.

Offices:

Palace Chambers, 9, Bridge Street, Westminster, S.W.

THE JOURNAL.

Publication Committee:

The President.

Sir F. A. Abel, F.R.S.	Prof. A. K. Huntington.
A. H. Allen.	F. Hurter, Ph.D.
G. H. Bailey, D.Sc., Ph.D.	Ivan Levinstein.
Joseph Bernays, M.I.C.E.	Prof. R. Meldola, F.R.S.
H. Brunner.	Ludwig Mond.
W. Lant Carpenter.	E. K. Muspratt.
Prof. Frank Clowes, D.Sc.	B. E. R. Newlands.
W. Y. Dent.	C. O'Sullivan, F.R.S.
Prof. Jas. Dewar, F.R.S.	John Pattinson.
John Heron.	W. H. Perkin, Ph.D., F.R.S.
D. B. Hewitt, M.D.	Sir H. E. Roscoe, M.P., F.R.S.
David Howard.	John Spiller.
Prof. J. J. Hummel.	A. Norman Tate.
	Thomas Tyrer.

Editor:

Watson Smith, The Owens College, Manchester.

NOTICES.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Post Office Orders in payment of subscriptions should in all instances be made payable at the General Post Office, London.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Society's Office will be closed from the 5th to the 14th August inclusive.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January 1883, and January, February, and April 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once, stating price required, with Mr. Cresswell. The stock of all other numbers is at present sufficient for the Council's requirements.

LIST OF MEMBERS ELECTED, 10th JULY, 1889.

Berry, G. F., Atlas Chemical Works, West Ferry Road, Millwall, E., works manager.

Cowan, Lt.-Col. and Alderman Phineas, 15, Lancaster Gate, Hyde Park, W., soap maker and sugar refiner.

Holliday, Jas. R., 4, Bennett's Hill, Birmingham, solicitor.

Kempson, Jno. F., Pye Bridge Chemical Works, near Alfreton, Derbyshire, chemical manufacturer.

Mawdsley, Peter A., 8, Eaton Road, Chester, alkali manufacturer.

Orndorff, Dr. Wm. R., Cornell University, Ithaca, N.Y., U.S.A., instructor in chemistry (on U.S. Commission to Paris Exhibition).

LIST OF MEMBERS ELECTED, 23rd JULY, 1889.

Babington, Percival, Owens College, Manchester, analyst.

Ball, Arthur, c/o Messrs. Burroughs, Wellcome, and Co., Snow Hill Buildings, E.C., pharmaceutical chemist.

Brennan, Edmund J., P.O. Box 419, Johannesburg, S.A.R., mining agent.

Chamberlain, H. G., 22, Forest Drive West, Leytonstone, E., isinglass merchant.

Cronquist, Albert W., Royal Wharf, Skeppsholmen, Stockholm, Sweden, lecturer in Government Torpedo School.

Ewens, Paul, 87, Shirland Gardens, Maida Vale, W., civil engineer.

Gent, Wm. Thos., Misterton, Gainsboro', analytical chemist.

Hall, Robt. E., c/o Box 407, Johannesburg, S.A.R., assayer.

Hartmann, Dr. Wm., 186, Suffolk House, Cannon Street, E.C., chemist.

Hugill, Francis J., Rosedale, Lubbock Road, Chislehurst, Kent, manufacturing chemist.

Lewkowitch, Dr. Julius, Whitehall Soap Works, Leeds, manufacturing chemist.

Little, Wm. G., Blendon Cottage, Bexley, Kent, chemical manufacturer.

Ostlere, Edward, Messrs. Barry, Ostlere, & Co., Kirkcaldy, N.B., linoleum manufacturer.

Pielsticker, Carl M., Suffolk House, Cannon Street, E.C., engineer.

Pratt, Walter E., Chemical Laboratory, Midland Railway Co., Derby, analytical chemist.

Searl, Albert, c/o Messrs. Howards and Sons, City Mills, Stratford, E., analyst.

Staniland, Alf. E., 7, Nicholas Lane, London, E.C., cement manufacturer.

Wood, Jas., Stockwith-on-Trent, Gainsborough, engineer.

CHANGES OF ADDRESS.

Archbutt, L., 1/o Rose Hill; 11, Charnwood Street, Derby.

Bailey, Walter P., 1/o Silvertown; 8, South Park, Ilford, Essex.

Barber, Geo., 1/o 23; 27, Studley Road, Forest Gate, E.

Bell, Geo., 1/o Runcorn; 59, Sandown Lane, Wavertree Road, Liverpool.

Bramwell, Major E.; Journals to Navigation Chemical Works, St. Helens.

Cameron, Ian, 1/o Lisbon; retain Journals until further notice.

Crawford, D., 1/o Caldercruix; Ferryfield Printworks, Alexandria, N.B.

Edmonds, H. R., 1/o East 28th Street; 532, West 20th Street, New York, U.S.A.

Hastings, Hugh, 1/o Bradford; Woodford Cottages, Chester Road, Kidderminster.

Herroun, E. F., 1/o Deptford; Riverdale, Humber Road, Westcombe Park, S.E.

Joynson, F., 1/o Edgbaston; Clock Face, near St. Helens.

Mackinnon, A. K., 1/o Drayton Gardens; 105, St. George's Road, S.W.

Miller, Geo., 1/o Bold; c/o Widnes Alkali Co., Ltd., Widnes.

Naef, Dr. P., 1/o Zurich; Wymington Park, Northwich.

Quibell, Oliver, 1/o High Field; Magnus Lodge, Newark-on-Trent.

Redwood, Boverton, 1/o Gracechurch Street; 4, Bishopsgate Street Within, E.C.

Redwood, Robt., 1/o Gracechurch Street; 4, Bishopsgate Street Within, E.C.

Reed, Albert E., 1/o Cardiff; Highdene, Station Road, Sidcup, Kent.

Staub, Dr. A., 1/o Northwich; Sand, Glarus, Switzerland.

Waché, Alfred, 1/o Douai; 11^{Bis} Rue Nain, Ronbaix, France.

Watson, J. Cecil, 1/o Birchvale; c/o Daniel Lee & Co., Castleton, Manchester.

Williams, M. W., 1/o Ponders End; 4, Grove Gardens, Regent's Park, N.W.

TEMPORARY CHANGES OF ADDRESS.

Chase, Prof. Roscoe L., July No. to 11, Varnum Avenue, Pawtucketville, Lowell, Mass., U.S.A.

Johnston, W. G., July No. to c/o A. Burns-Glen; 8, Great Winchester Street, E.C.

PROCEEDINGS

OF THE

EIGHTH ANNUAL MEETING.

THE Annual General Meeting of the Society was held on Wednesday, the 10th July, in the theatre of the Royal Institution, London.

The President, Mr. LUDWIG MOND, took the Chair at 11 o'clock, and called upon the Secretary to read the Minutes of the last Annual Meeting. These having been duly confirmed, Mr. Henry Brunner proposed and Dr. D. B. Hewitt seconded, that Mr. Ivan' Levinstein and Mr. A. H. Allen should be appointed scrutators, to examine and report upon the ballot papers for election of new Council.

Mr. E. C. C. STANFORD inquired whether this course was necessary, seeing that the election was already practically settled by the number of nominations being equal to the number of vacancies. After some further discussion, it was decided that the procedure prescribed by the bye-laws ought to be followed, and the resolution was carried.

The General Secretary then read—

THE REPORT OF THE COUNCIL.

THE Council has the honour to report that the membership of the Society has increased from 2,395, as reported at the last meeting, to 2,445, or a net increase of 50 members. During the year 223 members have been elected, and 173 have been removed by death, resignation, and other causes.

The losses by death have been unusually heavy, and include the following names eminent in pure and applied science:—Dr. J. Peter Griess, F.R.S., the discoverer of the azo-compounds; Dr. Wm. Wallace, City Analyst of Glasgow, an authority on sanitation; J. J. Coleman, Chairman of the Glasgow and Scottish Section, the inventor of the Bell-Coleman mechanical dry air refrigerator; R. D. Silva, Professor of Analytical Chemistry at the Ecole Centrale, Paris; John Williams, a Vice-President of our Society, and at one time President of the Pharmaceutical Society, an authority of great weight in pharmacy, and one whose genial presence and counsel we greatly miss; Dr. Warren De la Rue, F.R.S., a former President of the Chemical Society, whose researches in chemistry, electricity, and astronomy are historical; Dr. R. S. Newall, F.R.S., identified with the invention of wire rope and the manufacture of submarine cables; and Dr. John Percy, F.R.S., late President of the Iron and Steel Institute, author of "Percy's Metallurgy."

During the year 55 papers and 5 communications have appeared in the Journal. Our thanks are due to those who have favoured the Society by reading these papers.

The Journal daily increases in importance as a work of reference, and every effort is made by the Publication Committee to add to its value. Within the last few weeks Mr. Watson Smith has arranged to give up his lectureship at the Victoria University, and, taking up his abode in London, has agreed to make the editing of the Journal his main occupation, and this on terms which, after full

deliberation, have been deemed satisfactory. The Council hopes that, in securing for the future his services, which have been so valuable in the past, it has promoted the best interests of the Society in whose continued prosperity the Journal is so important a factor.

This step has been rendered possible by the satisfactory state of our finances. On the 21st June last the Treasurer reported the sum of 3,688*l.* 15*s.* 9*d.* invested and 1,211*l.* 4*s.* 5*d.* in the Bank, as against 2,088*l.* 11*s.* 9*d.* invested and 1,761*l.* 12*s.* 9*d.* in the Bank a year ago. The Revenue last year, as will be seen from the balance sheet, amounted to 918*l.* 14*s.* 9*d.* more than the expenditure; due mainly to increased profit from advertisements in the Journal, and economies in printing and publishing effected without in the least detracting from the quality of the Journal. This year the profits from advertisements will be less, as the Council has agreed to accept a lower sum on the representation of the publishers, who had over-estimated the returns from this source.

The increased salary of the Editor under the arrangement alluded to above, the cost of providing further office accommodation, the cost of housing and binding the books presented by Mr. Raphael Weldon, referred to in the last report, and the improbability of large accessions of members in the future, render this surplus most welcome, and we are thus enabled to face the future with confidence and hope.

Among minor matters connected with the Journal, the following may be mentioned:—A new class called "Photographic materials and processes" has been added to the Journal and Patent Literature, the code of rules for those engaged in the production of the Journal has been revised, the Journal is now printed in uniform type throughout, and we shall publish at the end of 1890 a collective subject-matter index of the first nine volumes.

The adoption of the Report was moved by Dr. Hugo Muller, seconded by Col. Gamble, and carried unanimously.

The Honorary Treasurer (Mr. E. RIDER COOK) then presented the accounts for the year, published on page 504. He urged members to avail themselves more fully of the system of paying their subscriptions by bankers' orders. Those members who omitted to send in their subscriptions promptly were deprived of their Journals solely through that carelessness so common to busy men in dealing with private matters. The Society did not suffer, because the subscriptions always arrived eventually; but as bankers were willing to collect subscriptions, members might surely avail themselves more fully of the convenience. He would also ask members to bear in mind that at the beginning of every year, especially during January, the work of his department was very heavy, and that it was impossible for him, without a special staff, to acknowledge all subscriptions the moment they came in. He had received certain letters of complaint on the subject, but he was sure that when they knew the circumstances, members would make due allowance for slight delays occurring at such moments of pressure. He was glad to report that, although the Council had invested 1,500*l.* during the year, he had now in hand over 1,200*l.*, which was quite enough to meet expenses until the subscriptions for next year came in.

THE PRESIDENT moved that a vote of thanks be tendered to Mr. Rider Cook for the care and skill with which he had filled the position of Hon. Treasurer for eight years. He was sure that it was unnecessary for him to go into any details on the subject, and hoped that the vote would be carried by acclamation.

Mr. JOHN SPILLER seconded the motion, which was carried by acclamation.

THE HON. TREASURER in returning thanks said that he considered himself an exceedingly fortunate official. The duty of a treasurer was usually to supply funds; but this Society was so prosperous that he had only to take care of and invest its money. That was an exceptional position, and one which it was a gratification to hold.

STATEMENT OF REVENUE AND EXPENDITURE FOR THE YEAR 1888.

REVENUE.				EXPENDITURE.				
	£	s.	d.		£	s.	d.	
Annual Subscriptions for 1888:—				Journal Expenses:—				
59 received in 1887 (less 13s. 1d. short paid)	73	1	11	Publishing	1,272	6	3	
Odd amounts on account of 1888 subscriptions received in 1887 ..	1	17	0	Editor's Salary	250	6	0	
2,186 received in 1888 (at £1 5s. each) ..	2,732	10	0	" Expenses	80	16	8	
2 " " (at £1 1s. each) ..	2	2	0	Abstractors	259	3	0	
1 " " (at £1)	1	0	0	Indexing Journal	30	0	0	
Excess payments	0	6	5	Journals	13	18	6	
Sundry balances of subscriptions for 1888—short paid in 1887	1	0	6	Patent Lists	45	3	6	
12 received in 1889	15	0	0					
2,260								
11 Life Composition Fees	*165	0	0					
Interest on Deposit Account		21	1	1	Sundries, Printing	52	14	5
Interest on Metropolitan Stock		53	7	11	Secretary's Salary	310	0	0
Journal:—					Sectional Expenses	211	6	8
Sales	180	3	10		Hon. Treasurer's Assistant	42	0	0
Advertisements	600	0	0		Office Expenses	70	12	5
					Stationery	38	1	10
					Auditors' Fee	5	5	0
					Solicitors' Charges	8	18	10
					Reporting Annual Meeting	13	18	10
					Addressing Circulars	2	5	10
					Bank Charges	1	18	5
					Secretary's Petty Cash	40	3	9
					Treasurer's Petty Cash	14	11	0
					Balance of Revenue over Expenditure	918	14	9

Memorandum. Journals in Stock:— Nos., value £
 42 Subscriptions for 1858 owing not included in above.
 * Placed to capital account.

THE TREASURER—IN ACCOUNT WITH THE SOCIETY OF CHEMICAL INDUSTRY FOR THE
YEAR 1888.

Dr.			YEAR 1888.		Cr.
	£ s. d.	£ s. d.		£ s. d.	£ s. d.
To Cash on Deposit (31st December, 1887) .	750 0 0		By Journal Expenses :—		
Balance at Bank. ditto .	397 8 7		Publishing	1,431 7 7	
Balance in Secretary's hands..... ditto ..	1 14 3		Editorial	623 11 8	
	<u>1,059 2 10</u>		Carriage of Stock to London	9 15 3	
Less subscription returned.....	1 1 0	1,058 1 10	Insurance of Stock	<u>2 10 0</u>	
				2,067 4 6	
Annual Subscriptions :—			Sundries Printing, &c.....		65 19 2
23 subscriptions for the year 1887			Sectional Expenses :—		
(£1 5s. each).....	28 15 0		Birmingham Section.....	7 1 5	
2,186 subscriptions for the year 1888			Glasgow Section.....	41 17 9	
(£1 5s. each)	2,732 10 0		Liverpool Section.....	25 19 0	
2 subscriptions for the year 1888			London Section.....	73 4 6	
(£1 1s. each).....	2 2 0		Manchester Section.....	43 1 0	
1 subscription for the year 1888			Newcastle Section	<u>20 17 0</u>	
(£1).....	1 0 0			211 0 8	
70 subscriptions for the year 1889			Secretary's Salary	310 0 0	
(£1 5s. each).....	87 10 0		Office Expenses :—		
3 subscriptions for the year 1889			Rent	60 0 0	
(£1 1s. each)	3 3 0		Fires, Gas, Attendance, and In-		
1 subscription for the year 1890			surance.....	<u>10 12 5</u>	
(£1 5s.).....	1 5 0			70 12 5	
			Honorarium to Hon. Treasurer's assistant for work		
2,286			in 1887.....	42 0 0	
Excess payments.....	0 6 5		Honorarium to Secretary for work in connexion		
Sundry balances of subscriptions for 1887			with transfer of printing in 1887	21 0 0	
and 1888—short paid in 1887	1 8 6		Stationery.....	45 11 10	
Sundry amounts paid on account of 1889	<u>0 10 0</u>	2,858 9 11	And-tors' Fee	5 5 0	
			Solicitors' Charges	17 17 10	
Life Composition Fees.....	165 0 0		Purchase of £1,049 1s. 3d. Metropolitan 3 ^d . Stock..	1,075 0 0	
Interest on Deposit Account.....	21 4 1		Reporting at Annual Meeting.....	13 18 10	
Interest on Metropolitan Stock	53 7 11		Addressing Circulars	2 5 10	
Journal :—			Bank Charges on Scotch and Irish Cheques	1 18 5	
Advertisements.....	679 16 8		Secretary's Petty Cash :—		
Sales	<u>192 8 10</u>	872 5 6	Postage, Telegrams, and Orders....	16 16 8	
			Books, Stationery, Gratuities, Trav-		
			elling Expenses, and Sundries... ..	10 10 2	
			Expenses at Annual Meeting	<u>10 7 11</u>	
				37 14 9	
			Treasurer's Petty Cash	14 11 0	
			Cash on Deposit (31st December, 1888)..	709 0 0	
			Balance at Bank. ditto ..	317 18 1	
			Balance in Secretary's hands..... ditto ..	<u>8 10 11</u>	
				*1,026 9 0	

* In addition to this there is an amount of £2088 11s. 7d. Metropolitan 3% Consolidated Stock, invested in the names of Mr. David Howard and Mr. Edward Rider Cook.

We have compared the above Statement with the Receipts, Counterfoils, Vouchers, and Books of the Society,
and certify it as correct.

(Signed) THEOBALD BROS. & MIALL,
Chartered Accountants.

ELECTION OF AUDITORS.

Mr. G. H. MAKINS moved that Messrs. Theobald Bros. and Miall, Chartered Accountants, be re-elected auditors for the ensuing year. The motion was seconded by Mr. John Pattinson and carried unanimously.

ANNUAL GENERAL MEETING FOR 1890.

Professor CLOWES said that he deeply regretted the unavoidable absence of the Chairman of the Nottingham Section, from whom he had just received a telegram asking him to explain his inability to attend for the purpose of inviting the Society to hold its General Meeting at Nottingham next year. In conveying that invitation to the Society at large, he was happy to be able to say that the Council had already received it with approval. Members would be aware that Nottingham was centrally placed and well served with railways. Though there was not much chemical industry in the town itself, there was the lace and hosiery manufacture, which would be found interesting by some members; and there was also the tannery of Sir John Turney (Chairman of the Section), which was one of the largest in the country. Beyond this, however, he hoped that there would be an attractive programme of visits to places within easy reach of Nottingham. Some of the Burton brewers had already expressed their willingness to entertain members; and he did not doubt that Sheffield would be willing to show them something of the iron and steel industries. With regard to the lighter part of the programme, he was sure that if the meeting were disposed to accept the invitation, Nottingham would try to maintain its reputation for hospitality, and do its best to make the visit pleasant and interesting to all who should attend.

The motion was seconded by the President elect (Sir LOWTHIAN BELL, Bart., F.R.S.) and carried by acclamation.

THE PRESIDENT'S ADDRESS.

At the inaugural meeting of our Society held in London eight years ago, I had the honour to read a paper on the "Patent Laws, with special reference to Chemical Inventions." In this paper I made the following remark:—

"Science tells us how very far we are from attaining our industrial aims with anything approaching the theoretical expenditure of force. Science also tells us in what directions we may look forward to arriving at improvements. I might say that we are on the eve of creating a science of invention, that is, of developing scientific methods for solving industrial problems."

As exemplifying to a certain extent the application of methodical research to an industrial problem, I propose to bring before you to-day an account of the work I have been engaged in for many years in relation to the procuring of new and abundant supplies of ammonia, and to investigations connected therewith.

Through the classic researches of Lawes and Gilbert, who proved, in opposition to no less an authority than Liebig, that ammonia is a most valuable manure which enables us not only to maintain, but to multiply the yield of our fields, and thus to feed on the same area a much larger number of inhabitants, the immense importance of an abundant supply of ammonia, more particularly for the Old World, with its teeming population and worn-out soil, has been apparent to every one.

For many years Europe has paid to South America millions upon millions of £s for ammonia in the shape of guano, and more recently, since the supply of guano practically ceased, for nitrate of soda, which effectually serves same purpose as ammonia. During the past year South America exported 750,000 tons of nitrate, of which 650,000 went to Europe, representing a value of not less than 6,500,000*l*.

The problem of saving this immense expenditure to Europe, of making ourselves independent of a country so far away for the supply of a material upon which the prosperity of our agriculture—our most important industry

—depends, by supplying this ammonia from sources at our own command, is certainly one of the most important which our science has to solve.

It is more than 100 years since Berthollet ascertained that ammonia consists of nitrogen and hydrogen, two elements which we have in great abundance at our command; and innumerable attempts have been made during this century to produce this valuable product by the direct combination of the elements, as well as by indirect means. It has been equally well known that we are in possession of three abundant sources of nitrogen:—

- (1.) In the shape of matter of animal origin.
- (2.) In the shape of matter of vegetable origin.
- (3.) In the atmosphere, which contains no less than 79 per cent. of uncombined nitrogen.

In olden times ammonia was principally obtained from animal matter, originally in Egypt by the distillation of camel dung, later on from urine, and from the distillation of bones and horn. The quantity so obtained was very small and the products very expensive. The introduction of coal gas for illumination gave us a considerable and constantly increasing supply of ammonia as a by-product of the gas manufacture, and until recently all practical efforts to increase our supply of ammonia were directed towards collecting and utilising in the best possible manner the ammonia so obtained. The immense extension of the coal gas industry all over the world has in this way put us into possession of a very considerable amount of sulphate of ammonia, amounting in Europe now to 110,000 tons per annum. In recent years this has been augmented by the ammonia obtained by the distillation of shale, by the introduction of closed ovens for the manufacture of coke, combined with apparatus for condensing the ammonia formed in this manufacture, and also by the condensation of the ammonia contained in the gases from blast furnaces working with coal. But all these new sources have so far added only about 40,000 tons of sulphate of ammonia to our supply, making a total of 180,000 tons per annum, of which about 120,000 are produced in the United Kingdom, while we still import 650,000 tons of nitrate of soda, equivalent to 500,000 tons of sulphate of ammonia, to make up our requirements.

Many processes have from time to time been proposed to obtain ammonia from other sources. The distillation of turf, which contains upwards of 3 per cent. of nitrogen, has received much attention, and a large number of inventors have endeavoured to produce ammonia from the nitrogen of the air; but none of these processes have to my knowledge been successful on a manufacturing scale.

My attention was called to this subject at an early part of my career. Already, as far back as 1864, I undertook experiments to utilise, for the production of ammonia, waste leather, a waste material of animal origin at once abundant and very rich in nitrogen, containing from 12 per cent. to 15 per cent. of this element. Distillation in iron retorts yielded about half the nitrogen of this material in the form of ammonia, the carbon remaining in the retorts containing still from 6 per cent. to 8 per cent. Distillation with a moderate quantity of hydrate of lime increased the yield of ammonia only by 1 per cent. to 1½ per cent. A rather better result was obtained by distilling the ground residual carbon with hydrate of lime; but this operation proceeded very slowly, and the total yield of ammonia still remained very far below the quantity theoretically obtainable, so that I came to the conclusion that it was more rational to utilise the leather, reduced to powder by mechanical means, by mixing it directly with other manures.

A few years later I became connected with a large animal charcoal works, in which sulphate of ammonia was obtained as a by-product. Here again I was met with the fact that the yield of ammonia by no means corresponded with the nitrogen in the raw material, and that the charcoal remaining in the retorts contained still about half as much nitrogen as had been present in the bones used.

From this time forward my attention was for many years given exclusively to the soda manufacture, and it was only in 1879 that I again took up the question of ammonia. I then determined to submit the various processes which had

been proposed for obtaining ammonia from the nitrogen of the air to a searching investigation, and engaged Mr. Joseph Hawliczek to carry out the experimental work.

These processes may be broadly divided into three classes :

- (1.) Processes which propose to combine nascent hydrogen with nitrogen at high temperatures or by electricity, with or without the presence of acid gases.
- (2.) Processes in which nitriles are first formed, from which ammonia is obtained by the action of hydrogen or steam.
- (3.) Processes in which cyanides are first formed and the ammonia obtained from these by the action of steam.

We began with an investigation of those processes in which a mixture of steam and nitrogen or of steam and air is made to act upon coke at a high temperature, sometimes in the presence of lime, baryta, or an alkali, sometimes in the presence of hydrochloric acid.

Very numerous patents have been taken out in this direction, and there is no doubt that ammonia has been obtained by these processes by many inventors; but as I was aware that coke contains a considerable quantity of nitrogen, frequently as much as 1.5 per cent., which might be the source of the ammonia obtained, I determined to carry on the investigation in such a way as to make quite certain whether we obtained the ammonia from the coke or from the nitrogen of the atmosphere, or from both. For this purpose we made for every experiment carried on by a mixture of nitrogen or air with steam another experiment with steam alone, carefully excluding nitrogen from the apparatus. A very large number of experiments carried on at carefully determined temperatures, ranging from 500° to 1,200° C., and in which the directions given by the various inventors were most carefully observed, all led to the same result, viz., that the quantities of ammonia obtained were the same whether nitrogen was introduced into the apparatus with the steam or whether steam alone was used, thus proving conclusively that the ammonia obtained was derived from the nitrogen contained in the coke.

Further, on carefully determining the nitrogen in the coke used, it was found that the quantity of ammonia we had obtained in burning coke in a current of nitrogen and steam very nearly corresponded with the total nitrogen in the coke, so that we subsequently made our nitrogen determinations in the coke by simply burning it in a current of steam.

A process belonging to this class, proposed by Hugo Fleck, in which a mixture of carbonic oxide, steam, and nitrogen is made to pass over lime at a moderate red heat in order to obtain ammonia, was also carefully tried. It was claimed for this process that it produced nascent hydrogen at temperatures at which the ammonia is not dissociated, and for this reason succeeded where others had failed. We found that a considerable amount of hydrogen was obtained in this way at a temperature not exceeding 350° C., and that the reaction was nearly complete at 500° C.; but although we tried many experiments over a great range of temperatures, we never obtained a trace of ammonia by this process.

Amongst experiments with processes of the second class, based upon the formation of nitriles and their subsequent decomposition, the nitriles of boron and titanium had received most attention from inventors. The nitride of boron, which is obtained by treating boric acid with carbon in the presence of nitrogen, when acted upon by steam, forms boric acid again and yields the whole of its nitrogen in the form of ammonia; but the high temperature at which the first reaction takes place, and the volatility of boric acid in a current of steam, make it impossible to utilise this reaction industrially.

There seemed to be a better chance for a process patented by M. Tessier du Mothay, who proposed to bring a mixture of nitrogen and hydrogen into contact with titanium nitride and thus to form ammonia continuously. Titanium is the only element of which we know at present several combinations with nitrogen, and the higher of these does on being acted upon by a current of hydrogen at an elevated temperature, produce ammonia and a lower nitride of titanium; but this lower nitride does not absorb nitrogen under any of the conditions under which we tried it, which explains the fact that if we passed a current of hydrogen and nitrogen

over the higher nitride, we at first obtained a quantity of ammonia corresponding to the quantity which the nitride would give with hydrogen alone, but that the formation of ammonia then ceased completely.

Thus far we had quite failed to get the nitrogen of the air into action.

With the third class of processes, however, based upon the formation in the first instance of cyanides, we found by our very first experiments that the nitrogen of the atmosphere can be easily led into combination. A few experiments showed that the cyanide of barium was much more readily formed than any other cyanide; so we gave our full attention from this time to the process for obtaining ammonia by means of cyanide of barium invented by MM. Marguerite and Sourdeval. This process consists in heating a mixture of carbonate of barium with carbon in the presence of nitrogen, and subsequently treating the cyanide of barium produced with steam, thus producing ammonia and regenerating the carbonate of barium. A great difficulty in this process is that the carbonate of barium fuses at high temperatures, and when fused attacks fireclay goods very powerfully.

We found that this can be overcome by mixing the carbonate of barium with a sufficient quantity of carbon and a small quantity of pitch, and that in this way balls can be made which will not fuse, so that they can be treated in a continuous apparatus in which the broken briquettes can be charged from the top, and after treatment can be withdrawn from the bottom.

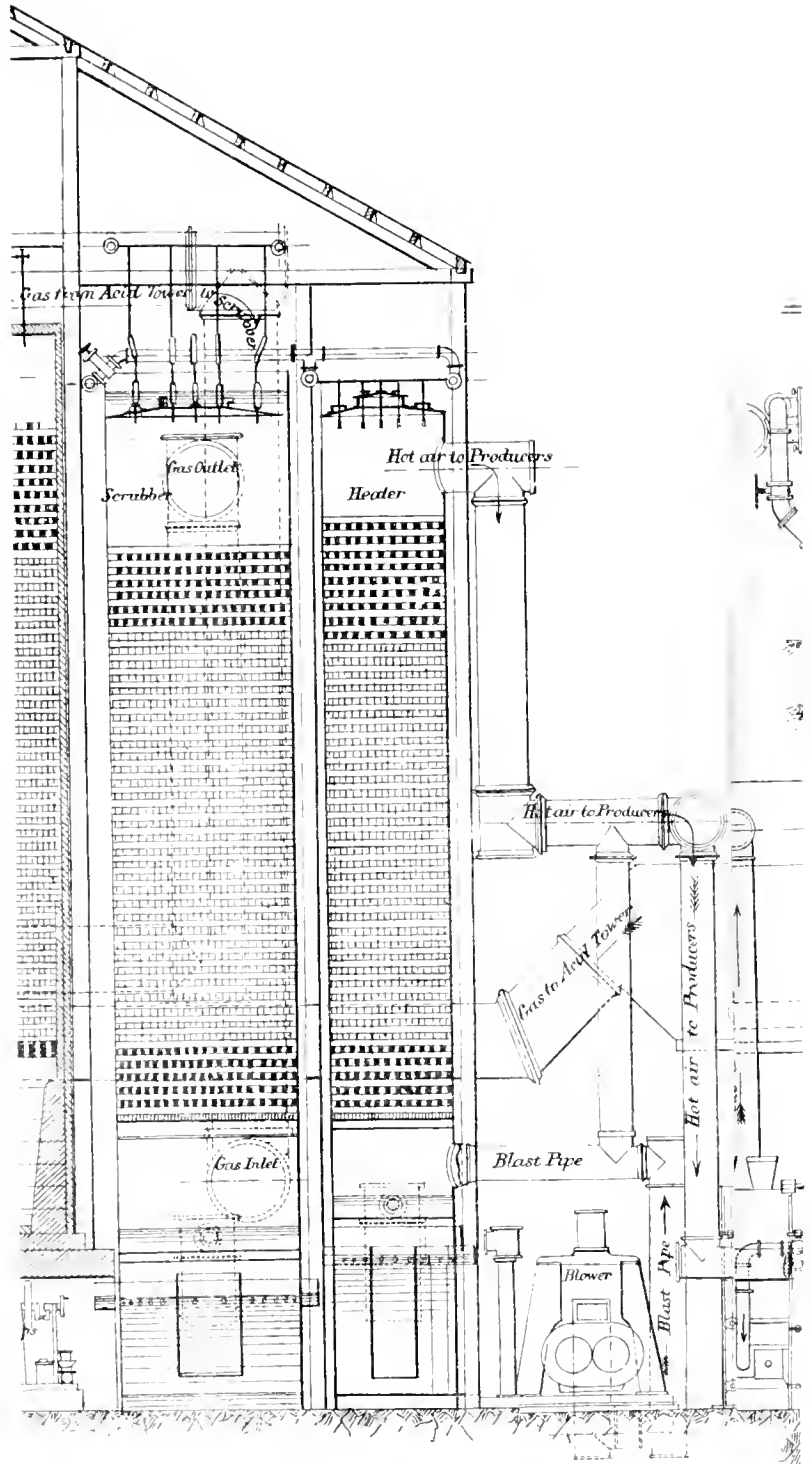
We found that the formation of cyanides required a temperature of at least 1,200° C., and proceeded most readily at 1,400° C., temperatures which, although difficult to attain, are still quite within the range of practical working; and we found no difficulty in obtaining a product containing 30 per cent. of barium cyanide, corresponding to a conversion into cyanide of 40 per cent. of the barium present.

We found, however, that the cyanide when exposed to the atmosphere at a temperature above 300° C. is readily destroyed under re-formation of carbonate of barium, so that it is absolutely necessary to cool it down to this temperature before exposing it to the atmosphere, a fact of great importance that had hitherto been overlooked.

The operation for producing ammonia and regenerating the carbonate of barium by acting upon the cyanide with steam offers no difficulty whatever, and if the temperature is not allowed to exceed 500° C. the results are quantitative. The regenerated carbonate of barium acts actually better than the ground witherite used in the first instance, and if care is taken that no impurities are introduced by the pitch which is used to re-make the briquettes and to replace the small amount of carbon consumed at each operation, I see no reason why it should not continue to act for a very long time.

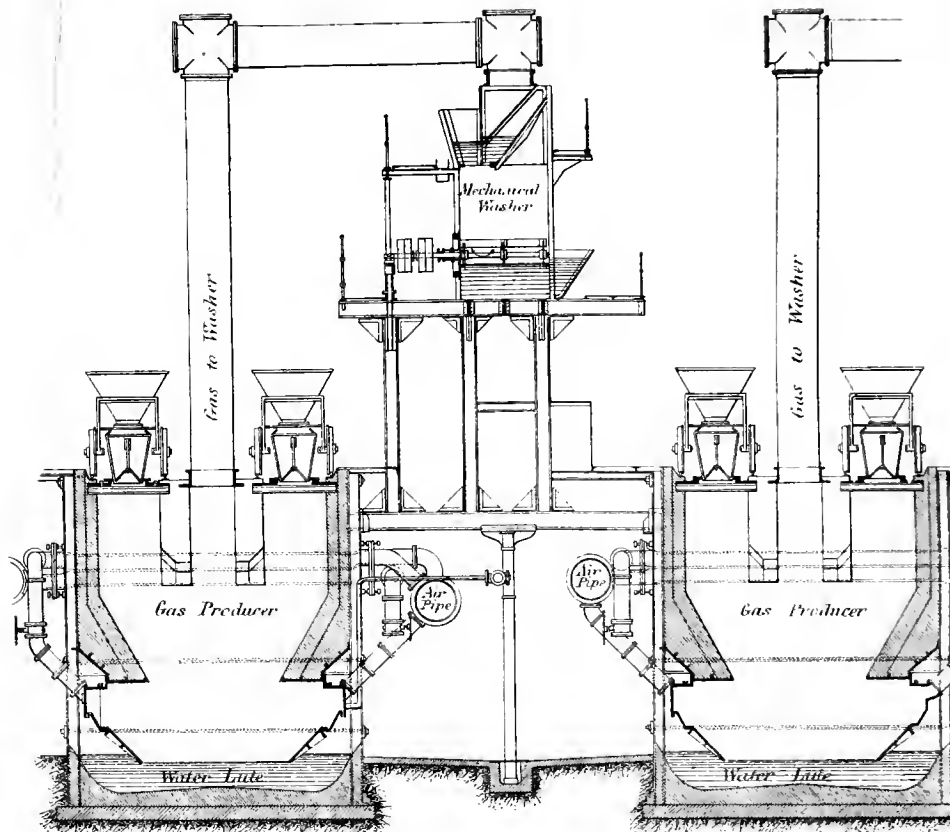
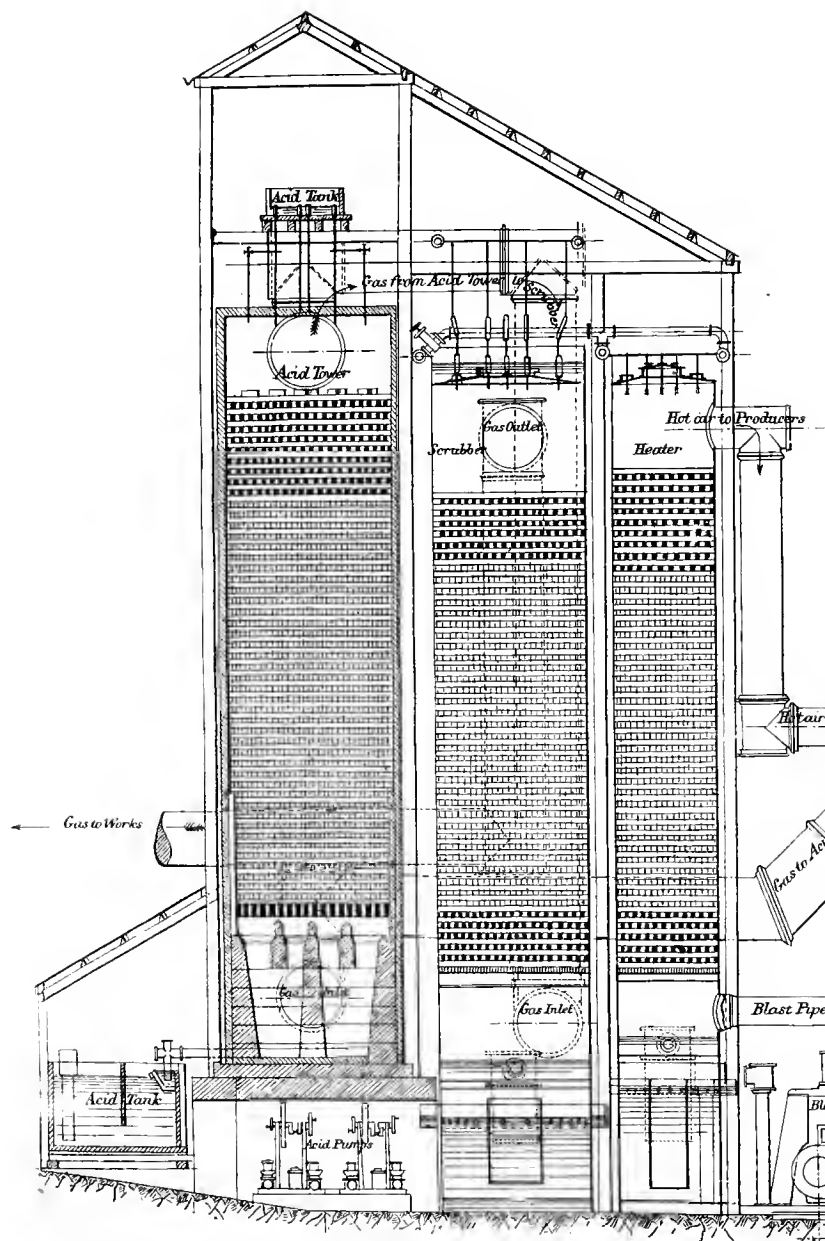
The cyanide is not acted on by carbonic oxide, but carbonic acid destroys it at high temperatures, so that it is not possible to produce it by heating the briquettes directly in a flame free from oxygen, but containing carbonic acid. The process has, therefore, to be carried out in closed vessels, and I designed for this purpose the following apparatus:—

Clay retorts of moderate dimensions and thin walls are placed vertically in a furnace, passing through the hearth as well as through the arch of the furnace. These are joined at the bottom to cast-iron retorts of the same shape as the earthenware retort. Through a cast-iron mouthpiece on the top of the retort the material was introduced, while in the cast-iron retort below, the material was cooled to the necessary temperature by radiation, and by the cold nitrogen gas introduced into the bottom of it. The lower end of the cast-iron retort was furnished with an arrangement for taking out from time to time small quantities of the material, while fresh material was in the same proportion fed in at the top. As a source of nitrogen I used the gases escaping from the carbonating towers of the ammonia-soda process. The formation of cyanide of barium from barium carbonate, carbon and nitrogen absorbs a very large amount of heat—no less than 97,000 calories per equivalent of the cyanide formed—which heat has to be transmitted

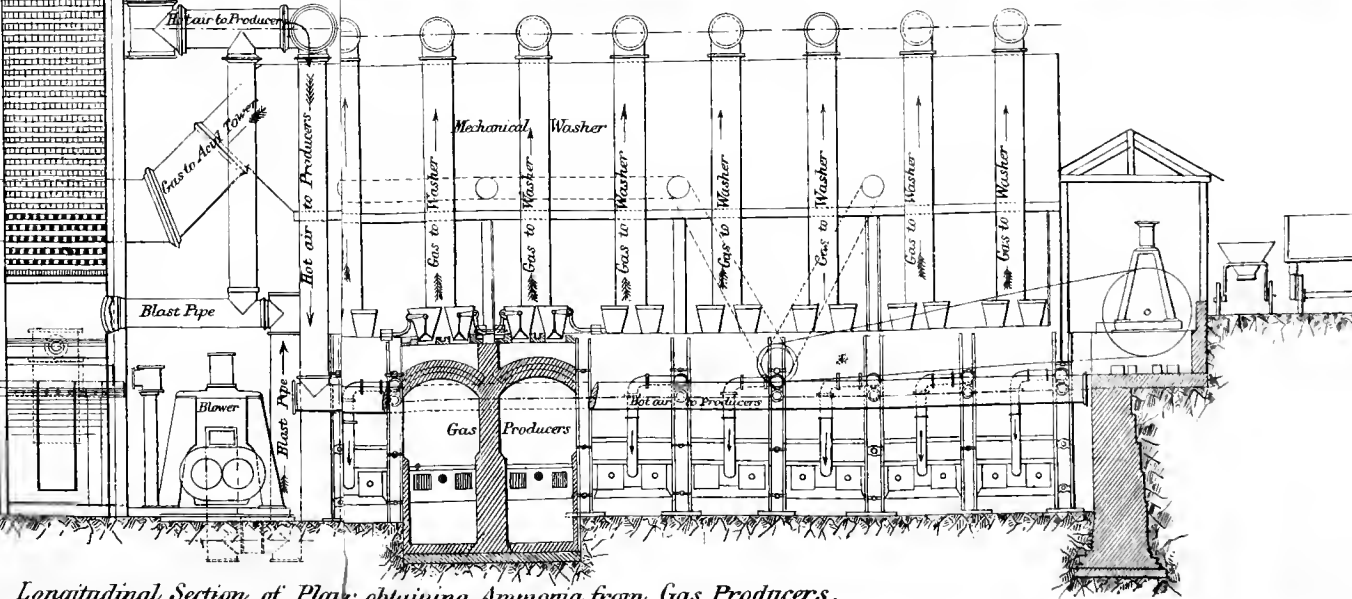


Longitudinal Section of Plant obt

506'



Cross Section through Gas Producers.



Longitudinal Section of Plant obtaining Ammonia from Gas Producers.

through the walls of the retort. I therefore considered it necessary to use retorts with very thin walls, but I did not succeed in obtaining retorts of this description which would resist the very high temperatures which the process requires, and for this reason I abandoned these experiments. I was at that time not acquainted with the excellent quality of clay retorts used in zinc works, with which I have since experimented for a different purpose. I have no doubt that with such retorts the production of cyanides by this process can be carried out without great difficulty.

I believe that the process will prove remunerative for the manufacture of cyanogen products, which, if produced more cheaply, may in the future play an important rôle in organic synthesis, in the extraction of noble metals and possibly other chemical and metallurgical operations.

The process certainly also offers a solution of the problem of obtaining ammonia from the nitrogen of the atmosphere, but whether this can be done with satisfactory commercial results is a question I cannot at present answer, as I have not been able to secure the data for making the necessary calculations.

I am the more doubtful about this point, as in the course of our investigations I have found means to produce ammonia at small cost and in great abundance from the immense store of combined nitrogen which we possess in our coal-fields.

Among the processes for obtaining ammonia from the nitrogen of the air which we investigated, was one apparently of great simplicity, patented by Messrs. Rickman and Thompson. These gentlemen state that by passing air and steam through a deep-coal fire, the nitrogen so passed through is to a certain extent converted into ammonia. In investigating this statement we found that the process described certainly yields a considerable quantity of ammonia, but when we burned the same coal at a moderate temperature by means of steam alone in a tube heated from the outside, we obtained twice as much ammonia as we had done by burning it with a mixture of air and steam, proving in this case, as in all others, the source of the ammonia to have been the nitrogen contained in the coal. The quantity of ammonia obtained was, however, so large that I determined to follow up this experience, and at once commenced experiments on a semi-manufacturing scale to ascertain whether they would lead to practical and economic results.

I came to the conclusion that burning coal by steam alone at temperatures at which the ammonia formed should not be dissociated, although it yielded more ammonia, would not lead to an economic process, because it would require apparatus heated from the outside, of great complication, bulk, and costliness, on account of the immense quantity of raw material to be treated for a small amount of ammonia obtainable.

On the other hand, if the coal could be burned in gas producers by a mixture of air and steam, the plant and working of it would be simple and inexpensive, the gas obtained could be utilised in the same way as ordinary producer gas, and would pay to a large extent for the coal used in the operation, so that although only one-half of the ammonia would be obtained, it seemed probable that the result would be economical.

I consequently constructed gas producers and absorbing plant of various designs and carried on experiments for a number of years. These experiments were superintended by Mr. G. H. Beckett, Dr. Carl Markel, and, during the last four years, by Dr. Adolf Staub, to whose zeal and energy I am much indebted for the success that has been achieved. The object of these experiments was to determine the most favourable conditions for the economic working of the process with respect to both the cost of manufacture as well as the first cost and simplicity of plant. The cost of manufacture depends mainly upon the yield of ammonia, as the expenses remain almost the same whether a large or a small amount of ammonia is obtained; the only other item of importance is the quantity of steam used in the process. We found the yield of ammonia to vary with the temperature at which the producer was working, and to be highest when the producer was worked as cool as was compatible with a good combustion of the fuel. The temperature again depended upon the amount of steam introduced into the

producer, and of course decreased the more the steam increased. We obtained the best practical results by introducing about two tons of steam for every ton of fuel consumed. We experimented upon numerous kinds of fuel, common slack and burgy of the Lancashire, Staffordshire, and Nottinghamshire districts. We found not much difference in the amount of nitrogen contained in these fuels, which varied between 1.2 and 1.6 per cent., nor did we find much difference in the ammonia obtained from these fuels if worked under similar conditions. Employing the quantity of steam just named we recovered about half the nitrogen in the form of ammonia, yielding on an average 0.8 per cent. of ammonia, equal to 32 kilos. of sulphate per ton of fuel. In order to obtain regular results we found it necessary to work with a great depth of fuel in the producers, so that slight irregularities in the working would not affect results. Open burning kinds of slack do of course work with the greater ease, but there is no difficulty in using a caking fuel, as the low temperature at which the producers work prevents clinkering and diminishes the tendency of such fuels to cake together.

The quantity of steam thus required to obtain a good yield of ammonia is rather considerable, and threatened to become a serious item of expense. Only one-third of this steam is decomposed in its passage through the producer, and two-thirds remain mixed with the gases which leave the producer. My endeavours were consequently directed towards finding means to recover this steam, and to return it to the producers, and also to utilise the heat of the gases which leave the producers with a temperature of 450° to 500° C., for raising steam for the same purpose. The difficulties in the way of attaining this end and at the same time of recovering, in a simple manner, the small amount of ammonia contained in the immense volume of gas we have to deal with, were very great. We obtain from one ton of coal 160,000 cubic feet of dry gas at 0° C. and atmospheric pressure. The steam mixed with this gas as it leaves the producer adds another 80,000 cubic feet to this, and the large amount of latent heat in this quantity of steam makes the problem still more difficult. The application of cooling arrangements, such as have been successfully applied to blast-furnace gases, in which there is no steam present, and which depend upon the cooling through the metallic sides of the apparatus, is here practically out of the question. After trying a number of different kinds of apparatus, I have succeeded in solving the problem in the following way:—

The gases issuing from the producers are led through a rectangular chamber partly filled with water, which is thrown up in a fine spray by revolving beaters so as to fill the whole area of the chamber. This water, of course, becomes hot; a certain quantity of it evaporates, the spray produced washes all dust and soot out of the gases, and also condenses the fixed ammonia. The water thus becomes, to a certain degree, saturated with ammonia salts, and a certain portion of it is regularly removed from the chamber and distilled with lime to recover the ammonia. This chamber is provided with water lutes, through which the tar condensed in it is from time to time removed. From this chamber the gases, which are now cooled down to about 100° C., and are loaded with a large amount of water-vapour, are passed through a scrubber filled with perforated bricks, in which the ammonia contained in the gases is absorbed by sulphuric acid. In this scrubber a fairly concentrated solution of sulphate of ammonia containing 36 to 38 per cent. is used, to which a small quantity of sulphuric acid is added, so that the liquid leaving the scrubber contains only 2.5 per cent. of free acid. This is necessary, as a liquid containing more acid would act upon the tarry matter and produce a very dark-coloured solution. The liquid running from the scrubber is passed through a separator in which the solution of sulphate of ammonia separates from the tar. The greater portion of the clear liquid is, after adding a fresh quantity of acid to it, pumped back through the scrubber. A certain portion of it is, after treatment with a small quantity of heavy tar-oils, which take the tarry matter dissolved in it out, evaporated in conical lead-lined pans furnished with lead steam coils, and which are kept constantly filled by the addition of fresh liquor until the whole mass is thick. This is then run out on a strainer

and yields, after draining and washing with a little water, a sulphate of ammonia of very fair quality, which finds a ready sale. The mother-liquor, which contains all the free acid, is pumped back to the scrubber. The gas on entering this scrubber contains only 0.13 volume per cent. of ammonia, and on leaving the scrubber it contains not more than one-tenth of this quantity. Its temperature has been reduced to 80° C., and is fully saturated with moisture, so that practically no condensation of water takes place in the scrubber. The gas is next passed through a second scrubber filled with perforated wood blocks. In this it meets with a current of cold water which condenses the steam, the water being thereby heated to about 78° C. In this scrubber the gas is cooled down to about 40°–50° C., and passes from it to the gas main leading to the various places where it is to be consumed. The hot water obtained in this second scrubber is passed through a vessel suitably constructed for separating the tar which is mixed with it, and is then pumped through a third scrubber, through which, in an opposite direction to the hot water, cold air is passed. This is forced by means of a Roots blower through the scrubber into the producer. The air gets heated to about 76° C. and saturated with moisture at that temperature by its contact with the hot water, and the water leaves this third scrubber cold enough to be pumped back through the second scrubber. The same quantity of water is thus constantly used for condensing the water-vapour in one scrubber and giving it up to the air in the other. In this way we recover and return to the producer fully two-thirds of the steam which has been originally introduced, so that we have to add to the air, which has thus been loaded with moisture, an additional quantity of steam equal to only one-third of the total quantity required before it enters the producer. This additional quantity of steam, which amounts to 0.6 ton of steam for every ton of fuel burnt, we obtain as exhaust steam from the engines driving the blowers and pumps required for working the plant.

The gas producers which I prefer to use are of rectangular shape, so that a number of them can be put into a row. They are 6 feet wide and 12 feet long inside. The air is introduced and the ashes removed at the two small sides of the producer which taper towards the middle and are closed at the bottom by a water-lute of sufficient depth for the pressure under which the air is forced in, equal to about 4 inches of water. The ashes are taken out from underneath the water, the producers having no grate or fire-bars at all. The air enters just above the level of the water through a pipe connected with the blower. These small sides of the producer rest upon cast-iron plates lined to a certain height with brickwork, and this brickwork is carried by horizontal cast-iron plates above the air entrance. In this way a chamber is formed of triangular shape, one side of which is closed by the ashes, and thus the air is distributed over the whole width of the producer.

The gas is taken out in the middle of the top of the producer by an iron pipe and fuel charged in by hoppers on both sides of this pipe. Between the pipe and the hoppers two hanging arches are put into the producers a certain distance down and the fuel is kept above the bottom level of these hanging arches. This compels the products of distillation, produced when fresh fuel is charged in, to pass through the incandescent fuel between the two hanging arches, whereby the tarry products are to a considerable extent converted into permanent gas, and the coal dust arising from the charging is kept back in the producer.

The details of construction of this plant will be easily understood by reference to the diagrams before you.

The fuel we use is a common kind of slack, and contains, on an average, 33.5 per cent. of volatile matter, including water, and 11.5 per cent. of ashes, leaving 55 per cent. of non-volatile carbon.

The cinders which we take out of the producer contain, on an average, 33 per cent. of carbon. Of this we recover about one-half by riddling or picking, which we return to the producer. The amount of unburnt carbon lost in the cinders is thus not more than 3 per cent. to 4 per cent. on the weight of fuel used.

The gas we obtain contains, in a dry state, on an average, 15 per cent. of carbonic acid, 10 per cent. of carbonic oxide, 23 per cent. of hydrogen, 3 per cent. of hydrocarbons, and 49 per cent. of nitrogen.

The calorific value of this gas is very nearly equal to 73 per cent. of the calorific value of the fuel used, but in using this gas for heating purposes, such as raising steam or making salt, we utilise the heat it can give very much better than in burning fuel, as we can completely burn it with almost the theoretical quantity of air, so that the products of combustion resulting do not contain more than 1 to 2 per cent. of free oxygen. Consequently the heat escaping into the chimney is very much less than when fuel is burnt direct, and we arrive at evaporating, by means of the gas, 85 per cent. of the water that we would evaporate by burning the fuel direct, in ordinary fire-places.

We have, however, to use a certain quantity of steam in the producers, and in evaporating the sulphate of ammonia liquors, which has to be deducted from the steam that can be raised by the gas in order to get at the quantity of available steam therefrom obtainable. The former amounts, as already stated, to 0.6 ton, the latter to 0.1 ton of steam per ton of fuel burnt, making a total of 0.7 ton. The gas obtained from one ton of fuel evaporates 5.8 tons of water in good steam boilers, working at a rate of evaporation of 50 to 55 tons per 24 hours under 90 lbs. pressure. Deducting from this the 0.7 ton necessary for working the plant, leaves an available amount of steam raised by the gas from one ton of fuel of 5.1 tons, equal to 75 per cent. of the steam that we can obtain from the same fuel by hand-firing.

In addition to the gas, we obtain about 3 per cent. of tar from the fuel. This tar is very thick, and of little commercial value. It contains only 4 per cent. of oils volatile below 200° C., and 38 per cent. of oils of a higher boiling point, consisting mostly of creosote oils very similar to those obtained from blast furnaces; and only small quantities of anthracene and paraffin wax.

I have made no attempts to utilise this tar except as fuel. It evaporates nearly twice as much water as its weight of coal, and we have thus to add its evaporative efficiency to that of the gas given above, leading to a total of about 80 per cent. of the evaporative efficiency of the fuel used in the producers. The loss involved in gasifying the fuel to recover the ammonia therefrom amounts thus to 20 per cent. of the fuel used. This means that, where we have now to burn 100 tons of fuel, we shall have to burn 125 tons in the producers in order to obtain ammonia equal to about half the nitrogen contained therein. Our actual yield of ammonia on a large scale amounting on an average to 32 kilos., equal to 70.6 lb. per ton of fuel, 125 tons of fuel will turn out 4 tons of sulphate of ammonia. We thus consume 6.25 tons of fuel for every ton of sulphate obtained, or nearly the same quantity as is used in producing a ton of caustic soda by the Le Blanc process—a product not more than half the value of ammonium sulphate. At present prices in Northwich this fuel represents a value of 35s. If we add to this the extra cost of labour over and above the cost of burning fuel in ordinary fire-places, the cost of sulphuric acid, bags, &c., we come to a total of 4*l.* 10*s.* to 5*l.* per ton of sulphate of ammonia, which at the present selling price of this article, say 12*l.* per ton, leaves, after a liberal allowance for wear and tear of plant, an ample margin of profit. With a rise in the price of fuel, this margin, however, rapidly decreases, and the working of the process will, of course, be much more expensive on a small scale, as will also be the cost of the plant, which under all circumstances is very considerable. The great advantages incidental to this process over and above the profit arising from the manufacture of sulphate of ammonia, viz., the absolute impossibility of producing smoke and the great regularity of the heating resulting from the use of gas, are therefore, as far as I can see for the present, only available for large consumers of cheap fuel.

We have tried many experiments to produce hydrochloric acid in the producers, with the hope of thereby increasing the yield of ammonia, as it is well known that ammonium chloride vapour, although it consists of a mixture of ammonia gas and hydrochloric acid gas, is not at all dissociated at temperatures at which the dissociation of ammonia alone has already taken place to a considerable extent.

I had also hoped that I might in this way produce the acid necessary to combine with the ammonia at very small cost. For this purpose we moistened the fuel used with concentrated brine, and also with the waste liquors from the ammonia-soda manufacture, consisting mainly of chloride of calcium; and we also introduced with the fuel balls made by mixing very concentrated chloride of calcium solution with clay, which allowed us to produce a larger quantity of hydrochloric acid in the producer than by the other methods. We did in this way succeed in producing hydrochloric acid sometimes less and sometimes more than was necessary to combine with the ammonia, but we did not succeed in producing with regularity the exact amount of acid necessary to neutralise the ammonia. When the ammonia was in excess we had therefore to use sulphuric acid as before to absorb this excess, and we were never certain that sometimes the hydrochloric acid might not be in excess, which would have necessitated to construct the whole plant so that it could have resisted the action of weak hydrochloric acid—a difficulty which I have not ventured to attack. The yield of ammonia was not in any case increased by the presence of the hydrochloric acid. This explains itself if we consider that there is only a very small amount of ammonia and hydrochloric acid diffused through a very large volume of other gases, so that the very peculiar protective action which the hydrochloric acid does exercise in retarding the dissociation of ammonia in ammonium chloride vapour, where an atom of ammonia is always in contact with an atom of hydrochloric acid, will be diminished almost to zero in such a dilute gas where the atoms of hydrochloric acid and ammonia will only rarely come into immediate contact with each other. When we burnt coke by a mixture of air and steam in presence of a large excess of hydrochloric acid, the yield of ammonia certainly was thereby considerably increased, but such a large excess cannot be used on an industrial scale. I have therefore for the present to rest satisfied with obtaining only half the nitrogen contained in the fuel in the form of ammonia.

The enormous consumption of fuel in this country—amounting to no less than 150 million tons per annum—would at this rate yield as much as five million tons of sulphate of ammonia a year, so that if only one-tenth of this fuel would be treated by the process, England alone could supply the whole of the nitrogenous compounds, sulphate of ammonia, and nitrate of soda at present consumed by the Old World. As the process is especially profitable for large consumers of fuel situated in districts where fuel is cheap, it seems to me particularly suitable to be adopted in this country. It promises to give England the privilege of supplying the Old World with this all-important fertiliser, and while yielding a fair profit to the invested capital and finding employment for a considerable number of men, to make us, last not least, independent of the New World for our supply of so indispensable a commodity.

Before leaving my subject, I will, if you will allow me, give you in a few words a description of two other inventions which have been the outcome of this research. While looking one day at the beautiful, almost colourless, flame of the producer gas burning under one of our boilers, it occurred to me that a gas so rich in hydrogen might be turned to better use, and that it might be possible to convert it direct into electricity by means of a gas battery.

You all know that Lord Justice Grove showed, now 50 years ago, that two strips of platinum partly immersed in dilute sulphuric acid, one of which is in contact with hydrogen and the other with oxygen, produce electricity. I will not detain you with the many and varied forms of gas batteries which Dr. Carl Langer (to whom I entrusted this investigation) has made and tried during the last four years, in order to arrive at the construction of a gas battery which would give a practical result, but I will call your attention to the battery before me on the table, which is the last result of our extended labours in this direction, and which we hope will mark a great step in advance in the economic production of electricity.

The distinguishing feature of this battery is that the electrolyte is not employed as a mobile liquid, but in a

quasi-solid form, and it is, therefore, named Dry-gas battery. It consists of a number of elements, which are formed of a porous diaphragm of a non-conducting material (in this instance plaster of Paris), which is impregnated with dilute sulphuric acid. Both sides of this diaphragm are covered with very fine platinum leaf perforated with very numerous small holes, and over this a thin film of platinum black. Both these coatings are in contact with frameworks of lead and antimony, insulated one from the other, which conduct the electricity to the poles of the battery.

A number of these elements are placed side by side, with non-conducting frames intervening, so as to form chambers through which the hydrogen gas is passed along one side of the element and air along the other.

This peculiar construction allows us to get a very large amount of duty from a very small amount of platinum. One of the batteries before you, consisting of seven elements, with a total effective surface of half a square metre, contains 2½ grms. of platinum leaf and 7 grms. of platinum black, a total of 9½ grms. of platinum, and produces a current of 2 amperes and 5 volts, or 10 watt, when the outer resistance is properly adjusted. This current is equal to nearly 50 per cent. of the total energy obtainable from the hydrogen absorbed in the battery.

In order to maintain a constant current, we have from time to time (say once an hour) to interchange the gases, so as to counteract the disturbing influence produced by the transport of the sulphuric acid from one side of the diaphragm to the other. This operation can easily be performed automatically by a commutator worked by a clock.

The water produced in the battery by the oxidation of the hydrogen is carried off by the inert gas mixed with the hydrogen, and by the air of which we use a certain excess for this purpose. This is important, as if the platinum black becomes wet, it loses its absorbing power for the gases almost completely and stops the work of the battery. To avoid this was in fact the great difficulty in designing a powerful gas battery, and all previous constructions which employed the electrolyte as a mobile liquid failed in consequence.

The results obtained by our battery are practically the same whether pure oxygen and hydrogen or air and gases containing 25 per cent. of hydrogen are used; but we found that the latter gases must be practically free from carbonic oxide and hydrocarbons, which both interfere very much with the absorbing power of the platinum black. We had thus to find a cheap method of eliminating these two gases from the producer gas, and converting them at the same time into their equivalent of hydrogen. The processes hitherto known for this purpose, viz., passing a mixture of such gases with steam over lime (which I mentioned some time ago) or over oxide of iron or manganese, require high temperatures which render them expensive, and the latter do not effect the reaction to a sufficient extent for our purpose.

We have succeeded in attaining our object at a temperature below that at which the gases leave my producers, viz., at 350° C. to 450° C., by passing the producer gases, still containing a considerable excess of steam, over metallic nickel or cobalt. These metals have the extraordinary property of decomposing almost completely, even at the low temperature named, carbonic oxide into carbon and carbonic acid and hydrocarbons into carbon and hydrogen.

In order to carry the process out with small quantities of nickel and cobalt, we impregnate pumice stone or similar material with a salt of nickel or cobalt, and reduce this by means of hydrogen or producer gas. These pieces of pumice stone are filled into a retort or chamber and the hot gases passed through them. As the reaction produces heat it is not necessary to heat the chambers or retorts from the outside when the necessary temperature has once been attained. This process has not yet been carried out on a large scale, but the laboratory experiments have been so satisfactory that we have no doubt as to its complete success. It will enable us to obtain gases containing 36 per cent. to 40 per cent. of hydrogen and practically free from carbonic oxide and hydrocarbons from producer gas at a very small cost, and thus to make the latter suitable for the production of electricity by our gas battery. We obtain, as stated before

50 per cent. of the energy in the hydrogen absorbed in the battery in the form of electricity, while, if the same gas was consumed under steam boilers to make steam, which, as I have shown before, could in this way be raised cheaper than by burning fuel direct, and if this steam was turned into motive-power by first-rate steam engines, and the motive power converted into electricity by a dynamo, the yield of electricity would in the most favourable case not exceed 8 per cent. of the energy in the gas. I hope that this kind of battery will one day enable us to perform chemical operations by electricity on the largest scale, and to press this potent power into the service of the chemical industries.

The statement is frequently made that "Necessity is the mother of invention." If this has been the case in the past I think it is no longer so in our days, since science has made us acquainted with the correlation of forces, teaching us what amount of energy we utilise and how much we waste in our various methods for attaining certain objects, and indicating to us where and in what direction and how far improvement is possible; and since the increase in our knowledge of the properties of matter enables us to form an opinion beforehand as to the substances we have available for obtaining a desired result. We can now foresee, in most cases, in what direction progress in technology will move, and, in consequence, the inventor is now frequently in advance of the wants of his time. He may even create new wants, to my mind a distinct step in the development of human culture. It can then no longer be stated that "Necessity is the mother of invention;" but I think it may truly be said that the steady methodical investigation of natural phenomena is the father of industrial progress.

SIR LOWTHIAN BELL, Bart., F.R.S., in moving a vote of thanks, said that the meeting had had the privilege of listening to a description of results obtained by a man of exceptional intelligence and learning supplemented by that devotion of mind which qualified him to pursue his work with great energy and perseverance. The importance of the President's address could not possibly be over-rated. At various periods different substances had been put forward as indications of the civilisation of the people. He remembered hearing from Dr. Ure that he considered the consumption of sulphuric acid to be the most accurate measure of the civilisation of a people. In course of time sulphuric acid gave way to soap, the consumption of which was probably still regarded as the great exponent of civilisation by such of his fellow-citizens as had thereby made their name. From what he had heard that morning, however, he should be inclined to make soap yield to ammonia, as sulphuric acid had in its time succumbed to soap. For not only was ammonia of great importance to us as a manufacturing nation, but it almost appeared to be a condition of our existence. England had a large population concentrated on an area so small as to make it almost a matter of apprehension whether the surface could maintain the people upon it. We were now importing almost as much food as we consumed, and were thus more and more dependent on the foreigner. Under certain conditions this would become a very serious matter, and thus any one who showed how to produce plenty of ammonia at a cheap rate was a benefactor to his country. Mr. Mond's process seemed to come nearer to success than any which had preceded it, and it needed no words from him to induce the meeting to accord a hearty vote of thanks to the President for his admirable paper.

MR. J. C. STEVENSON, M.P., in seconding the motion, said that no paper could be more interesting and valuable to the Society than that just delivered by the President. It opened out a future for the advancement of chemical industry, which almost overcame one by the greatness of its possibilities. Mr. Mond had performed an invaluable service by investigating the various methods proposed for the manufacture of ammonia, and clearing the decks of those processes supposed by their inventors to be valuable but proved by him to be delusive. It gave him hearty pleasure therefore to second the vote of thanks proposed by Sir Lowthian Bell.

The vote having been put and carried by acclamation, after a brief reply from the President:

The SECRETARY read the report of the scrutators, which showed that 158 ballot papers had been sent in, 154 voting for the proposed list intact, and four substituting other names. The gentlemen nominated in the list issued by the Council were therefore declared elected.

The following is a list of the Council for 1889—90.

President.

Sir Lowthian Bell, Bart., F.R.S.

Vice-Presidents.

R. Forbes Carpenter.	S. H. Johnson.
Prof. F. Clowes, D.Sc.	Ludwig Mond.
Sir J. Neilson Cuthbertson.	Dr. Hugo Müller, F.R.S.
Prof. James Dewar, F.R.S.	Dr. W. H. Perkin, F.R.S.
Jas. Duncan.	Dr. Edw. Schunck, F.R.S.
Dr. John Evans, F.R.S.	Prof. W. A. Tilden, F.R.S.

Members of Council.

L. Archbutt.	B. E. R. Newlands.
S. B. Boulton.	Jno. Pattinson.
Jno. Brook.	Jno. Spiller.
Jno. Calderwood.	E. C. C. Stanford.
Alexander M. Chance.	J. C. Stevenson, M.P.
A. E. Fletcher.	A. Norman Tate.

Treasurer.

E. Rider Cook.

Foreign Secretary.

Dr. Ferdinand Huerter.

The PRESIDENT moved a vote of thanks to the managers of the Royal Institution for their kindness in permitting the Society to meet in that renowned and historic place, and which he hoped would be a good augury for the success of the business still before them. In proposing this vote, he wished particularly to express thanks to his friend, Professor Dewar, to whom the Society was indebted for the invitation.

DR. W. H. PERKIN, F.R.S., seconded the resolution, which was carried by acclamation.

The PRESIDENT then proposed a vote of thanks to the officers of the Society, the officers of Sections, and the Editor and staff of the Journal. It was, he said, quite unnecessary for him to speak to members of the Society of the merits of those gentlemen. Month by month the results of their labours came before the members, who, he hoped, made it their duty to go carefully through the Journal and make those results their own.

MR. DAVID HOWARD had great pleasure in seconding the proposal. He had watched very carefully the working of the Society during the past year, and was, therefore, in a position to know how much it owed to its officers. The effective power of a great machine was in proportion to the absence of friction, and, happily for the Society of Chemical Industry, there had been so little friction in its working that there was but little palpable evidence of the force exerted. That force was exerted in the right direction, and the success of the Society must be the measure of the skill of its officers, and not the noise made in the process.

This concluded the business of the meeting, but before separating, advantage was taken of the opportunity afforded for inspecting the laboratories, physical and chemical, and the historic collection of apparatus belonging to the Institution, under the guidance of Professor Dewar's assistants, Mr. R. N. Lennox and Mr. J. W. Heath.

VISIT TO MESSRS. DOULTON'S LAMBETH POTTERY.

About 230 members then made their way to Messrs. Doulton's art pottery on the Albert embankment, and, by invitation of Sir Henry Doulton, partook of luncheon. This was served in the dining rooms ordinarily set apart for the use of the artists. Ranged along the walls were cases

containing historical collections of the Lambeth Pottery Japan productions, with a small but choice selection of Japanese, French, Italian, and other foreign specimens of ceramic ware.

Meanwhile a select company was entertained by Sir Henry Doulton in his own room. In reply to a vote of thanks proposed by the President, Mr. Ludwig Mond, and received with enthusiasm, Sir Henry Doulton made some interesting statements with regard to his staff of artists and designers, and the educational course by means of which the firm obtained their supply of artistic talent. He said, that whatever might be alleged as to the need of imported talent from abroad for other purposes, he had found no such necessity in his department. His supplies of artists and designers came from the locality, and he had never regretted the day when he succeeded in securing the co-operation of the Lambeth School of Art. He had found to his surprise plenty of artistic talent in Lambeth, and he believed that the nation generally only needed development by a proper system of education to afford artists and designers in abundance. He thought that every child should learn drawing in order to secure that concert of hand and eye which was the basis of all art-work; but beyond this there still remained a rarer and higher gift, viz., that imaginative and creative faculty known as genius, which differed as much from educated mediocrity as did the well-spring from the pool. That too—as they would see for themselves—was to be had in Lambeth.

From the luncheon rooms parties of members, conducted by Sir Henry Doulton, Messrs. H. L. and J. Doulton, Mr. W. P. Rix, and the managers of departments, started at short intervals to inspect the processes carried on in the studios and works. Only a comparatively small portion of the premises were seen on this occasion; time would not permit more than a tithe of the somewhat scattered series of buildings that constitute the Lambeth pottery to be seen. The works cover some seven or eight acres of ground, and over 1,600 persons are now employed. Commencing on the ground floor with the department devoted to the rapid and almost automatic production by machinery of the humble but useful drain pipes, which are still the staple production of the firm, the visitors viewed with interest the process of "throwing" and "lathing," the building up of large chemical vessels and condensing worms, the fitting together of stoneware taps, and machine presses for the production of chemical pipes and bends. Huge flagons, bottles of all sizes, and delicate vases were seen to be formed at the various "wheels" from the same raw material and with the same rapidity and precision. From this it was but a step to the clean and well-lighted studios where the art pottery is decorated. Here the novel methods—many of them quite distinctive and peculiar to the Doulton pottery—excited much comment and admiration. The studios each contain from 10 to 30 intelligent young girls under the superintendence of a skilled forewoman. Next were reached the special rooms of those artists who have by their genius contributed so largely to the success of the firm they serve. The Misses Hannah and Florence Barlow were found etching direct on the soft clay examples of animal, bird, and plant life, Miss Hannah Barlow giving a proof of her wide knowledge of the brute creation by making some spirited impromptu etchings on a vase taken up at random. Mr. John Eyre and Mr. McLennan (painters) entertained their visitors with some fine studies of tile and panel decoration, and imparted much valuable information on the principles of art as applied to their particular industry. Mr. Marshall and Mr. Butler (designers and carvers), Miss Florence Lewis, Miss Kate Rogers, and Miss Butterson (painters of faience), and others whose names are familiar in the artistic world, were also visited; but the culminating event was a chat with Mr. George Tinworth, and an inspection of the two historical works now being modelled by him.

After viewing the studios there were the show-rooms to visit, where in addition to the large display of art-wares, a few chemical exhibits had been arranged, comprising an improved stoneware acid force-pump of six inches bore, large acid proof-cocks of the same dimensions, worms and acid pipes in stoneware, and an enormous receiver of the

same material in one piece. Here also were arranged beautiful examples of "faience," "impasto," "Silicon," and, latest production of all, "Carrara" ware. But even here the *pièce de résistance* was Mr. Tinworth's great work in clay, "Christ brought before Herod," which elicited general admiration.

VISIT TO LAMBETH PALACE.

Meanwhile, members were assembling at the gate of Lambeth Palace, the town residence of the Archbishop of Canterbury, where they were received by Mr. Mandeville B. Phillips, his Grace's private secretary. From the Gate Tower, a huge building erected by Cardinal Morton in the reign of Henry VII., visitors were conducted to the Lollards' Tower, one of the oldest parts of the building, in an upper chamber of which Sir John Oldcastle is believed to have been imprisoned. The plank walls were covered with devout inscriptions, and still showed the rings to which prisoners were chained. In the corner was the "oubliette," now closed, which tradition states to have been the mode of egress for the bodies of many victims of religious persecution. In early days this tower was nearly surrounded by water, and it is quite possible that the cellars at the base were open to the tide. At any rate, during the Commonwealth it was from this tower that the Rev. Guy Carlton let himself down by a rope, while his wife waited below in a boat. The rope proving too short, the priest had to drop, and in so doing he broke his leg. But he managed, nevertheless, to scramble into the boat, and escape to the Continent. On the Restoration he was rewarded for his devotion and pluck with a bishopric.

From the top of the Lollards' Tower is obtained a splendid view of London and the river, with the gardens and park of the palace in the foreground. In this park thousands of poor children come to play; and the boon to the poor and crowded neighbourhood which it affords is almost incalculable.

In the chapel, an early English structure, restored and embellished early in this century, the Rev. St. Clair Donaldson, one of the Archbishop's chaplains, explained that the windows, which were somewhat archaic in character, were the third set in succession made from the same design, the two previous ones having been destroyed in popular commotions. All three sets were practically alike, and were derived from a series of prints in a "block book" now preserved in the British Museum. The remains of Archbishop Parker, after enduring many vicissitudes, at length have found a resting-place here. In an adjoining room, now used as a vestry, Cranmer composed much of the English Church Service.

Passing through the dining-room, a noble apartment, on the walls of which were a chronological series of portraits of the Archbishops of Canterbury, beginning with Cranmer and Laud, and ending with Tait, the party reached the library, where, under the guidance of the librarian, Mr. S. M. Kershaw, F.S.A., they could inspect at their leisure the fine prints and works on its tables and shelves. This library was erected on the site of the old hall, pulled down during the Commonwealth, by Archbishop Juxon, who is supposed to have had some assistance from Wren. It is a curious compound of Classic and Gothic work, and has a fine oak roof.

CONVERSAZIONE.

At 9 o'clock the President and Mrs. Mond held a reception at the Grosvenor Gallery, which was attended by about 900 ladies and gentlemen. Invitations had been issued to all members of the Society of Chemical Industry, the Fellows of the Chemical Society and the Institute of Chemistry residing in or near the metropolis, and to the Councils of the Royal Society, the Royal Institution, the Institution of Civil Engineers, the Pharmaceutical Society, and other learned bodies. Among those present were:—Dr. W. J. Russell, F.R.S., President of the Chemical Society, and Miss Russell, Sir Lowthian Bell, Bart., F.R.S., and party, Mr. J. C. Stevenson, M.P., Mrs. Stevenson, and party, Professor A. R. and Mrs. Leeds, Dr. P. F. and Mrs. Frankland, Dr. J. H. Gladstone, F.R.S., and Miss Gladstone, Mr. and

Mrs. E. K. Muspratt, Mr. C. Spagnoletti, Professor W. Grylls Adams, F.R.S., Dr. and Mrs. Karl Blind, Mr. and Miss Mansergh, Dr. John Evans, F.R.S., and party, Mr. Kenrick B. Murray, Mr. Charles Cochrane, President of the Institution of Mechanical Engineers, Dr. H. Sprengel, F.R.S., Dr. Hugo Müller, F.R.S., Sir Julian Danvers, Maj.-Gen. J. F. D. Donnelly, Sir John Coode, G.C.M.G., President of the Institution of Civil Engineers, Professor S. B. Newbury, Professor W. A. Tilden, F.R.S., Professor W. Dittmar, F.R.S., Professor Dewar, F.R.S., and Mrs. Dewar, Dr. James Bell, C.B., F.R.S., President of the Institute of Chemistry, Professor Ferguson, Glasgow University, M. F. H. Gossage, Dr. P. R. Japp, F.R.S., Mr. W. Lant Carpenter and Mrs. Carpenter, Mr. A. Norman Tate and Miss Tate, Mr. A. E. Fletcher and Mrs. Fletcher, Mr. and Mrs. J. Spiller, Dr. Thos. Stevenson, Mr. C. E. Groves, F.R.S., Mr. and Mrs. Percy C. Gilchrist, Mr. and Mrs. A. H. Allen, Dr. H. E. Armstrong, F.R.S., and Mrs. Armstrong, Mr. B. E. R. Newlands, Sir Philip Magnus, Professor Meldola, F.R.S., and Mrs. Meldola, Mr. E. C. C. Stanford, Professor F. Clowes, D.Sc., Mr. Ivan Levinstein, Mr. S. B. Boulton, Dr. D. B. Hewitt, Mr. Calderwood, Mr. P. J. Worsley, Mr. John Brock, Mr. Alex. M. Chance, Mr. Eustace Carey, Mr. Jas. Duncan, Mr. S. H. Johnson and Mrs. Johnson, Mr. and Mrs. Swan, Professor Carey Foster, F.R.S., and Mrs. Foster, Dr. C. R. Alder Wright, F.R.S., and Mrs. Wright, Professor Marshall Ward, Mr. William Anderson and party, Colonel Gamble and party, Mr. D. Howard and party, Mr. and Mrs. Charles Hawksley, Sir James N. Douglas, Professor Hughes, F.R.S., Dr. W. H. Perkin, F.R.S., and party, Mr. Francis Galton, Mr. J. T. Brunner, M.P., Mrs. Brunner, and party, and numerous others.

The Prince's band, conducted by Messrs. F. R. Kinke and A. W. Cornish, performed at intervals during the evening, and the Misses Thomas gave a fine rendering upon the piano of Grieg's "Norwegian Dances" and Moszkowski's "Poland" and "German Round," the last of which was especially admired. Miss Adelaide Thomas, A.R.C.M., also gave Chopin's "Barearolle" and a "Tarantella" by Nicodé in her well-known artistic style. By 10 o'clock the rooms were so thoroughly filled that some considerable perseverance was necessary to enable the guests to examine in detail the fine collection of modern art displayed around the walls. The approaches and corridors were tastefully decorated with palms and exotics, and, thanks to the electric light, at no time during the evening was the atmosphere oppressive. The refreshments and general arrangements left nothing to be desired. The company separated shortly before midnight.

SECOND DAY.

On Thursday, July 11th, about 250 members availed themselves of a special steamer which had been provided, and proceeded up the River Thames to the Manbré Saccharine Co.'s works at Hammersmith. Here they were received by the manager, Mr. E. G. Francis, Dr. Bechler, Dr. Burnand, and Mr. C. C. Hutchinson, who escorted them round the works. The principal manufactures of this firm are invert sugar made from cane sugar, and brewers' saccharine or glucose, made from sago flour and other amylaceous substances.

After the inspection, the members partook of lunch, provided by the firm, and at the close of the proceedings a hearty vote of thanks to the Directors and Staff was proposed by Mr. David Howard, and received with enthusiasm.

The party then re-embarked and proceeded to—

THE ROYAL GARDENS, KEW.

In the absence of the Director, the members were received by the Assistant Director (Mr. D. Morris). The party was divided into groups, and under the guidance of Mr. J. R. Jackson (Curator of the Museums) and Mr. George Nicholson (Curator of the Gardens) visited the several

Museums, the Palm House, the collection of economic plants, Miss North's Gallery of Drawings, and the Arboretum with its fine collections of New and Old World species of trees.

At this point the President joined the party, which soon after divided, some proceeding to the Star and Garter by road, while others returned to the steamer to continue their journey by river. After leaving Brentford, whose well-known gas-works were concealed by a leafy eyot, Sion House, with its famous lion, and the old-fashioned town of Isleworth were passed, and later on a glimpse was obtained of the Royal Observatory in the Old Deer Park. All were much struck by the beauty of the landscape, enhanced as it was by most brilliant weather. Richmond was soon reached, and the members found their way in groups, by way of the gardens and terrace, to the "Star and Garter."

THE ANNUAL DINNER.

In the evening about 200 of the members and their friends dined together in the new ball-room of the Star and Garter Hotel, Richmond. The President, Mr. Ludwig Mond, was in the chair, supported, on the right, by Sir John Coode, K.C.M.G., President of the Institution of Civil Engineers, and, on the left, by Professor Dewar, F.R.S. The guests and visitors included the following:—Dr. James Bell, C.B., F.R.S., President of the Institute of Chemistry; Mr. Charles Cochrane, President of the Institution of Mechanical Engineers; Professor Leeds, President of the Stevens Institute of Technology at Hoboken, U.S.A.; Professor Spencer Newbury, of Cornell University, Chief of the American Commission to the Paris Exhibition; the Hon. W. Massey-Mainwaring, Chairman of the Native Guano Company; Lieut.-Colonel and Alderman Cowan; Mr. D. Morris, Assistant Director of the Royal Gardens at Kew; Mr. Henry Sharp and Mr. E. B. Ellice-Clark, Directors of Brin's Oxygen Company; Mr. W. P. Rix, of Messrs. Doulton and Co.; Mr. E. Garcke, Manager of the Brush Electrical Engineering Company, Limited; Mr. J. T. Brunner, M.P.; Mr. E. Rider Cook, Hon. Treasurer; Mr. David Howard, Chairman of the London Section; Mr. Alexander M. Chance; Mr. E. K. Muspratt; Mr. E. C. C. Stanford; Mr. John Pattinson; Professor Dittmar, F.R.S., of Anderson's College, Glasgow; and Professor J. Campbell Brown, of University College, Liverpool.

Grace having been said by the Rev. F. Relton, the company sat down to an excellent dinner.

After dinner the proceedings opened with a performance on the piano of Wallace's "Grand Polka de Concert" by Mr. F. E. Choveaux.

In proposing the first toast of the evening, "The Queen and Royal Family," the PRESIDENT said that during Her Majesty's long and happy reign the progress of science and of its applications had been even more remarkable than the progress of wealth and general culture. The Royal family, and foremost amongst them the Prince of Wales, had always followed the illustrious example of their father in appreciating and doing all in their power for the advancement of science and of the arts and manufactures of the country.

The toast having been received in the usual loyal manner, Mr. Arthur Thomas sang in excellent style "On the Zuyder Zee," and, being encored, gave the Jodel song from "Rip van Winkle."

Mr. E. RIDER COOK who, in the unavoidable absence of the President elect, proposed the toast of "The Society of Chemical Industry," said he was unexpectedly called upon to fill a position of honour but one of exceptional difficulty. He could hardly imagine an English audience more difficult to address than the Society of Chemical Industry. They were nearly all commercial men having all the acuteness engendered by the competition of the times, and, in addition, sufficient knowledge of science to distinguish real grit from anything like froth. But obedience was one of the best characteristics of Englishmen, and Mr. Tyrer was a tyrant who was willingly obeyed because he set an example of

heartily and thorough work in behalf of the Society. That must be his apology for venturing to undertake the toast of the Society of Chemical Industry, with which he would couple the name of its respected President. The Society was a comparatively new one, but it had already made its mark on the commerce of England, and had, he believed, now entered upon a course of prosperity which would enable it in the early future to deepen that impression. What were their objects in starting the Society? If he understood them rightly, one of the main objects was to substitute in the various chemical industries scientific exactness for the old rule of thumb. They wanted in this great manufacturing country to do away with the phrase "near enough." That was a phrase which he hated to hear in the factory. To his mind the only thing near enough was the exact thing wanted; and one object of the Society was to teach manufacturers to make up their minds what they wanted in their works and then to insist on having the real thing and no substitute. Another aim of the founders of the Society was to help one another as far as possible without injuring themselves. He believed that it was quite possible for even keen competitors in business to do that to a considerable extent. The little things that they could thus learn of one another's methods were helpful in saving trade expenses but did not affect the special knowledge which each man had in his own business. Another very laudable object was to enable English manufacturers to hold their own in the great contest of nation with nation. Some people thought that other nations, by means of a higher national education than England had ever attempted, were giving their workmen, foremen, and heads of departments advantages which Englishmen did not possess; and, in their own quiet way, with no political aims whatever, the founders of the Society had done what they could to compensate for the disadvantages of our national educational system. They were persevering in that course still; and though they would hail with pleasure anything that the Imperial Parliament might do in fulfilment of its duties, they would continue to do their best to make up the deficiency. He would be sorry to stop there, for the aim of the Society was not only that its members and English manufacturers generally should hold their own amongst the nations, but that by their Journal and their communications with other countries they should help forward the great progress of humanity at large, in the production of the necessities and luxuries of life with the least possible expenditure of labour and money, and thus enable every man to better enjoy his existence. These were some of the objects of that Society to which he asked his audience as patriotic Englishmen to join with him in wishing success. But he had to associate with the toast the name of their President, Mr. Mond. Mr. Mond was known all the world over as one of those fortunate men who had been very successful in business; but those who had had the advantage of hearing the address which he had given at the Annual Meeting, would agree with him that "fortunate" was not the word to use; for Mr. Mond had deserved the success which he had attained. In listening to his able description of all the attempts to manufacture ammonia from its different sources they had felt that his success had been attained not by luck but by hard work, and by bringing his powerful mind and keen intellect to bear upon the work in the best possible way. That address had taught them that commercial success could only be achieved in one way—by understanding thoroughly what one was dealing with, and then industriously pegging away until one arrived at the best possible way of dealing with it. To him, that paper was not only interesting on account of the matters it actually brought before him, but it had a charm in the visions it suggested of what might be in the future. He had been accustomed to regard the gases from furnaces as noxious bodies to be got rid of as far as possible. But when he heard the description of Mr. Mond's new battery, and was told that the gases coming from the producer were to be the means of evolving electricity at a cost compared with that obtained by the mechanical power of a steam engine or the ordinary electrical machines of 8 to 50, he was lost in wonder as to the possible developments of this new power. There was no limit to the field of research and energy before them. Young men were there, and he would

advise them to follow the example of the President as shown in his address. They knew not what discoveries were before them in the future, allowing men to be relieved from toilsome labour and permitting the necessities of life to be produced so readily as to give even ordinary labourers time not only for recreation but for the improvement of their intellects. He therefore gave as a toast worthy of their hearty reception, Prosperity to the Society of Chemical Industry, and long life, happiness, and health to its President, Mr. Mond.

The PRESIDENT, in reply, said that he thanked the company most heartily for the way in which they had received the toast of the Society, and still more for their hearty reception of Mr. Rider Cook's very kind remarks with respect to himself. He had been connected with the Society from the very beginning, and had done the best he could for it—however little that might be—and he frankly admitted that he felt very proud of the Society. During the comparatively few years of its existence it had achieved something, and there was every indication that it would achieve more, if only the younger members would follow the example and work upon the lines laid down by the founders of the Society. He saw around him a number of gentlemen who had filled the post of President before him, and all of whom had done a great deal more than perhaps the general body of members knew towards the success the Society had attained. If the younger members would go into the work with the same amount of enthusiasm, with the same understanding of the high aims before them, and of the necessity for working together to assist, as Mr. Rider Cook had well said, in the progress of the application of science to the industrial arts, not only in the interest of one country but in the interests of humanity, the Society would continue in its successful career, and its work would be blessed for a great number of years to come. Mr. Rider Cook had referred in very kind and gratifying words to the work which he had done and to the address which he had had the pleasure of delivering. He could only say that if he had been successful it was due to the earnestness and perseverance with which he had applied the knowledge that he owed to others to the task of solving some of the problems of industrial science. He would be proud, indeed, if he had succeeded in showing the younger members of the Society the way in which the solution of such problems should be attempted.

Then followed a trio for flute, violin, and piano, by Messrs. Remart, Smith, and Choveaux.

On rising to propose the next toast, that of "The Learned Societies," the PRESIDENT said that he felt that he was taking the place of a much better man, but he had just received a telegram from Sir Henry Roscoe, expressing his deep regret that important parliamentary duties prevented him from being present. He also must express his great regret that Sir Henry was absent, because he was quite unprepared for it and did not feel equal to the task of taking his place and proposing so important a toast. He was in a special difficulty about this toast, because he was not clear what "the Learned Societies" meant. Did it include the Society he was addressing? He hoped so; because it had been the earnest desire of himself and of all who had assisted in its formation that it should be a learned Society. He was not sure either whether the term included such societies as the Civil Engineers and the Mechanical Engineers, both of which he personally considered came within its meaning. At any rate, on the present occasion he proposed to assume that the term included all societies whose object was to apply learning to the benefit of humanity. He ran no risk of error in stating that the Society of Chemical Industry believed that all industrial progress must be based upon the application of scientific knowledge, and that any attempt on the part of manufacturers to get on without a sound groundwork of science must be abortive. He therefore had great pleasure in proposing this toast, coupling it with the names of Professor Dewar—their excellent friend and a most worthy representative of the Universities, and of he did not know how many learned societies; certainly the representative of the Royal Institution, by whose benevolence they had been enabled to hold their meeting under such auspicious circumstances—and of Dr. James Bell, who, as President of the

Institute of Chemistry, was an eminent representative of that science with which they were most closely connected.

Professor DEWAR, in responding, said that he thoroughly appreciated the high compliment which the President had paid him in associating his name with the learned societies. He deeply regretted that his friend Sir Frederick Bramwell was unable to be present, because he would have been a much fitter man to reply to that toast, especially as the President had referred to the use of the Royal Institution, of which Sir Frederick was the Honorary Secretary. The rooms of the Royal Institution had been granted as generously and heartily as he had expected. He could only say to those who were connected with the chemical side of abstract science and not with the Society of Chemical Industry (if there were any such), that the sooner they got into it the better. He said so because he hoped that the partnership between abstract and applied science which formed the foundations of the Society would continue as firmly in the future as in the past. It was of the utmost importance to each that that alliance should continue to exist in the closest possible manner. So far, the Society of Chemical Industry had behaved in the most generous manner to abstract science, as the list of its past Presidents proved, including, as it did, the names of Sir Henry Roscoe, Sir Frederick Abel and Dr. Perkin. It was clear therefore that the Society recognised the necessity of that union, which he trusted would long continue. In the interests of that alliance he hoped that the Society's Journal would not be too strictly confined to applied chemistry, but that it would continue to include that necessary amount of abstract knowledge which was the spirit and essence of the times. He admitted that what he was advocating tended to make the editorial duties extremely onerous; still he hoped that under the new arrangements with respect to the Editor it would be found possible to maintain that generous infusion of abstract knowledge into the Journal which he held to be necessary in the interests of the broad culture of the Society. It happened that there were among them that night representatives of abstract science from the United States as well as those of their own country. He was sure that the Society of Chemical Industry would cordially welcome Dr. Leeds and Dr. Newbury. Dr. Leeds had been to England before, and was well-known to Englishmen by his original work in both abstract and applied science; and of Dr. Newbury he need say no more than that he had come over to represent the Government of the United States at the great Paris Exhibition. He hoped that both gentlemen would take back with them to the United States a pleasant recollection of their reception by that Society. True, their American friends had a Society of the same sort at home; but he knew their love of the parent country was so great that they would not neglect the opportunity of becoming members of the Society of Chemical Industry. There were many other points which he might touch upon if time permitted; but as a matter of fact he had been led to expect that the only duty he would probably be called upon as a past President to discharge at the London meeting would be that of presiding at some musical and artistic entertainment to be given by the members and their friends. There were some who seemed to think that an office of that character suited him better than replying for learned societies. That was a point which they could decide for themselves on the occasion of the At Home of the Society on the morrow evening. At any rate, he trusted that the concert would prove to be so good as not to be considered out of place as an addendum to that evening's dinner.

Dr. JAS. BELL expressed profound regret at the absence of Sir Frederick Bramwell. He felt certain it would have been highly interesting to have heard Sir Frederick describe a few typical instances of the marvellous improvements effected by civil and mechanical engineers towards minimising labour, and diminishing the cost of production. It had been pointed out by one speaker that in competing successfully with other nations, it was not sufficient to merely obtain approximate results in manufacturing processes, but that it was absolutely necessary to obtain exact results. Manufacturers could not be too strongly impressed with the fact that the old rule-of-thumb methods had now

no chance in the industrial competitive race among nations, and that successful managers of works nowadays must be men possessed of sound scientific knowledge, and well grounded in theoretical and practical chemistry. The man who was not so qualified would unequivocally fail to exercise an intelligent control over chemical manufacturing operations, and be unable to successfully discover the causes of abnormal results. Great difficulty had hitherto existed in distinguishing between the qualified and the unqualified chemist; there was no definition of a chemist, and there was no authorised licensing body to guarantee the qualifications of a man calling himself a chemist. With the view of supplying this want, an important step had been taken by the incorporation of the Institute of Chemistry of Great Britain and Ireland, and a Fellow of that body might now be assumed to have passed through a proper and systematic course of training in theoretical and practical chemistry, and to be qualified to undertake chemical work. The Institute of Chemistry, by undertaking to guarantee the qualifications of a professional chemist, had an important bearing upon the manufacturing industries of the country; and to the Society of Chemical Industry was of especial interest and importance, from the influence which it was likely to exercise in encouraging a sound education in theoretical and practical chemistry. In conclusion, he heartily joined Professor Dewar in thanking the company for so cordially drinking to the toast of the Learned Societies.

Then followed Germain's "Bolero" admirably played on the violin by Mr. T. Harry Smith.

Mr. DAVID HOWARD, in proposing "Our Guests," said that he entirely lacked that sense of antagonism which had so strong a hold upon some orators in speaking, since in his case "our guests" were not strangers. There was a time when chemists looked upon chemistry as a self-satisfying atom; later on they came to think of it as a dyad, satisfied with the kindred sciences of heat and electricity. But they had learned better since, and now regarded it as what he might call a polyad, having an infinite number of unsatisfied affinities; in fact, they now knew that there was no science employed in the industries which was alien to their own science of chemistry. He had the honour of coupling with the toast the name of Sir John Coode, a name of the highest eminence in the great profession to which he belonged. The two sciences were intimately allied, for engineers were dependent on chemistry for the manufacture and testing of the materials they employed and relied on. He had also to couple with the toast the name of Lieut.-Colonel Cowan, eminent in the material use of scientific processes; and likewise the names of their guests from America, from whom Englishmen were separated neither by race, language, nor sympathies, and who therefore could not be regarded as strangers. Engineers might not call themselves chemists—though many of them were chemists in a measure—but they pursued the same objects as the members of that Society, profited by each other's labours and studies, and were linked together in that great whole—the industry of the civilised world.

Sir JOHN COODE said that he could quite agree with the remark made with such emphasis by Mr. Rider Cook, that there was no more diffident body of men to address than the Society of Chemical Industry. Bearing that remark in mind, he felt himself to be in a somewhat appalling position in being called upon to respond to the toast just given. However, he did respond to it with gratitude, because he felt that it was no light matter to be invited down to a beautiful spot like Richmond and entertained in the manner in which he and his fellow-guests had been. That was the least he could say, but even if he said much more he should still fail to convey all that he felt. He heartily endorsed what Mr. Howard had said with respect to the connection between the Society he was addressing and civil engineers. He as an engineer knew how very much they owed to chemical science. He was pleased to learn that the Society numbered so many members; it was little more than an infant in point of age, but a growing and prosperous infant, and one which he trusted would progress in the future even more than in the past. He was glad to hear Professor Dewar's

remarks about the Society's Journal, which he hoped to be able to look into occasionally and learn a great deal therefrom. On behalf of the visitors and for himself, he begged to return heartfelt thanks for the kind manner in which they had been received and entertained by the Society.

Lieut.-Col. and Alderman Coway was deeply gratified by the kind way in which his name had been received. This was the last occasion on which he would have the honour of being with the Society as a guest, for the Secretary had just informed him that the additional honour of being elected a member of the Society had been conferred upon him; therefore, although he hoped to be present at many similar gatherings of the Society in future, it would necessarily be in a different capacity. Many of the previous speakers had referred to the learned societies and to the progress of science. For his own part, he had always felt that the advancement of art, of manufactures, and of commerce must be limited by the power of the country to take advantage of the applications of science. He was old enough to recollect the manufactures of 30 years ago, and had kept some reminders of his own particular industry. To look at those objects had much the same effect on him as an inspection of the Ark might be expected to produce on a modern shipbuilder. Might we then take a suggestion from that, and think what the historian of the future would say of the manufactures of the present day. He hoped, and felt, it would be something to this effect:—In the year 1889 we saw England as of old in keen competition with the entire world. Her great natural powers of which she had always been so justly proud still stood her in good stead, but side by side with these she had enlisted a new ally, and science was made to march in the van abreast with industry. Science and erudition were no longer hidden mysteries, but were to be seen broadcast in the land, adding by their beneficent influence to the progress and greatness of the country. It was thus that England, no longer relying on the sword, but confident in her new alliance, was able to challenge all comers, and to emerge with success and triumph from the competition. He thanked them for the honour done to him that evening, for the honour of being elected one of their body, and for the honour conveyed by their proposed visit to his works on the following day.

The President said he could not suffer the company to leave without asking it to drink the health of the Secretary of the London Section of the Society, their friend Mr. Tyrer, to whom they were all indebted in the highest degree for that very pleasant and successful meeting.

The toast having been enthusiastically pledged with full honours, Mr. T. TYRER said that at that late hour it would ill become him to do more than thank the President and the company sincerely for the kind manner in which his health had been proposed and received. A large number of gentlemen had contributed to the success of the meeting, and their names appeared on the programme; but in the performance of the responsible duties of Honorary Secretary of the London Section of the Society he had had the able assistance of two gentlemen whose names did not appear, the General Secretary of the Society, Mr. Cresswell, and Mr. Peirce. The Committee of the Section had permitted him to delegate as much of the work as possible; and his own share of the work might really be summed up in three words—to ask, to negotiate, and to complete. All the details of the work had been done thoroughly and well by Mr. Peirce, aided, guided, and counselled by the General Secretary, Mr. Cresswell. Honour to whom honour was due. He therefore could not allow the President to thank him for work which he had not really done. Nor could he sit down without saying that the thanks of the members were due above all to the President, who had given him *carte blanche* with respect to all the arrangements for the conversation, and also to the Committee of the London Section.

THIRD DAY.

MESSRS. TRUMAN, HANBURY, AND BUXTON'S BREWERY.

On Friday morning about 50 members paid a visit to Messrs. Truman, Hanbury, and Buxton's brewery in Spitalfields. This establishment has always taken a leading position among the English breweries, and at present ranks next after Guinness', Bass', and Allsopp's in productive power. It covers an area of over six acres, and when in full work the daily output is 2,000 to 2,500 barrels. Over 10,000 tons of coal are consumed per annum, and between 700 and 800 men and about 200 horses are employed. The stores contain 15,000 quarters or 45,000 cwt. of malt, and a proportionate quantity of hops. The water is derived chiefly from a well 850 ft. deep, with headings 200 ft. deep, and extending 150 ft. outwards. In the short time at the disposal of the visitors it was impossible to make a thorough examination of the vast building and all its admirable apparatus and appointments; but a good general inspection was made under the courteous guidance of Mr. Snelling, chief of the brewing department, and Mr. Jeffers, chief of the stores. Commencing with an inspection of the cask washing and cooling yards, the party was next led to the handsome and well-appointed range of stables, which afford accommodation for about 200 horses, the official name of each animal being painted over its stall. From the stables the visitors proceeded to the mashing house, where four gigantic tuns were in operation. Some 600 quarters of malt were here under treatment, the capacity of the largest tuns being 160 qrs. Leaving the mashing tuns (and passing on their way the celebrated Tuke's self-feeding smoke-consuming furnaces, which Messrs. Truman, Hanbury, and Buxton began to use in 1848 out of pity for the then flourishing silk industry of Spitalfields, but which have proved so economical in their operation as to have saved the firm 100,000*l.* in coal alone), the visitors made an examination of the seven huge coppers into which the wort is pumped direct from the mashing tuns, to be boiled with the requisite quantity of hops. After passing through the vast hop stores, fragrant with the golden produce of Kent, the party followed pretty closely the progress of the wort, by the strainers, in which the spent hops are separated out, up to the cooling loft at the top of the building, an area of 35,000 sq. ft., divided into four shallow compartments of copper, over which a current of cool air constantly passes. Descending again, they entered the refrigerating room, containing seven large machines, in which the wort is rapidly cooled from about 140° to about 60° F. A floor lower they entered one of the vast fermenting rooms and saw this critical portion of the brewer's work in all its stages. The process of fermentation is now chiefly carried on in slate tanks, of which there were over 50 in this one room, of an average capacity of about 150 barrels; but in a room subsequently entered were to be seen four "fermenting vats," leviathans of the old school, of most portentous appearance, and each capable of holding 1,400 barrels. After the "fermenters" came the "cleansing backs," shallow slate vessels in which the liquor settles, while the yeast is skimmed off and run down "parachutes" into slate vessels beneath, where sufficient of it is preserved for future operations, the rest, after passing through filter-presses, being exported to France for use in the distillation of spirit. This was the last operation to be seen, since the finished beer, after leaving the cleansers, is run, if "black," into huge vats for maturing, and if ale, into casks ready for consumption. Leaving the brewery, therefore, the visitors were now conducted through the spacious, and apparently endless, store-rooms, in one of which they found luncheon awaiting them, and at once formed themselves into a sampling committee for the purpose of fully testing the various products, black, brown and golden, the genesis of which they had so industriously traced.

After luncheon, Mr. A. H. Allen moved a vote of thanks to the firm of Truman, Hanbury, and Buxton for their kindness in affording the members an opportunity of visiting their great and historic brewery and of seeing for themselves "how much science was put into a glass of ale," and to

Mr. Snelling and Mr. Jeffers for their efforts in making the visit so thoroughly pleasant and instructive. The vote was carried enthusiastically and was briefly responded to by Mr. Snelling on the part of the firm.

MESSRS. COWAN'S SUGAR REFINERY.

About 20 members proceeded to Messrs. Cowan's sugar refinery, where they were received by Lieut.-Col. Cowan and his son. In the laboratory they were first shown the details of the various processes of sugar refining on a small scale, from raw beet-sugar to fine white. They were then taken over the works and shown each process on the large scale, including the manufacture of animal charcoal and its revivification, and the manufacture of tar and gas from the waste products, the last being consumed on the premises. After inspecting the furnaces, with their mechanical feed, and the engines, the party proceeded to the soap factory with its stock and packing departments. The greater part of the works were unfortunately in a very unfinished state, owing to the recent fire, but are being replaced as rapidly as possible by absolutely fireproof constructions. A vote of thanks proposed by Mr. Thos. Christy was received with acclamation.

THE KINGSTON SEWAGE WORKS.

About 40 members availed themselves of the invitation of the Native Guano Company, Limited, to visit these works, where the sewage of Kingston and Surbiton is treated by the well-known system of this company. In the unavoidable absence of the Hon. W. Massey-Mainwaring, the chairman of the company, they were received by Mr. W. Cameron Sillar, a director, Mr. W. Stevens, secretary, and Mr. C. E. Robinson, the engineer.

The company claim for their process:—

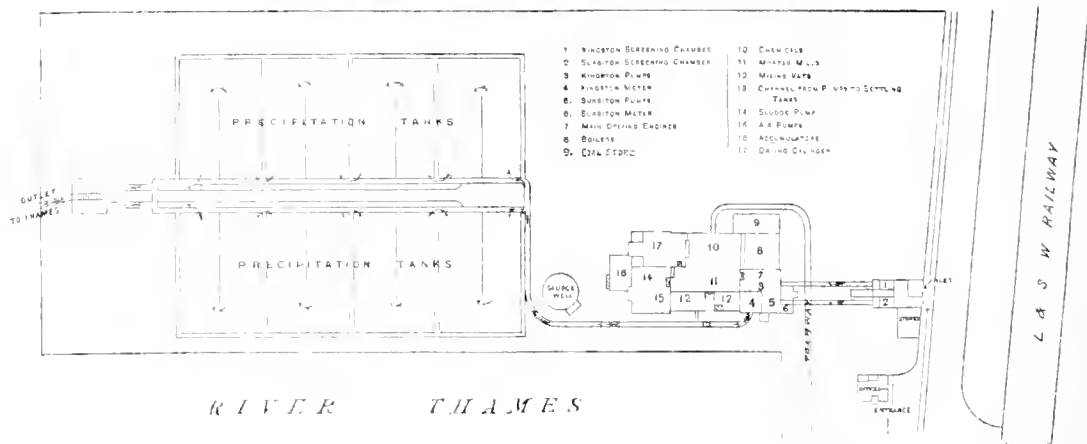
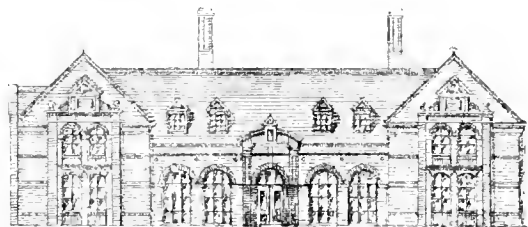
1. That the effluent water therefrom is sufficiently purified to be admissible into any river within the requirements of the Rivers Pollution Prevention Act, and without injury to fish.
2. That this is effected without nuisance.

3. That the materials used in the process do not injure or destroy the manurial qualities of the sewage, which are consequently preserved for agricultural use in a dry, portable, and inoffensive form.

The sewage is received in tanks, in its passage to which it receives, first, a mixture of clay, charcoal, and a small quantity of blood or other glutinous body capable of coagulation, and secondly, a solution of crude sulphate of alumina distributed in such wise as to secure thorough intermixture. In its progress through the tanks the matter in suspension goes to the bottom, while the clear supernatant fluid passes away into the river without filtration or any other subsequent treatment. The tank room requisite is only about what would be required for one day's supply of sewage, and accordingly a very limited area of land is required. The addition of the charcoal and clay at once arrests all offensive odour, no matter how foul the sewage may be, and this freedom from nuisance continues throughout the whole of the process. The tanks are cleaned periodically. The deposit or "sludge" is pumped into filter-presses where the superabundant moisture is removed, and further dried by artificial heat till it assumes the appearance of dry earth, when it is ready for market. One feature of this process is that no lime is used at all, unless a test shows the sewage entering the works to be abnormally acid from manufacturing refuse, in which case it is, of course, necessary to neutralise it, and consequently the effluent always remains on the acid side of neutrality; a condition unfavourable to secondary fermentation, and hence sewage fungus.

At the conclusion of the inspection the party adjourned to luncheon, where, in response to a vote of thanks proposed by the general secretary, Mr. Cameron Sillar explained the rationale of the process and how each purifying agent worked. Alluding to the clay, he said that their process might be described as the reverse of irrigation, for they brought the earth to the sewage instead of the sewage to the earth. The charcoal used was a waste product of another manufacture, and, in fact, the sulphate of alumina was the only chemical used which could not be had at the mere cost of carriage.

The accompanying sketches show a front view of the buildings and a block plan of the works. The Kingston sewage on reaching the works passes into the screening



chamber and through a grating, which intercepts coarse matter likely to choke or injure the pumps, and thence through a culvert to a pump-well under the main building, where it receives the clareoal, clay, and blood. The sewage thus partially treated is raised about 12 feet by centrifugal pumps, of which there are three, each driven by a 15 horse-power engine and capable of lifting 1,650 gallons per minute. The pumps discharge into a meter chamber where the sewage is measured and the quantity registered. On leaving the meter the sewage flows along an open channel to the settling tanks, receiving on its way the precipitating agents. There are eight tanks, each 85 feet long by 50 feet broad and 6 feet average working depth, holding 450,000 gallons, or 1,200,000 gallons in the aggregate, which gives a capacity of 30 gallons per head for a population of 40,000. The treated sewage flows in a continuous stream through the tanks, precipitating as it flows, and passes clear, bright, and odourless into a covered channel discharging into the Thames. The tanks are cleaned periodically, the deposit or "sludge" being pumped into the sludge-well by a Tangey-Holman double-action pump at the rate of 500 gallons per minute. From this well the sludge is first drawn into four sludge vessels, or accumulators, by the creation of a vacuum, and is then forced by air pressure, at 100 lb. on the square inch, into filter-presses on the first floor of the building, from which it is removed in hard cakes. There are two of Scott's air pumps and 11 of the Native Guano Company's filter-presses. The pressed cakes are dried in a Borwick's drying cylinder (with fan and condensing apparatus attached), ground into powder, and sold as Native Guano. The Surbiton sewage is separately received and screened, and is pumped by centrifugal pumps, through a meter, into the Kingston pump-well. There are three pumps, each driven by an 8 horse-power engine, and capable of lifting 750 gallons per minute. The boilers are of the locomotive multitubular type, working at a pressure of 150 lb. per square inch—one of 80 horse-power and two of 60 horse-power each. The two main-driving engines, each of 40 horse-power, are used alternately, and, like the pump-engines, are of Messrs. Willans and Robinson's patent kind. Two mortar mills are used for grinding the deodorisers, which are then mixed in vats and discharged into the pump-well; and there are two vats for dissolving the precipitating agents. A small centrifugal pump supplies water from the river for the boilers, mixing the chemicals, &c. The works have been constructed for treating, by the Native Guano Company's processes, the sewage of 35,000 people; but with certain comparatively inexpensive additions, they will meet the requirements of a population of 50,000.

At present the sewage being treated is	
that of Kingston, with a population of	26,156
And of Surbiton, with a population of	11,912
Total	38,068

In a short time Hampton Wick (population 2,500) will send its sewage over the railway bridge to these works by one of Shone's ejectors.

THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION, LIMITED.

On Friday afternoon about 50 members visited the Brush Electric Light Works and inspected the various methods of manufacture employed by that corporation, and the working of various pieces of electrical apparatus.

The following attracted most attention:—Electric locomotives for tramway work. These locomotives, made for tramways in different parts of the world, are driven by "Victoria" motors geared down to the axles of the cars by special gearing, of which the principal novel feature is a magnetic coupling designed by Mr. J. S. Raworth, the Brush Corporation's superintending engineer. This coupling takes the place of the clutch or friction coupling which has sometimes been employed for such purpose, but has the great advantage that it can be put in or out by merely making a contact. It is arranged to connect the motor through one

or other of two sets of gear in order to obtain the advantage of high speed and large output whether the cars are running up-hill at a slow rate or on the level at a high rate of speed. The visitors next inspected the "monkey" running on a line on the overhead system. The object of this "monkey" is to maintain continuously a connexion between the line and the car. In another case accumulators are being used to supply power to the motors, the cars being in this case independent of a connexion with the generating station. The visitors also inspected a number of engines under test, driving dynamos particularly intended for ship lighting. A number of "Brush" and "Victoria" dynamos were seen either in testing or in course of construction. The alternate current apparatus of the corporation was represented by the "Mordey-Victoria" alternators, transformers, automatic regulators, and the "Brush" alternate current arc lamp. All this apparatus was being manufactured on a large scale, and the visitors had an opportunity of seeing some of it in operation.

BRIN'S OXYGEN COMPANY.

About 150 members assembled at these works, where they were received by Mr. Henry Sharp, chairman, Mr. Ellice-Clark, managing director, and Mr. Elias, director. Mr. Ellice-Clark, in welcoming the visitors on behalf of the company, pointed out that the works were mainly experimental and therefore were naturally not extensive. The directors, when they took the exploitation of these patents in hand, were desirous of showing manufacturers and others that the extraction of oxygen and nitrogen was not a mere laboratory experiment, but that it was undoubtedly a continuous and industrial process, and one which might be carried out in their own factories. And in spite of great practical difficulties—which members as manufacturers would readily appreciate—and also, he was sorry to say, of considerable prejudice from quarters where it ought hardly to have been expected, he thought they would be able to show members that the process was a perfectly practical and also an economical one. For the benefit of those members who might not be quite familiar with the process, he might say that oxide of barium (prepared in a porous condition from the nitrate) was introduced in pieces about the size of walnuts into steel or cast-iron retorts. These retorts, placed in a vertical position in a gas furnace, were heated to about 1,400°, and air, carefully purified from moisture and carbonic acid, then pumped through them under a pressure of about 15 lb. on the square inch. The baryta absorbed the oxygen, becoming converted into barium peroxide, and when this peroxidation was completed or carried as far as is found in practice to be economical, the pump was reversed and the pressure in the retorts thus reduced. As soon as the reduction of pressure had reached about 26—28 in. of mercury below the normal, the peroxide began to give up its oxygen (becoming reduced again to the monoxide) which passing through the pump was delivered into a gas-holder. A complete operation (oxidation and deoxidation) lasted about 10 minutes, at the end of which time the operation commenced *de novo*. Nearly 140 operations were thus made a day. The life of the baryta was a very long one, and in fact at first it actually improved by use. As a rule oxygen of about 96 per cent. purity was made, and what may be called commercial oxygen of a purity of over 90 per cent. sent out. When the gas was wanted for distribution at a distance it was drawn from the holder by a compression pump which forced it into steel cylinders under a pressure of 120° atmospheres.

The members, in parties of about 25—30, were then conducted over the works by Mr. Henry Sharp, Mr. Ellice-Clark, Mr. Ellice Elias, Mr. K. S. Murray (assistant engineer), and Dr. Thorne (chemist). Here the chief improvement which has been effected of substituting vertical retorts and a constant temperature (change of pressure only being relied on) for horizontal retorts and changing temperatures was pointed out. Attention was also called to the precautions adopted for preventing accidents in the compression of coal gas and oxygen by the use of separate compressors and differently coloured cylinders for each gas. The applications of oxygen to the

purification of gas, to bleaching, to the maturing of spirits, &c. (see this vol., p. 82), were also referred to. In proposing subsequently a vote of thanks to the directors, Mr. D. Howard said that Brin's oxygen process was of special interest to chemists, not from the size or complexity of the plant employed, but from the very simplicity of the arrangements which had triumphed over difficulties which were either unknown or thought little of in the laboratory stage of the researches. These difficulties, unless they had been met by most skilful treatment, must have been utterly fatal to success. It was but one more example of the great lesson of industrial chemistry, viz., that practical difficulties only began when theory scored a success.

GROTH'S ELECTRIC TANNING PROCESS.

A few members visited the works of Messrs. Tebbitt Bros., Bermondsey, to inspect a new process of electric tanning, the invention of Mr. L. A. Groth. In an empty tanning pit was placed a circular vat with revolving gear on which were suspended raw hides, presumably in tan liquor. Adjoining this was a dynamo, wires from which were connected with copper plates inside the vat, and it was claimed by the inventor that the electric current so produced shortened the time of tanning from three months to about one month. Further details of this process will be awaited with interest.

The proceedings of the Annual Meeting terminated with a smoking concert at the Café Monico, conducted by Mr. J. C. Butterfield, who was assisted by some talented artistes and a quartette party. The President occupied the chair, and a most high-class and enjoyable programme was provided.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	R. Messel.
H. E. Armstrong.	B. E. R. Newlands.
W. Lant Carpenter.	B. Redwood.
W. Crowder.	T. Royle.
W. J. Dibdin.	John Spiller.
C. Graham.	Wm. Thorp.
S. Hall.	C. R. Alder Wright.
C. C. Hutchinson.	

Hon. Local Sec. and Treasurer:

Thos. Tyrer, Garden Wharf, Battersea, S.W.

Meeting held Monday, May 6th, 1889.

MR. DAVID HOWARD IN THE CHAIR.

NOTES ON EXPLOSIVES.

BY C. NAPIER HAKE.

GLANCING briefly at the past history of the subject, it will seem that until comparatively recently, perhaps within the memory of many here present, gunpowder was practically the only explosive in use, both for industrial and military purposes. Although it no longer holds this unique position,

it is by no means superseded nor, curious as it may seem, is it likely to be at present. There is certainly no explosive known which lends itself so easily to so many and such varied purposes. To use Mr. Alfred Nobel's words,* "In a mine it is used to blast without propelling; in a gun to propel without blasting; in a shell it serves both purposes combined; in a fuse, as in fireworks, it burns quite slowly without exploding. Its pressure exercised in those numerous operations varies between 1 oz. (more or less) to the sq. in. in a fuse, and 85,000 lb. to the sq. in. in a shell. But, like a servant of all work, it lacks perfection in each department, and modern science, armed with better tools, is gradually encroaching on its old domains." The discovery of gun cotton, in 1846, was the commencement of a new epoch in explosives. Although at first taken up eagerly by all European Governments, it was for a time abandoned after 20 years of severe testing. The disastrous experience of these 20 years was due to an imperfect chemical knowledge of its properties and to the absence of good methods of manufacture.

In 1847, almost simultaneously with the discovery of gun cotton, nitroglycerin first made its appearance, but for the same causes it fell into disrepute, leaving behind it even a worse record of disaster than its predecessor, gun cotton. But this was only for a time; the patient and courageous labours of Sir Frederick Abel as regards gun cotton, and of Mr. Alfred Nobel as regards nitroglycerin, brought these powerful agents under control, and demonstrated the conditions under which they are chemically stable; the application of the principles of detonation to them was the finishing touch to a great work. Since that period, and up to the present time, gun cotton and the nitroglycerin class of explosives have held the first position wherever a powerful agent is required. Many attempts have been made to displace them, and yet one cannot at the moment point to any serious competitor; but a vast field of research has been opened, and there is no lack of labourers adding day by day to our knowledge of the subject.

Leaving history, and before entering upon the more practical portion of my paper, I should like to glance briefly at the theory of the subject. Let us consider for a moment what is meant by the term explosive. An explosive may be defined as any solid or liquid substance or compound, which on the application of heat or shock becomes very rapidly converted, either wholly or partially, into the gaseous state with the evolution of heat.

Explosives may be conveniently divided into two classes, generally known as "high" and "low" explosives. The former are the more powerful, and their explosion is usually effected by "detonation," and is, consequently, very rapid; the latter are usually exploded by simple ignition, and their explosion proceeds progressively by combustion. Dynamite may be taken as a type of the former, and gunpowder as a type of the latter class. It is, however, not easy to hold strictly to this classification since, under certain circumstances, the terms may become practically interchangeable.

Detonation may, for practical purposes, be defined as the (almost) instantaneous resolution of an explosive into other forms of matter, chiefly permanent gases occupying many times the original bulk of the explosive, and hence exerting enormous power; it is usually induced by the ignition of an explosive of the fulminate class.

In examining an explosive, its chemical composition should first be ascertained, and from this, in the light of our present experience, it is possible to draw many inferences, such, as for example, the products of its decomposition, the quantity of heat, and the nature of the gases evolved, its probable effectiveness as an explosive, its stability, and its sensitiveness to concussion and friction. To arrive at its chemical composition presents, comparatively speaking, the least difficulty. It is not so easy to arrive at a correct conclusion as regards its products of decomposition. What is specially required is the equation of its decomposition under conditions most favourable to the production of the maximum effect as an explosive; from this equation may be

* On Modern Blasting Agents, by Alfred Nobel, 1878.

calculated according to well-known laws the quantity of heat evolved by the decomposition and the volume of gases produced. But the many and varying conditions which influence the mode of decomposition of different substances, the difficulty of determining high temperatures with accuracy, the complication of thermo-chemical laws, and many other considerations, interfere with the absolute correctness of the result. Nevertheless, a very fair relative one is obtainable. Chlorate of potassium and nitrate of ammonium are examples of the varying decompositions of certain compounds under varying conditions, the latter being capable of decomposition in no less than seven different ways.

To determine the theoretical effectiveness of an explosive it is necessary to know two things :—

1st. The volume and temperature of the gases evolved :

2nd. The quantity of heat evolved by the chemical change occurring during the explosion.

The effectiveness of an explosive is dependent on the volume of the gases evolved, the amount of heat generated, and the rapidity of the explosion. The pressure is due to the gases evolved, and is dependent on their volume and temperature. The work done is dependent on the amount of heat evolved, and may be expressed by the formula $123 M$, where M is the number of units of heat evolved. These factors are modified favourably or otherwise by a variety of conditions, such as the chemical nature of the explosive, the rapidity of the chemical change, or by the method of firing, whether by ignition or by detonation. Time is therefore an important factor. Dissociation modifies the effect of an explosive by diminishing the initial pressure, but does not affect the total thermal value, as the heat which is absorbed in the first instance is reproduced by the union of the dissociated elements as the temperature falls. The pressure is the factor which produces rupture of the envelope, but does not necessarily produce any extended mechanical effects, such as smashing or dispersion. This last, as already said, represents the heat equivalent or work. What may be termed the "power of an explosive" is influenced by the rapidity of the chemical change on explosion, and of two explosives evolving the same amount of heat, and therefore the same amount of work, that explosive which is the more rapid does that work in a shorter time, *e.g.* :—Fifteen tons lifted 1 ft. high represents the same amount of work done whether we do it in a second, a minute, or an hour; but the power necessary to do it in one minute we call a horse power; if we wish to do it in a second, we require 60-horse power.

Further, rapidity of detonation, or the velocity of propagation of what Berthelot has termed the "explosive wave," is another important consideration. An illustration of the difference with which the velocity of molecular transformation can be transmitted is exemplified by the behaviour of blasting gelatine, for instance, under various circumstances. If we light a small portion it smoulders away. On the contrary, if more strongly heated, it burns more rapidly, but in both cases the combustion proceeds at a slow rate from layer to layer, and the mechanical effects are nil when unconfined. If we detonate a similar cartridge, also unconfined, the results are very different; great mechanical effect is produced, because the decomposition is almost instantaneous. In fact the detonation is transmitted with enormous rapidity throughout the entire mass.

The actual velocity of the explosive wave has been measured, and has been found to be from 5—6,000 inches per second for gun-cotton, and about 5,000 metres per second for dynamite. At this rate the explosion of a cartridge a foot long would only occupy $\frac{1}{24,000}$ th part of a second, while a ton of dynamite cartridges about $\frac{1}{2}$ diameter, laid end to end, and measuring one mile in length, would be exploded in one quarter of a second by detonating a cartridge at either end.

The theoretical efficiency of an explosive cannot in practice be realised in useful work for several reasons, as, for instance, in blasting rock :—

(1.) Incomplete combustion.

(2.) Compression and chemical changes induced in the surrounding material operated on.

(3.) Energy expended in the cracking and heating of the material which is not displaced.

(4.) The escape of gas through the blast hole and the fissures caused by the explosion.

The useful work in blasting consists partly in shattering the rock and partly in displacing the shattered masses. The proportion of useful work obtainable from the employment of explosives has been variously estimated at from 14 to 33 per cent. of the theoretical maximum potential. For the purposes of comparison it does not matter whether we take the theoretical or practical efficiency of an explosive, since these stand in the same relation to one another, as will be seen from the following tables :—

MECHANICAL EQUIVALENT OF EXPLOSIVES.

Roux and Sarrau.

	Theoretical Work in Kilos.	Relative Value.
Blasting powder with 62 per cent. KNO_3 ...	242,335	1.0
Dynamite with 75 per cent. nitroglycerin ...	548,250	2.26
Blasting gelatin with 92 per cent. " ..	766,813	3.16
Nitroglycerin.....	794,563	3.28

Relative value of—

Dynamite.....	1.0
Blasting gelatin	1.4
Nitroglycerin.....	1.45

In this connexion the following records are also of interest :—

	Dynamite.	Blasting Gelatine.
St. Gothard's railway.....	1.0	1.16
Tenkeroda mine	1.0	1.45
Tarnowitz excavation.....	1.0	1.41
Mansfelder "	1.0	1.33
Mean.....	1.0	1.41

Experiments made in lead cylinders gave the relative value of—

Dynamite	1.0
Blasting gelatin	1.4
Nitroglycerin	1.4

The stability of an explosive is of first importance. Decomposition may occur either spontaneously or through the aid of some foreign agency. The stability of an explosive is dependent on :—

Firstly. Its chemical constitution.

Secondly. Its freedom from certain impurities.

Some explosive compounds when properly manufactured show no tendency to decompose under ordinary conditions, as for example nitroglycerin or gun-cotton. Conditions which influence the neutrality of these explosives, however, are favourable to their spontaneous decomposition.

A solution of dinitrobenzene in fuming nitric acid, though a very powerful explosive, and not dangerous in itself as regards liability to decomposition, would be a source of danger to certain other explosives stored with it, in so far as their neutrality would be endangered by the absorption of acid fumes.

As an instance of spontaneous decomposition of two compounds, in themselves fairly stable, may be noted chlorate of potassium and nitrate of ammonium. These two powerful oxidising agents react rapidly on each other with the evolution of chlorine compounds, and in the presence of a combustible and under otherwise favourable

conditions the heat evolved is sufficient to cause explosion. Again, experience has shown that nitrate of ammonium and gun-cotton are more or less incompatible owing to a tendency to spontaneous decomposition. Sulphur and iron or sulphur and zinc, when mixed together under favourable conditions, react on each other with evolution of heat sufficient to ignite gunpowder, and this has actually occurred in firework compositions.

For these reasons explosives which from the nature of their constitution have a tendency to generate or evolve acid fumes, or otherwise possess elements of an objectionable nature as regards their influence on stability, are dangerous.

Sensitiveness to concussion or friction or to ignition is another form of expression for instability under somewhat different conditions. The two are however very much governed by the same laws. Broadly speaking, the sensitiveness of an explosive as of any chemical substance is directly as the heat evolved by its decomposition and inversely as the temperature of its decomposition. A chlorate mixture is therefore more sensitive than a nitrate mixture. The law is, however, modified by the physical character of the explosive substance; for instance, fulminate of mercury in a finely-divided state is extremely sensitive to concussion or friction, yet large crystals of the same material are far more sensitive to the same treatment. Elevation of temperature tends as a rule to increase the sensitiveness of an explosive; yet blasting gelatin becomes more sensitive to concussion and friction when in the frozen condition.

I will conclude these theoretical considerations by one more reference to detonation. As before stated, the usual method of ignition employed for low explosives, of which gunpowder is a characteristic type, is a fuse. "High" explosives, on the other hand, are almost always detonated. The best agent for this purpose is found to be fulminate of mercury, and there are special theoretical reasons why this should be so. Fulminate of mercury possesses the following composition, $C_2N_2HgO_2$, and yields on detonation $(CO)_2$, N_2 , Hg . It explodes at a temperature of $360^\circ F$. It is also readily exploded by concussion or by friction, such as scratching it with a pin or by contact with strong nitric or sulphuric acid. It appears, therefore, that no compound liable to dissociation is formed, and therefore no influences exist which would tend to moderate the expansion of the gas and diminish the violence of the initial shock. Generally speaking one may say that it is neither the volume of gases disengaged nor the heat evolved which gives to fulminate of mercury its peculiar character or special advantages, for it is surpassed in both these directions by many other explosive bodies. Its superiority is demonstrated best when in close contact with an explosive, and its effectiveness is due to three causes:—

Firstly. Its nearly instantaneous decomposition by simple inflammation, even when but slightly confined.

Secondly. The almost total absence of dissociation products.

Thirdly. Its great density.

By reason of these conditions the definite products of the reaction appear to form all at once before the gases have had time to expand to a volume greater than that of the original solid.

Passing on to a more practical consideration of the subject, I do not propose to dwell on explosives generally, but only to describe such as are actually in practical use. Those wishing to know what has been suggested in the past with regard to explosives would do well to consult Major Cundill's "Dictionary of Explosives."^{*} In this valuable little book between 300 and 400 suggestions for explosive mixtures are recorded and fully described.

The following table is taken from this work, and shows the mode of classification and the number of varieties of each class:—

	Varieties.
Gunpowder	16
Nitrate mixtures other than gunpowder	63
Chlorate mixtures	67
Nitro-compounds containing nitroglycerin	82
Gun-cotton and other nitro-compounds	64
Picric powders	11
Sprengel explosives	5
Miscellaneous explosives, including fulminates	49

Many of these are mere chemical curiosities, and the large majority, for some reason or other, have never advanced beyond the experimental stage.

Looking at this table, it is obvious that gunpowder no longer retains its supreme position. It is, however, still largely used for mining purposes, especially where a slow explosive is required.

Modern activity in the invention of new explosives has no doubt broken through the monopoly which gunpowder so long enjoyed, but it has also brought forth many new and valuable improvements both as regards the composition and manufacture of this explosive.

I am aware that gunpowder deserves far more attention than I am able to give to it in this paper; but its new varieties are so numerous and its application so varied both for civil and military purposes, that it would be impossible to enter into detail in an essay of necessarily restricted length without excluding matter of, at the moment, greater interest.

In Major Cundill's "Dictionary of Explosives" 67 chlorate mixtures are described, and of these only one, to my knowledge, has been authorised. In the report of Her Majesty's Inspectors of Explosives for 1886, Dr. Dupré, F.R.S., who from his long connexion with the Explosives Department has an exceptional experience as regards the properties of explosives, says as regards dangers in the use of chlorate of potassium:—

"Chlorate of potassium, on account of the readiness with which it lends itself to the production of powerful explosives, offers a great temptation to inventors of new explosives, and many attempts have been made to put it into practical use, but so far with very limited success only. This is chiefly owing to two causes. In the first place, chlorate of potassium is a very unstable compound, and is liable to suffer decomposition under a variety of circumstances, and under, comparatively speaking, slight causes both chemical and mechanical. All chlorate of potassium mixtures are liable to what is termed spontaneous ignition or explosion in the presence of a variety of materials, more particularly of such as are acid; and all chlorate mixtures are readily exploded by percussion, such as a glancing blow, which might easily, and would often occur, in charging a hole. In the second place, there is some evidence to show that this sensitiveness to percussion and friction increases by keeping, more especially if the explosive is exposed to the action of moist and dry air alternately. If inventors would only keep these characteristics of chlorate mixtures in mind they would frequently save themselves serious disappointment."

The picric powders are few in number, and form a subdivision of the great nitro-compound class. With the exception of picric acid itself, no practical importance can at present be attached to this class of explosives. The fact that picric acid without the addition of oxidising agents forms a powerful explosive when fired by a detonator, was pointed out by Dr. Sprengel, F.R.S., in 1873, in his well-known research on a "New Class of Explosives." It is supposed to form an ingredient of the French military explosive melinite, the composition of which is kept secret. In 1885 M. Turpin patented the application of picric acid as an explosive for military and other purposes. Its comparative inertness under ordinary conditions and high density (1.6) gives it certain advantages as a filling for shells. For blasting purposes, however, it has the objection that it gives off actively poisonous gases and forms carbonic oxide on combustion, owing to a deficiency of oxygen in its composition.

^{*} A Directory of Explosives, by Major Cundill, R.A.H.M., Inspector of Explosives. Royal Artillery Institution, 1889.

In consequence of a disastrous explosion* which occurred at a chemical factory near Manchester, and which was brought about by the accidental mixing of picric acid and litharge in a molten state during a fire, picric acid has, by an Order in Council, been brought within the scope of the Explosives Act as regards manufacture and storage except when—

“(a.) It is wholly in solution.

“(b.) When it is not wholly in solution, but is being manufactured or stored in a factory, building, or place exclusively appropriated to the manufacture or storage of picric acid, and in such manner as effectually to prevent any picric acid from coming into contact (whether under the action of fire or otherwise) with any basic metallic oxide or oxidising agent, or other substance capable of forming with picric acid an explosive mixture or explosive compound, or with any detonator or other article capable of exploding picric acid, or with any fire or light capable of igniting picric acid.

“Moreover, all picrates or mixtures of picric acid with any basic metallic oxide, &c., as detailed in (b.) are to be deemed explosives within the meaning of the Act for all the purposes of the said Act unless such picrates or mixtures be wholly in solution.”

Although from the above list of explosives the number appears large, the number in practical use in this country is very small, and may be taken under three headings, namely,—

1st, gunpowder.

2nd, gun-cotton and other nitro-compounds.

3rd, nitro-compounds containing nitroglycerin.

The explosives included under the Sprengel class, although re-patented from time to time by various “inventors,” appear to be all covered by Dr. Sprengel’s original patents Nos. 921 and 2462, 1871. For practical reasons bearing on the safety properties of this class of explosives, none of its varieties have been authorised in this country. Dr. Sprengel’s researches, however, must be looked upon as most valuable contributions to our knowledge of explosives generally, and there can be but little doubt that the new class of explosives, of which bellite is a typical representative, is more or less the outcome of these researches.

Gun-cotton is essentially a military explosive. In the compressed form its density is about 1·0, and when properly manufactured, it shows no tendency to decompose. When wet it is non-sensitive to ordinary concussion or friction. It may, however, be exploded by a dry primer of the same material, even when saturated with water. For these reasons it possesses special advantages for all military and naval operations in which a violent explosive is required. But for the discovery of nitroglycerin, gun-cotton would, no doubt, have played an important rôle in mining operations. In this direction, however, it has not kept pace with its development and utilisation for war purposes. Its chief objection for blasting purposes is that it is deficient in oxygen, the disengaged products of the explosion containing large quantities of carbonic oxide (28·5 per cent.). This particular drawback has been overcome by incorporating with it nitrate of potassium or nitrate of baryta, the oxygen contained in these salts effecting a more complete combustion, and rendering the resulting gases less obnoxious than those resulting from pure gun-cotton. Special preparations in this direction have been introduced under the name of “Potentite,” “Tonite,” &c., and are used with considerable success as blasting agents.

Nitroglycerin compounds, however, take the first rank as blasting agents, their superiority lying chiefly in their cheapness, greater strength, and density. The manufacture of nitroglycerin is a comparatively simple process, and is fully described in technical works. The features of the process which are of the greatest importance are the purity of the glycerin, strength of the acids, and the complete washing of the finished product. Rapidity of working

depends largely on the strength of the acids, since the heat evolved is least when the strongest acid is employed. The output is increased, the action goes on more uniformly, and is more easily controlled.

Pure nitroglycerin (nitroglycerol) is a colourless mobile liquid possessing a definite composition. Its specific gravity is 1·26 at 60° F. When ignited in small quantities, it burns slowly away. When heated, however, to a temperature of 370° F. it explodes with great violence. When spread in thin layers it is extremely sensitive to slight concussions or blows. At a temperature of 40° F. it takes the crystalline form, and becomes solid and contracts one-twelfth of its volume. In this condition it is far less sensitive to blows and concussions than in the liquid form. One litre of nitroglycerin produces, when exploded under the most favourable conditions, a volume of gas equivalent to over 10,000 litres. The application of nitroglycerin, or of any liquid or semi-liquid compound, or mixture of the same, as an explosive agent, has been almost universally abandoned, and in this and most other countries even prohibited.

Nitroglycerin enters into the composition of a very important class of explosives, possessing the generic title of dynamite. A very large number of such exist under various fancy names, but for convenience they may be divided into three classes, namely:—

1. Dynamite in which nitroglycerin is alone the active principle; a chemically inactive material, such as kieselguhr, being used merely as an absorbent, as, for example, in ordinary dynamite No. 1.
2. Dynamite in which the absorbent used is, in itself, an explosive or combustible, such as, for example, “Atlas powder.” This class of dynamite is little used in this country.
3. Dynamite in which the liquid character of the nitroglycerin is destroyed by gelatinising it by means of gun-cotton, with or without the addition of oxidising agents.

The ordinary dynamite of commerce as used in this country is a mixture of 75 parts by weight of thoroughly purified nitroglycerin with 25 parts by weight of a porous infusorial earth known as kieselguhr, and consisting mainly of silica. In the case of kieselguhr dynamite, detonation is the more readily effected, and the combustion is more complete the more nearly the absorbing power of the kieselguhr is satisfied; but even then it is not perfect unless confined. Now, at present, no dynamite containing more than 75 per cent. of nitroglycerin is permitted in this country, and as the kieselguhr which is now generally employed has a greater absorbing power, it becomes necessary to reduce it by the addition of less absorbing materials, such as barytes, mica, tale, or ochre, in substitution for an equal amount by weight of kieselguhr.

Dynamite, as above described, is a soft plastic material, possessing a specific gravity of 1·4, varying in colour from light-yellow to yellowish red. It retains completely the properties of nitroglycerin while its tendency to explode, by slight concussions or blows, is diminished. It can be exploded under ordinary conditions by a detonator containing 5 grains of fulminate of mercury, or by heating to a temperature of 400° F., or by a sharp blow. When ignited by means of a fuse or match, it usually burns slowly away without exploding. When exposed for a short time to a temperature below 40° F. the nitroglycerin in the dynamite freezes and it becomes a hard solid mass. In this condition its sensitiveness to concussion is greatly diminished; but it is more liable to explode on simple ignition. Even a rifle bullet fired through it at a comparatively short distance fails to explode it, whereas a similar treatment would cause the detonation of the unfrozen material. The fact of dynamite freezing so readily is a fruitful source of accidents, occasioned more often by the reckless treatment it is subjected to with a view to restoring to it its plastic properties. Instances are on record of workmen placing frozen cartridges on the top of a fire or holding them on a shovel over a forge fire. Even when slowly thawed at a moderately increased temperature the greatest caution

* Full details of this accident are contained in a report (No. LXXXI., 1887), by Colonel Majendie, C.B., Her Majesty’s Chief Inspector of Explosives to the Secretary of State.

should be exercised in handling such cartridges. In actual contact with water for any length of time the nitroglycerin has a tendency to separate out, and it should therefore never be placed in wet blast holes unless properly protected. Accidents have occurred through neglect of such precautions, the nitroglycerin having percolated through crevices in the rock some distance from the seat of the charge.

Blasting gelatin is the characteristic type of class 3, and consists of—

Soluble guncotton, 7 per cent. to 8 per cent.

Nitroglycerin, 93 per cent. to 92 per cent.

It is prepared by adding a soluble guncotton to nitroglycerin. The latter dissolves the former and is converted into a pale yellow elastic gelatinous, semi-transparent mass. When ignited by a match it burns slowly with a yellow flame. When heated to 90°–95° F. it should not materially soften nor become moist or show any sign of exudation. At a temperature of 400° F. it explodes violently. Under ordinary conditions it is far less sensitive to concussion or blows than either of the ingredients of which it is composed. Its two constituents, each in themselves sensitive to ordinary means of detonation, become comparatively inert when united, owing to a change in their physical condition. When unconfined, a detonator containing 1 grm. of fulminate is insufficient to explode it. If, however, it be strongly confined so that the fulminate exerts its whole force, it explodes with a violence greater than that of nitroglycerin.

Blasting gelatin, like ordinary dynamite, freezes at 40° F. to a hard solid mass, and in this state, unlike dynamite, becomes more sensitive to concussion. A quantity of fulminate of mercury sufficient to detonate ordinary dynamite in the unfrozen condition will fail to detonate unfrozen blasting gelatin. The same quantity of fulminate, however, is sufficient to determine the explosion of frozen blasting gelatin, whereas it would be totally insufficient to explode frozen dynamite. Its behaviour is also the reverse of that of dynamite with regard to the impact of a bullet fired from a rifle. After long immersion in water, it becomes of a paler colour and opaque; but its explosive properties are unaffected. It is therefore specially adapted for submarine mining.

Two varieties of blasting gelatin have been recently introduced in this country, namely, gelatin dynamite, and gelignite. The first, as its name implies, ought to be placed midway between blasting gelatin and dynamite. It consists of a thin blasting gelatin mixed with other substances, such as cotton or wood meal, and contains about 80 per cent. nitroglycerin. The second variety contains the same ingredients as gelatin dynamite mixed with nitrate of potassium or other nitrate, and contains 60 per cent. of nitroglycerin. They are both very similar in appearance to blasting gelatin.

The invention and introduction of the blasting gelatin class of explosives marks a distinct advance in the history of modern high explosives, the importance of which is as yet but partially realised. The question of their stability has retarded their development, but when once removed it would appear that the problem so long confronting manufacturers of explosives would seem to be solved. Concentration of force in small compass, permanency, safety in use, and under ordinary conditions unaffected by immersion in water, all these properties seem to fulfil in a high degree the requisites of the ideal high explosive both for civil and military purposes.

Carbo-dynamite, the invention of Messrs. Borland and Reid, comes under the second of the dynamite class. The novel feature of this explosive consists in the use of a carbon, specially prepared, and capable of absorbing about nine times its own weight of nitroglycerin. The carbon employed for absorbing the nitroglycerin takes an active part in the explosion, and increases the energy over and above that which is due to the nitroglycerin contained in it. This arises from the fact that the nitroglycerin contains sufficient oxygen in excess to burn the carbon on detonation, leaving no residue. Two varieties of this explosive are manufactured, namely, No. 1 and No. 2.

Carbo-dynamite No. 1 is a soft plastic material possessing a specific gravity of 1.5. It consists of 90 parts by weight of thoroughly purified nitroglycerin, and 10 parts by weight of cork carbon. Like dynamite, it retains completely the properties of nitroglycerin, whilst the tendency to explode by slight concussion or blows is diminished. Unlike dynamite, however, it is not acted on by water even after long immersion, a property which makes it specially applicable for blasting in wet bore-holes. When detonated, it develops an energy about equal to that of blasting gelatin.

The No. 2 variety is very similar in appearance to No. 1, and consists of nitroglycerin, 50 per cent.; nitrate of potassium, 44 per cent.; carbon, 6 per cent. This variety develops an energy on detonation somewhat greater than that of dynamite No. 1.

Roburite, one of the latest additions to the list of explosives actually in use, consists of a mixture of nitrate of ammonium, dinitrobenzene, and chloronitrobenzene. The proportion of the chlorinated product is regulated so that 100 parts of the organic components shall not contain more than 4 per cent. of chlorine. It has a density rather less than that of water. Even when freshly made it requires a more powerful detonator to explode it than dynamite No. 1. When damp or slightly compressed it explodes with difficulty. It is non-sensitive to ordinary concussion or friction, and in contact with a flame ignites with difficulty. When heated it decomposes without exploding and burns with a smoky flame. These latter remarks hold good, at least, when small quantities are experimented with. On detonation, when strongly confined, it develops an energy comparable with dynamite No. 1. Although a "high explosive" it exerts on detonation more a rending effect—similar to gunpowder—than a shattering one. It has been used successfully for blasting coal and for quarrying.

"*Bellite*" and "*Securite*" are similar in composition to the above, in so far as their constituents consist of nitro-compounds of the aromatic series incorporated with oxidising agents, preferably nitrate of ammonium.

Favier's explosive which has, under the name of "Miners' safety explosive," been licensed in this country, consists of nitrate of ammonium and mono-nitronaphthalene, in the proportion of 91.5 of the former to 8.5 of the latter. The cartridges are made in the form of compressed hollow cylinders enclosed in waterproof wrappers. The central cavity is filled with a powerful explosive, such as dynamite or guncotton.

The few explosives which I have briefly referred to above, include all those of any importance which are in actual use for industrial purposes in this country.

The question "Which is the best explosive?" has often been put to me. It is like asking an engineer which is the best tool for drilling a hole. Every explosive has its special properties and no hard and fast rules can be laid down as regards the most economical application of explosives generally. A knowledge of the special properties of explosives enables one more or less to say which particular explosive is likely to be the most suitable for a particular class of work. To use a quick and powerful explosive for blasting coal would be as absurd as to use a diamond drill for boring holes through a deal board. The application of explosives to the best advantage is more a matter of judgment based on actual practical experience. Generally speaking one may say that for hard rock, especially in tunnelling, one would choose on economical grounds the most powerful class of explosives with a quick shattering action and of the highest possible density. For blasting coal or in quarrying marble or slate, and in all cases where the material operated on is required in large block, an explosive possessing a slow rending action is preferable.

The rapid development of the trade in modern high explosives has taken place under the controlling regulations of an Act of Parliament which came into force in 1875. That this Act was framed with considerable foresight in the interest of the trade and of public safety has been fully demonstrated by results. An examination of the reports made by Colonel Majendie, Her Majesty's Chief Inspector

of Explosives, and his colleagues, Colonel Ford and Major Cundill, to the Secretary of State, conveys a clear idea of the rapid growth of the explosives industry since 1875. The uniformly progressive increase in the number of factories and magazines, which naturally brings with it an increased employment of labour and an increased risk, has been accompanied by a steady decrease in the number of fatal accidents in manufacture and storage. During the years 1868-70 inclusive, when no sort of inspection existed, the annual fatalities amounted to 13 in number. The average fatalities for the four years preceding the Act were 37 in number, with 33 factories at work. There are now 112 factories in operation—many of them manufacturing new explosives—yet in 1888 only six fatal accidents are recorded, and of these three occurred in firework factories. The number of accidents recorded in the use of explosives do not show a diminishing tendency to the same extent, and for this the nitroglycerin class of explosives is chiefly responsible, but the result is not to be wondered at considering the increasing demand for these explosives. Further, it must be borne in mind that the use of explosives is not controlled by the provisions of the Act.

The average number of accidents in the use of gunpowder during the last 10 years is 28.4, causing 15.6 deaths, and injuries to 33.9 persons. The accidents in the use of dynamite and other nitroglycerin preparations during the last 10 years show an average of 18.4, causing 11.0 deaths, and injuring 21.4 persons.

1,120,800 lb. of dynamite were imported into this country in 1888 in 17 cargoes, showing a considerable increase over the quantity imported in 1887, and representing a value of between 50,000*l.* and 60,000*l.*, and Dr. Dupré reports that in no instance has he found it necessary to recommend the rejection of this foreign dynamite.

The conveyance of explosives by road is to a great extent controlled by local authorities, and the responsibility of enforcing the law practically rests with them. The transport of explosives on railways is still practically limited to gunpowder. This is much to be regretted, and in the interests of an important industry, and especially, as pointed out by Colonel Majendie, on grounds of public safety. In the annual report for 1887 he writes:—

"We regret to have to report that, notwithstanding repeated remonstrances, the railway companies have not yet seen fit to adopt a more liberal and reasonable policy with regard to the conveyance of dynamite and similar explosives. This subject has received attention in former reports, and in 1879 we made the following remark on the point:—

"This prohibitory policy, we desire emphatically to repeat, supplies a temptation to the surreptitious conveyance of the prohibited explosives which it is certain is not always resisted. As we stated last year, the practical effect is thus to introduce a greater risk than that against which the policy of the railway companies is professedly directed. If it is dangerous to carry dynamite openly in a properly constructed van by goods train, separated from all dangerous articles, and subject to the various precautions imposed by the byelaws, it must surely be more dangerous to convey it concealed, perhaps in unsuitable parcels, under the seats of smoking carriages, or among the miscellaneous baggage of a passenger train.

"The railway companies must know as well as we do that there is reason to believe that such surreptitious conveyance is deliberately practised on their lines, and upon what grounds they justify the continuance of a policy which tends directly to the encouragement of that practice, we are at a loss to imagine, unless, indeed, it could be supposed that the companies attach less importance to the possible (or under the present conditions we may perhaps say probable) occurrence of an accident than to the consideration that if any such accident were to occur the explosive which was being carried under their own regulations they would be responsible for damages."

"Again, in our 1879 Report, we said: 'The attention of the companies was formally called by the Board of Trade, at the instance of this Department, to the fact that this prohibitory policy supplies a temptation to the surreptitious conveyance of the prohibited explosives, which it is to be feared is not always resisted. The practical effect is thus to

introduce a greater risk than that against which the policy of the railway companies is professedly directed. If it is dangerous to carry dynamite openly in a properly constructed van by goods trains, separated from all dangerous articles, and subject to the various precautions imposed by the byelaws, it must surely be more dangerous to convey it concealed, perhaps in unsuitable packages, under the seats of smoking carriages or among the miscellaneous baggage of a passenger train. The information which we have received, although unfortunately not sufficiently definite to enable us to institute proceedings, leaves us in no doubt that such surreptitious conveyance is certainly sometimes practised, and that the practice is in some instances the direct outcome of the prohibitory railway policy above referred to.' To the opinion so expressed we decidedly adhere, confirmed therein by the experience of 1882, when Mr. F. H. Edwards, of Newcastle-on-Tyne, was convicted of taking 300 lb. of blasting gelatin with him, by passenger train (and partly in a smoking carriage) from Newcastle to Whitstable, and again in 1883, when John Payle was convicted of a similar offence, and again in 1884, when more than one such case was discovered.

"There is, we fear, too much reason to believe that these are merely instances which have accidentally come to light of a more or less considerable system of surreptitious conveyance of prohibited explosive, which the policy of the railway companies tends directly to encourage."

In France, Germany, and America all explosives are carried by railway companies under proper restrictions.

There is no doubt that the controlling provisions of the Act have appeared somewhat unnecessarily stringent to inventors and manufacturers in certain cases, but the manufacture and storage of explosives must always be accompanied by a certain amount of risk whatever the explosive may be, and obviously the Act must, to be effectual, deal on equal terms with explosives generally, without regard to individual claims to exemption from certain restrictions.

No country in the world possesses an Explosive Act so far-reaching and so efficiently carried out. On the other hand it may be said that no country can boast of such a high standard of manufacture, both as regards the purity and strength of its explosives.

DISCUSSION.

The CHAIRMAN said that the subject of Mr. Hake's paper was undoubtedly one of great and growing importance, and the thanks of the Society were due to him for his admirable résumé of it. Looking at the matter from the scientific side, and going back some 150 years, it was interesting to find that the phlogiston theory then held, although essentially a guess, came singularly near to the facts of modern thermo-chemistry. Being unsupported by quantitative knowledge it utterly failed, but it came very near the mark. The first effect of the advancement of Lavoisier's quantitative chemistry was to throw back a century the knowledge of thermo-chemistry, and seriously hinder progress in all questions bearing on endothermic and exothermic reactions. He could well remember how in the earlier days of Thomson's researches the subject was regarded as absolutely new. In that subject laid the germ of the whole question of explosives. He was very glad that Mr. Hake had called attention to Col. Majendie's important words concerning railway restrictions on the transport of high explosives. It was a common habit on the part of railway companies to practice what was, he thought, falsely alleged of those interesting birds who were said to hide their heads in the sand when danger threatened. It was no trifling matter for the public that in dealing with these dangerous bodies the action of railway managers was practically equivalent to saying to the manufacturers: "Do not tell us anything about it, but we will make such regulations that smuggling will be a necessity." He heartily wished that Col. Majendie had the power to carry his wise remarks into practice. It was just possible that the new Railway Rates Act might give a chance of obtaining some such power, and if so, he trusted that the opportunity would not be lost.

He concluded by inviting Dr. Dupré to give the meeting the benefit of his wide experience of the subject.

Dr. DUPRÉ said that he proposed to make a few remarks, but before doing so would be glad to hear the opinions of some of the practical members who were present. He was in a responsible and somewhat difficult position—a position which not infrequently caused him to be looked upon as a bugbear—and he desired to take this opportunity of dispelling some of the phantasies that seemed to exist in the brains of some inventors with respect to himself. He should therefore like to postpone his remarks until later in the discussion.

Nobody rising, Dr. DUPRÉ, continuing, said that he had listened to the paper with much interest, and it seemed to him that Mr. Hake need not have begun his paper in the modest manner he had done, as he had had a great amount of practical experience on the subject. As was well known to those present, no explosive was permitted to be manufactured in England until it had received the authorisation of the Home Office, and before that authorisation was given the explosive had to undergo a certain examination. But that examination was only imposed in the interests of the public safety, and there was no desire whatsoever on the part of the Home Office to interfere with an important industry, so long as that industry could be carried on without serious danger to the public. If inventors of explosives would but believe that, their feelings with respect to himself would, he thought, be considerably altered. He was often reproached with exercising severe restrictions under the present Act. But he wished to point out publicly, as he had often done to individual inventors, that he was acting under a law which had to be administered by the regular magistrates and judges. If any one infringed the Explosives Act, the Home Office had to prove their case in open court, and the offender was at liberty to call evidence to rebut that of the Home Office. In Germany, and he believed also in France, if an explosive was objected to, the authorities could simply enter the manufactory and order its destruction, without taking any steps to prove that it was dangerous. The position there reminded him strongly of the manner in which the Adulteration Act used to be carried out in Bavaria in the case of milk. The milk was brought to market in earthenware vessels, and it was the practice of the policeman charged with the duty to dip a steel rod into the milk, and to judge the quality of the milk by the character of the drops which ran down the rod on withdrawing it. If he thought the milk was not satisfactory, he simply opened his hand, down came the rod, and out went the bottom of the vessel, and the milk with it. In this country the authorities had not the power to take such summary measures, and therefore it was the more necessary that the initial examination of explosives should be carried out with extreme care. If this were not done, and an explosive proved objectionable, there would be great difficulty in stopping its manufacture. Mr. Hake had alluded in his paper to chlorate mixtures, and he might say that that class of explosives caused him very great trouble and anxiety. The diagram before them showed that no less than 67 chlorate mixture explosives had been invented, of which, not one, so far as he was aware, could be considered safe. They all broke down on one or two points. They were frequently chemically unstable, and they were all highly sensitive to combined friction and percussion. The Chairman might remember that in reference to some former remarks of his (Dr. Dupré's), he had spoken of broomsticks lying about in the Home Office. He confessed that he found a broomstick extremely useful for testing these explosives. Many of them which were said to be quite safe could be readily exploded by striking them with a broomstick on a deal floor. It should be remembered that explosives had often to be rammed into a bore-hole by means of a wooden rod; and even an iron rod was sometimes used. In doing this, a careless workman would often give just that slanting or glancing blow which was especially dangerous with chlorate mixtures. During the three first months of the present year, four lives had been lost, and a number of men seriously injured by explosions resulting from this practice. This point was therefore of great importance; and if any manufacturers or inventors were

present, he would say to them: do not bring forward any explosive for practical use until you have tested it with a penny broomstick—an apparatus as effective as it was simple.

Dr. GUSTAV BISCHOF wished to call further attention to the point raised by Mr. Hake as to the carriage of dynamite, &c. on railways. It would be in the memory of many present that in 1871 there was a general inquiry by the English railway companies into that subject. Being appointed the expert of the North British Railway Co. for the purposes of that inquiry, he had made a number of experiments. The result of one of them had puzzled him very much at the time, and he would refer to it now in the hope that some one might suggest a better explanation for it than he had been able to find himself. Among the questions which he had endeavoured to solve was the following: "Supposing a train laden with dynamite breaks down, or by any other means a number of cases of dynamite are scattered on the line, and another train runs into the *débris*, what will be the effect?" Mr. Nobel being willing to supply him with any quantity of dynamite, and the North British Railway Co. having placed an engine at his disposal, he had all the means for making an experiment on the point. He did so, and found that when he placed a quantity of dynamite on the rails, and laid a train of the explosive to a mass of dynamite scattered about near the rails, only the portions actually on the rails were exploded by the engine. He had referred to this experiment at the dinner given at the opening of Mr. Nobel's works near Glasgow, and the chairman of one of the railway companies who was present seemed to doubt it, remarking in his speech that he would have liked to witness the experiment. It was therefore privately arranged between the speaker and Mr. Nobel that this opportunity should be afforded on the return journey. Small portions of dynamite were accordingly scattered on the rails, and connected with larger quantities placed near by as before. The special train started on its return journey, the driver having been previously warned that there would be some slight detonations, of which he was to take no notice, but that he was to stop the train when they ceased. The train passed over the dynamite, and in an instant a head appeared in every window. He (Dr. Bischof) then addressed the visitors and said that a wish had been expressed to see this experiment, which he had endeavoured to gratify. Nothing remained but to prove that the explosions had not spread to the larger masses, and this he did by applying a fuse to the larger quantities of dynamite, which blazed up, showing that they had not been exploded. He had never been able to quite satisfy himself as to why the explosion did not spread, for one would expect such a detonation to have the same effect, as for instance, that by an ordinary detonating cap. He would be glad if any one experienced in the matter could suggest a reason for the peculiar action on this occasion.

Dr. DUPRÉ said that the difficulty mentioned by Dr. Bischof had occurred to others, and experiments such as that carried out by Dr. Bischof were a source of great trouble in dealing with dynamite and similar explosives. It was a characteristic of this class of explosives that when struck as a rule only that small portion which received the blow exploded. But there was no rule without an exception; and the exceptions to that particular rule were unfortunately numerous. Happily for Mr. Bischof's experiment it accidentally happened that no accident occurred; but it might just as likely have resulted in the explosion of the whole of the dynamite. As a rule that was what would happen, but occasionally it would not; and the exceptions were probably due to slight differences of temperature. For example, if gun-cotton was struck at the ordinary temperature, the explosion would be nearly always confined to the spot struck; but if struck at 80° or 90° the explosion would almost invariably spread. Dynamite could be safely fired at with a rifle at ordinary or low temperatures; but if fired at at summer temperature it would explode with very great violence. It was this characteristic of these explosives that led inventors with an insufficient amount of experience to claim for them that they would not go off by concussion, or that if they should,

it would only be the portion actually struck. That might hold good for a hundred times, and yet on the hundred and first time it might all explode. It was so with dynamite, and it was so with gun-cotton and analogous explosives. Gun-cotton might, for instance, be ignited in a 3-inch deal box and it would burn safely; but put it into a 3-inch box and there would probably be a dangerous explosion, so slight was the margin between danger and safety. Explosives were after all meant to explode, and it seemed to him, to say the least, unwise, when life and property were at stake, to rely too much on their assumed non-explosive character.

Mr. T. TYLER wished to remind members, especially those who had not been able to attend the general meeting at Glasgow last year, that in the Journal of the Society for July 1888 they would find a full account of the interesting experiments carried out at Messrs. Nobel's works during the visit of the Society. In that account would be found ample evidence of the statements now made by Mr. Bischof and Dr. Dupré. He referred to that because he knew of no series of similar experiments, the recapitulation of which to those who did not witness them so conclusively demonstrated the element of uncertainty referred to by Dr. Dupré. On the other hand, those who were present would well remember the almost extreme indifference with which they had seen dynamite handled on that occasion, thus justifying the observations of Dr. Bischof.

The CHAIRMAN, in proposing the usual vote of thanks to the author of the paper, said that he desired also to thank Dr. Dupré for his interesting remarks. He thought that it was of great advantage that one in Dr. Dupré's position should be able to give so lucid an explanation of his status. It was, of course, a great safeguard that no one holding a post of such authority was allowed to act except through the magistrates; though that was sometimes not an unimproved advantage, as the magistrates were often fundamentally ignorant of the subject. It was, for instance, somewhat perplexing when a magistrate showed such ignorance of the fundamental principles of science as to refuse to believe that it was possible to boil a substance without putting fire under it. Nevertheless, it was highly essential that every precaution should be observed, and that a clear case should be made out to an unbiassed mind before any serious action was taken. He would remind the members that most of them had for years regarded picric acid as a harmless substance, but they had all probably looked round their shelves with interest when it was discovered that it had bad habits at times. That was an example of how a substance might be handled for years without accident, and yet possess the possibilities of frightfully explosive power. It was just to guard against a great manufactory being set up on the strength of the supposed harmlessness of substances which might afterwards develop dangerous properties, that the Home Office was invested with its present powers. That office had, he considered, shown marvellous foresight and practical wisdom in the exercise of its functions, and if only similar thoughtfulness were shown by those who actually use explosives, there would have been far fewer accidents in mines and other places where high explosives were used. But, notwithstanding all the care of the authorities, men would use steel rods to ram cartridges into bore-holes, and thaw nitro-glycerin by direct heat from a fire; and while they continued those habits it would be impossible to prevent fatal explosions altogether.

Manchester Section.

Chairman: Ivan Levinstein

Vice-Chairman: Edw. Schneck.

Committee:

J. Angell.
G. H. Bailey.
R. F. Carpenter.
G. E. Davis.
H. Grimshaw.
Harold B. Dixon.

J. Grossmann.
P. Hart.
A. Liebmann.
Sir H. E. Roseve, M.P.
C. Truby.
D. Watson.

Hon. Local Secretary:

J. Carter Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Tuesday, May 7th, 1889.

DR. BAILEY IN THE CHAIR.

ON THE HEAT-PRODUCING POWERS OF TWELVE SAMPLES OF COAL DETERMINED BY BURNING IN OXYGEN (IN THE APPARATUS DEvised BY THE AUTHOR) COMPARED WITH THEIR THEORETICAL VALUES AS CALCULATED FROM THEIR CHEMICAL COMPOSITION.

BY WILLIAM THOMSON, F.R.S.E.

SOME time ago I read a paper before this Society giving a description of a simple apparatus I constructed for determining the heat produced by the combustion of coal in oxygen (this Journal, 1886, 581—584). I then promised to give a further paper on the comparison of the chemical composition of a number of different coals, with their heat-producing powers. I selected 12 samples as follows for these experiments:—

1. Coal from Nixon's Navigation Collieries, Glamorgan.
2. Thackerley Collieries, Tyldesley.
3. Tyldesley Coal Co.
4. (Scotch coal), Drumgray, near Glasgow, bottom of seam.
5. (Scotch coal), Drumgray, near Glasgow, "mid-rib" of seam.
6. (Scotch coal), Drumgray, near Glasgow, top of seam.
7. Bickershaw Main.
8. Pemberton 5 ft.
9. Crombourne.
10. Wigan 4 ft.
11. Bickershaw 7 ft.
12. Pendleton 4 ft. (Andrew Knowles & Co's., Limited).

Supplied by Edward Storey and Co., of Liverpool.

The only modifications in the apparatus originally employed are, first, that a small glass tube is fused on at right angles to the tube at the top of the glass bell which receives the oxygen delivery tube, and on which is attached a piece of india-rubber tube closed by a spring clip, so that the water in the calorimeter may be allowed to enter and completely fill the bell and come in contact with the apparatus without rendering it necessary to withdraw the copper oxygen delivery tube. When the combustion is finished, the glass bell is drawn to the surface of the water, the clip removed and slipped on to the projecting glass tube, and the bell, with its wire gauze rings, moved up and down to thoroughly mix the water and remove the heat from any part of the interior of the apparatus. The second modification is the fixing of the bottom rim of the bell to a brass collar by means of plaster of Paris, this rim being made to fit in the stand carrying

the platinum crucible and coal, by a bayonet joint, which can be rapidly fixed by merely placing the bell on the stand and twisting it round.

The third modification is the determination by direct experiment of the specific heat value (in terms of water) of the whole apparatus which comes in contact with the water. For this purpose, 2,000 grms. of water are heated in one vessel to about 10° above the atmospheric temperature, and the whole then rapidly poured into the calorimeter, at the temperature of the atmosphere, the bell apparatus, in which the combustion is made, being left in the large beaker, and arranged at first so that no water can enter. The loss of heat is taken after stirring for a few moments and then opening the clip to allow the water to enter the bell, after the manner of actually working the apparatus. The specific heat of the part of the apparatus which actually comes in contact with the water as it is used in making the experiment may thus be determined. It is necessary to have the flask or other vessel which holds the warm water as nearly as possible 2,000 cc. capacity, so that no heat may be lost by coming into contact with any portion of cold glass in the act of pouring. To find the amount of water to which the apparatus is equivalent, assume that *one-half* of the difference between the temperature of the 2,000 grms. of water and that of the air is equivalent to 2,000 grms. of water, and calculate the result by proportion. Thus, if the atmospheric temperature in the dry calorimeter be 60° F., and the water poured into it 68°, then, after mixing, if the temperature stand at 67·2°, the equivalent of water would be—

$$\frac{2,000 (68 - 67 \cdot 2)}{68 - 60} = 400 \text{ cc. of water,}$$

so that it would be assumed that 2,400 grms. of water are heated in the calorimeter instead of 2,000.

The analyses of the coals were made as follows:—

The volatile matter and coke were determined by heating about 150 grains in a platinum crucible with a well-fitting lid till all volatile matter had been driven off. The ash was determined by burning in a muffle furnace about 25 grains.

The sulphur was estimated by heating 50 grains of the coal with twice its weight of pure sodium bicarbonate till it was almost all burned away. The mass was then fused, and a little potassium nitrate added to ensure the complete conversion of the sulphur into sulphate. The filtered water solution of the fused mass was then precipitated with barium chloride in presence of free hydrochloric acid.

The nitrogen was determined by heating 50 grains of the coal in fine powder with soda lime in a tube in the combustion furnace, and passing the vapours into standard acid.

The carbon and hydrogen were determined by taking about 5 grains of the coal previously dried in an air-bath at 105° to 110° C. for one hour. By this means the moisture was estimated, and the coal so dried was then transferred to a porcelain boat, and burned, first with dry air free from carbon dioxide, and then with dry oxygen free from carbon dioxide, the gases being passed through red hot oxide of copper, and then through lead chromate to the calcium chloride tube and potash bulbs.

The comparisons for heating power deduced from the chemical composition given in the accompanying table are calculated by assuming that all the carbon found would yield on combustion 8,080 Centigrade units of heat. The oxygen present was assumed to be in combination with the hydrogen, as in water, so that an equivalent of hydrogen calculated from the oxygen present was deducted from the total hydrogen, and the difference in hydrogen calculated as giving 34,462 units of heat. The sulphur also which burned away was calculated as giving 2,220 units, whilst the nitrogen was not taken into consideration.

The following is the order in which the different samples stand, the figures on the left showing the order of value as obtained by direct experiment, the figures on the right giving the order of value as determined by calculation from the chemical composition.

Order by Experiment.		Order by Calculation from the Chemical Composition.
1	Nixon's Navigation Colliery.....	1
	A. Knowles and Co.'s Colliery, Pendleton	2
	Bickershaw Collieries, Wigan 4 ft.	4
	Drumgray (Scotch), top part of seam	6
5	Bickershaw Collieries, Bickershaw Main .	3
6	" " Crombourke.....	12
7	" " Bickershaw 7 ft. ..	9
8	Drumgray (Scotch), bottom of seam	5
9	" " Pemberton 5 ft.	8
10	Tyldesley Coal Co.	7
11	Drumgray (Scotch) (mid-rib).....	10
12	Thakerley Collieries	11

ANALYSES OF COAL.

	Nixon's Navigation Collieries, Glam.	Thakerley Collieries, Tyldesley.	Tyldesley Coal Co.	"Upper Drumgray Seam."			Bickershaw Collieries, Leigh, near Manchester.					A. Knowles & Co.'s Colliery.
				Bottom.	Hard Mid-rib.	Top Part.	Bickershaw Main.	Pemberton 5 ft.	Crombourke.	Wigan 4 ft.	Bickershaw 7 ft.	Pendleton 4 ft.
Volatile matter.....	11·722	30·103	32·085	25·633	24·264	27·553	29·809	32·287	31·666	28·314	31·228	28·527
Fixed carbon.....	84·046	50·276	57·755	65·037	60·899	64·629	63·879	56·464	57·871	64·099	61·212	65·661
Ash.....	3·216	14·902	4·086	6·549	12·576	4·286	1·961	4·550	3·313	2·749	*960	1·912
Moisture.....	1·016	4·719	6·074	2·781	2·261	3·532	4·360	6·699	7·150	4·838	6·600	3·900
	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000
Coke.....	87·262	65·178	61·841	71·586	73·475	68·915	65·831	61·014	61·184	66·848	62·172	67·573
Total sulphur.....	*787	1·619	*646	*749	*543	*862	1·006	1·021	1·449	1·238	*699	*629
Fixed sulphur.....	*068	*230	*154	Absent	Absent	Absent	*025	*089	*283	*171	*018	*040

ANALYSES OF COAL—continued.

	Description of Coal.											
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
	Nixon's Navigation Collieries, Glam.	Thackerley Collieries, Tyldesley.	Tyldesley Coal Co.	"Upper Dringray Seam."			Bickershaw Collieries, Leigh, near Manchester.					A. Knowles & Co.'s Colliery.
				Bottom of Seam.	Hard Middle.	Top of Seam.	Bickershaw Main.	Pemberton 5 ft.	Cronbourke.	Wigan 4 ft.	Bickershaw 7 ft.	Pendleton 4 ft.
Carbon	88.029	68.134	74.464	75.184	72.130	75.043	78.930	72.409	69.774	76.187	73.913	79.760
Hydrogen.....	4.112	4.777	5.105	4.982	4.672	5.123	4.904	5.158	4.819	4.964	4.858	4.893
Oxygen.....	1.977	4.861	8.251	7.865	6.565	9.391	7.239	8.844	12.445	8.458	11.320	7.517
Nitrogen.....	.961	1.218	1.528	1.599	1.253	1.757	1.565	1.498	1.333	1.437	1.668	1.429
Sulphur.....	.689	1.389	.492	.749	.543	.862	1.041	.932	1.166	1.067	.581	.589
Ash.....	3.216	14.902	4.086	6.549	12.576	4.286	1.961	4.550	3.313	2.749	.960	1.912
Moisture.....	1.016	4.719	6.074	2.781	2.261	3.532	4.360	6.699	7.150	4.838	6.600	3.900
	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
Total organic matter...	95.079	78.090	89.348	89.921	84.620	91.320	92.638	87.819	88.371	91.346	91.750	93.599
Which is composed of—												
Carbon	92.585	86.257	83.342	83.945	85.210	82.182	85.203	82.443	78.956	83.733	80.551	85.215
Hydrogen.....	4.325	6.047	5.713	5.541	5.521	5.610	5.294	5.873	5.453	5.434	5.294	5.227
Nitrogen.....	1.011	1.542	1.710	1.768	1.181	1.924	1.689	1.603	1.508	1.574	1.818	1.527
Oxygen.....	2.079	6.154	9.235	8.746	7.758	10.284	7.814	10.071	14.083	9.259	12.337	8.031
	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
Calorific power:—												
Found by experiment.....	8,340	6,448	7,069	7,384	6,954	7,533	7,465	7,242	7,456	7,552	7,417	7,736
Calculated.....	8,459	6,972	7,439	7,493	7,166	7,443	7,778	7,267	6,787	7,549	7,176	7,819

Mr. Scheurer-Kestner has lately published a number of similar analyses of a very interesting nature, but his results differ from mine in that all his figures obtained by experiment are higher than those obtained by calculation from the chemical composition. In my results the calculated figures in seven out of the 12 for calorimetric value are higher than the figures obtained by experiment, two are practically the same and three are lower.

I have to thank my assistant, Mr. J. Porter Shenton, for the very careful manner in which he made the analyses and experiments given in this paper.

DISCUSSION.

The CHAIRMAN did not understand what was meant to be the force of Mr. Thomson's remark, that in the case of one coal the result was higher than that obtained from burning pure carbon, because after all there was nothing to be astonished at in such a result. They knew that the heat of combustion of hydrogen was 34,000 calories as against 8,000 in the case of carbon, and there was no reason why the heat combustion of a particular coal composed of carbon and hydrogen should not be higher than a given amount of carbon if it were low in ash. He should like to ask Mr. Thomson in what way the coal was dried, because it was a matter of importance and there were one or two precautions which were frequently overlooked. At the time when this calorimeter was first brought before the Society, Mr. Thomson had promised to give further particulars as to determinations made upon coals which would add to the value of the paper. For his own part he never supposed that Mr. Thomson could expect more than very

approximate results from such an apparatus. Some had been very careful in the matter of their calorimeter, but had erred in not exercising sufficient care in the selection and examination of the coals chosen for experiment. Mr. Thomson, on the contrary, seemed to expect too much from his calorimeter, because whatever the calorimeter is calculated to do they could not expect accurate results from such an instrument. It might give comparable results, and these might be extremely valuable from a commercial point of view; but when it was sought to approach, as Mr. Thomson seemed inclined to do, a question of great scientific importance which had been already most carefully worked at, it was questionable whether any advantage was gained. It appeared to him that the problem which wanted solving was how to exercise more care in regard to the selection of the coals so as to admit of generalisation being deduced. To see, for instance, that they showed as far as possible similar physical characters and were not unlike with regard to their volatile constituents and ash. If a few samples of coals were examined in various ways experimentally they might learn some valuable facts. Mr. Thomson assumed that the whole of the moisture was condensed in the calorimeter. This he doubted. Whether all the allowances referred to were small or not they must affect the correctness of the results in a degree which could not be overlooked in measurements of calorific power of coal. Mr. Thomson had stated that the drying of the finely powdered coal was continued several hours till the weight was constant. His own experience was that the coal under these circumstances lost weight continually, first by giving up moisture and then by oxidation of the coal, and it was a matter in which some judgment was required as to when the moisture had been

driven off. Finely divided coal was known to oxidise even at temperatures below 100°C ., and he was acquainted with a case where it had even fired when a thin layer of dry coal was exposed to a temperature not exceeding 150°C .

Mr. Wm. Thomson, in reply, said he had gone into the question of the amount of heat carried off by the oxygen used in the combustion, and had found it to be so small that it was within the range of experimental error. He found it best to commence the experiment with all the apparatus at exactly the same temperature as the atmosphere.

It had been suggested that experiments should be commenced with the temperature a few degrees below the atmospheric temperature, but to get all the appliances, gas, and water to any temperature higher or lower than the normal, was a matter of great difficulty. Such a temperature would be liable to variation between the time when read off and when the experiment was made. He allowed everything to stand for a day, so that the apparatus, oxygen and water employed were all at the temperature of the atmosphere.

The amount of heat abstracted by the 2,000 grms. of water employed for the combustion of 1 gm. of coal amounted only to about 7°F . They had, therefore, the difference between the temperature of the air and the amount of gas, which varied from about $\frac{1}{3}$ to $\frac{1}{2}$ cubic foot. Now, if they took, for instance, the specific heat of oxygen or carbon dioxide, and the amount of gas required for the experiment as compared with the specific heat and quantity of water used, the error thus introduced was so small that for ordinary work it might be disregarded, as it lay within experimental error when the experiment was made without extraordinary precautions. As to the water converted into vapour by the change in temperature of the gas during the experiment, the difference between the amount of moisture in solution in the oxygen before the experiment and afterwards was so small that it might also for ordinary purposes be disregarded. As a test of the efficiency of this apparatus, he determined the heat produced by the combustion of purified charcoal, and found that it gave the figure obtained by Favre and Silbermann within 8 per cent. There was, however, one point which was necessary to observe, and that was the loss of heat from radiation. The heat gradually rose one degree per minute for the seven minutes during which the experiment lasted; then he left the apparatus to cool for seven minutes more, and he found it sufficiently accurate to divide the loss by two, and add that to the temperature obtained by the thermometer. This error might be much more accurately determined, but for ordinary practical purposes greater refinement is unnecessary. He thought the Chairman's suggestion to get two coals of different composition, but with the constituents built up chemically in the same manner, would be quite impossible. He had studied the question of error produced by the water taken up by the oxygen or burned gases during the experiment, but as the total quantity of water contained in $\frac{1}{3}$ to $\frac{1}{2}$ a cubic foot of gas at the ordinary temperature of the atmosphere was very small, and the amount due to the rise of 7° above the atmospheric temperature still smaller, the heat thus lost as latent heat might also for ordinary purposes be disregarded. It sometimes happened that when the oxygen was turned on too rapidly, or for some other reason some free carbon was liberated, the experiment might be regarded as spoiled; but when two experiments on the same coal were carried out satisfactorily, the results were the same, as nearly as the readings of the thermometer could be made. The thermometer he employed had a large bulb, and the readings could be made to about $\frac{1}{100}$ th of a degree F . The samples of coal used in his experiments were dried at 212°F . He suspected, like the Chairman, that the estimation of water by this method was unsatisfactory; but even Scheurer-Kestner worked this way, and he found that he soon reached a point when the coal ceased to lose weight. The Chairman mentioned the spontaneous ignition of coal dust at a temperature of 150°F . He must confess he could not understand this unless steam or moisture came in contact with it, and induced the oxidation of some finely-divided iron pyrites from which coal is never absolutely free.

Glasgow and Scottish Section.

Chairman: R. R. Tatlock.

Vice-Chairman: Wm. Dittmar.

Committee:

G. Beilby	R. Irvine.
Wm. Boyd.	G. McRobert's.
A. Crum Brown.	E. J. Mills.
J. Christie.	J. M. Milne.
W. S. Curphey.	T. L. Patterson.
D. B. Dott.	E. Smith.
Wm. Foulis.	E. C. C. Stanford.
J. Gibson.	A. Whitelaw.

Hon. Treasurer: W. J. Chrystal.

Hon. Local Secretary:

G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

A CORRECTION.

IN Dr. Weir's reply on page 448 of the June issue, he is incorrectly reported to have said that the Chinaman preferred to smoke opium containing little or no morphia because, if not used to excess, it would do him no harm. Dr. Weir wishes it to be stated that his meaning was misapprehended; and that what he did say was that the Chinaman preferred an opium which, as it happened, contained a much smaller percentage of morphia than the opium produced in, say, Asia Minor, because he found that he could obtain from such opium a greater percentage of *smokable extract* than from other kinds of opium richer in morphia.

Obituaries.

JOHN DALE, F.C.S.

JOHN DALE was born in Birmingham on the 11th of May 1815. He was educated in Birmingham and Warwick. In the latter town was an excellent schoolmaster, under whose care the subject of this sketch was placed, and to whose original and attractive mode of teaching Dale attributed much of the acuteness and power of observation subsequently developed in him.

This teacher was accustomed to take his pupils out walking, and to ask them questions on all natural objects that they came across, supplying them meanwhile judiciously from his own large fund of general information.

His school days at an end, John Dale went to Denbigh and was apprenticed to a chemist and druggist. Later on he removed to Rhyl, where he had access to a number of chemical and pharmaceutical books, and no doubt in the prosecution of his studies, all his spare moments were occupied.

He next proceeded to Manchester, and there acted as assistant to a Mr. Ansell, a chemist and druggist, a member of the Society of Friends, who was also an acquaintance of the renowned John Dalton. This was in the period between the years 1833 and 1835. (Ansell at that time was the only dealer in chemical apparatus to be found in Lancashire and Cheshire.) Under the circumstances it was only to be expected that Dale would soon make the acquaintance of

Dalton. That acquaintance once made, it soon ripened into friendship, for John Dale became Dalton's pupil. It was, moreover, but a foregone conclusion that so apt a pupil would be fired with the enthusiasm and genius of such a master, and indeed Dale not long after this commenced a course of lecturing on chemistry in all the principal towns of Lancashire. He received from Dalton especial commendation and, indeed, compliment on his skilful and original lecture-experimenting.

There now followed another slight change in a temporary removal to Altrincham. This, however, was soon succeeded by the return to Manchester, where a shop was taken in St. Mary's Gate, and it was during this period that Dale made the acquaintance of Mr. Thomas Roberts, with whom, some years later on, he entered into partnership. In the interim he became manager of a calico print works in Ardwick, and continued his duties in that capacity up to the year 1852, when he went to Cornbrook and started with Mr. Roberts the chemical works, which under his directorship became famous, and made widespread the name of the firm of Roberts, Dale, and Co. But previous to the entry of John Dale, these works had been occupied in the manufacturing of dyewood extracts, British gum, and wood spirit, and in the Exhibition of 1851, specimens of ultramarine manufactured by Kurtz were exhibited. It is noteworthy that after the formation of the new firm, numerous new methods of manufacture were introduced in place of older processes. This brings us to about the year 1854, when the staple trade of the firm was wood extracts and British gum. About this period the paperhanging trade began to develop, and the only colours then available were such as could be got at the oil and colourman's shop, such as *Venetian red*, *Verdigris*, *Bremen blue*, &c. Dale now introduced a much finer variety of colours; amongst them a much superior class of chrome yellows, and he gave a great impetus to the trade by introducing his lakes made from wood extracts. Shortly after, the manufacture of oxalic acid from sawdust by heating to fusion this material with the mixed alkalis, potash and soda, was commenced at the Warrington works, which later on was managed by Dale's eldest son, John. It was in accordance with a new process devised in Dale's laboratory and patented in 1856. The working of the new process, which marked a very important epoch in chemical industry, was undertaken in conjunction with J. D. Pritchard, and subsequently brought to further perfection by Dale, and carried on until such time as potash became sufficiently cheap to justify its sole use. Those who recollect the reports issued at that time of this process, will remember that the mode of separating the alkaline salts was based on the fact that whilst the potash salt was soluble the soda salt was insoluble in water. It is exceedingly probable that in connexion with the operations of this process, vacuum filtration on an industrial scale was employed for the first time; such an accelerated method of filtration being, of course, highly desirable in connexion with the separation of the oxalic acid solutions from gypsum, when the calcium oxalate obtained by causticising the insoluble oxalate of soda with boiling milk of lime, came to be treated with sulphuric acid. No doubt John Dale was perfectly aware of Gay Lussac's reaction discovered in 1829, by which carbohydrates and celluloses fused with potash yield oxalic acid. But he founded upon it the successful commercial process referred to. Just about this period, too, the manufacture of "solid caustic soda" was commenced and successfully prosecuted. The record now brings us to the year 1858, when Perkin discovered mauve, which he prepared from commercial aniline, using as his oxidising agent potassium bichromate. In conjunction with Caro, who was engaged as chemist about the years 1860 to 1861, Dale now endeavoured to find an equally effective oxidising agent to bichrome for preparing mauve, and at length it was discovered that copper sulphate, in conjunction with alkaline chlorides, answered the purpose; but to Dale's discernment was due the further and most important refinement of the process, involved in the judicious addition of a moderate amount of alkali. In fact, the obtainment of the desired yield of colour depended upon this collateral neutralisation with alkali. A distinct advantage was obtained in that, along with a good yield

of mauve, a black pigment was also produced, easily separated from the violet colouring matter and possessing a special value of its own. The formation of this black colour is all the more interesting inasmuch as it may be said to have led to the discovery of aniline-black by Lightfoot, to whom the reaction had become known.

In the meantime, C. A. Martins had been engaged as chemist at the Warrington works, and came there from Hofmann, in whose laboratory he had acquired a sound theoretical knowledge of the then recently discovered aromatic bases such as phenylene diamine, dimethylaniline, &c. He was at once set to work by Dale with the object of preparing new colours from such aromatic bases, through the medium of nitrous acid obtained from nitrite of soda.

From this course of experiments directly sprang the manufacture of Manchester brown ("Bismarck brown"), and Manchester yellow ("Martins yellow").

The patent for the Manchester yellow was taken out in the joint names of Dale, Caro and Martins (Eng. Pat. 2785 of 1864). Ordinary Aniline yellow or amido-azobenzene ("Fast yellow") was next placed in the market. The induline group, so named in the patent taken out by Dale and Caro (Eng. Pat. 3307 of 1863) was discovered about this period. Somewhat before this date, John Dale had commenced the manufacture of picric acid, first from Australian gum, and later on more advantageously from commercial carbolic acid.

Then followed the manufacture of aurin, which was also commenced about this period. John Dale's youngest son, R. S. Dale, was now set to work by his father upon the aurin process, which he completed, and in conjunction with Schorlemmer, wrought out the theoretical development of the subject, and with Schorlemmer succeeded in converting aurin into pararosaniline, thus establishing it as a triphenylmethane derivative (this Journal, 1885, 476). Further aniline colours were later on prepared in Dale's laboratory, and afterwards manufactured in the works. Among the names of those noted chemists who were engaged in Dale's laboratory were those of Caro, Martins, Schad, Leonhardt, and Koepf.

There were some novel and original processes devised and carried out during this period of great activity, which it may be interesting to notice. First and foremost amongst these was the use of the caustic soda and potash boiler, in which the evaporated water was utilised as steam, and consequently the fuel used in the evaporation was rendered more efficient, the steam being used for driving engines, whilst by the aid of this steam under pressure, the concentrated caustic liquors were at length, or when desired, forced over into a caustic pot, and there finished in the usual way. This method of working was modified later on, to the still greater economy of fuel, by the addition of vacuum apparatus, at the suggestion of Dale's youngest son.

A similar process and apparatus were subsequently used for the boiling down and recovery of esparto liquors by R. S. Dale.

But not only was the mind of Dale fertile and resourceful as regards manufacturing methods, but his ardent study of the pure science now stood him in good stead as regards analytical and valuation methods, and it is a fact that he mainly devised his own analytical processes. For example, the method for estimating tin with potassium bichromate was his, as was also that for determining indigo by reduction with copperas and lime, a vessel of water being connected with the closed vessel containing the reducing solution. As soon as the reduction was perfect (a siphon tube with tap connecting water vessel and reduced indigo solution) the tap was opened, and the volume of water sucked in corresponding to that of the oxygen absorbed, gave the data for calculating the weight of indigo present in the sample. It is believed that this method is now published for the first time. Another remarkably ingenious process was that devised by Dale as a rapid means of estimating in a quantity of the mixed alkalis, potash and soda, the amount of either. Each estimation only occupied half an hour. It was a volumetric method and was accurate

to half a per cent. Standard solutions of potash and soda were prepared. The mixture of the alkalis was taken and to it was first added a solution of tartaric acid to the point of neutralisation, and then just as much again for the production of bitartrate. The bitartrate of potassium being insoluble in a solution of bitartrate of soda of about 6° Tw., was fully precipitated. Filtration from the crystalline potassium salt now rapidly followed, and the precipitate was lightly washed with water, and both filtrate and precipitate were then separately treated with the respective solutions of known strength of potash and soda, whereby was alkalimetrically determined the excess acidity due to the bitartrates, and hence the amounts of the alkalis themselves present. R. S. Dale then modified his father's process, so as to render it available for mixtures of the chlorides and sulphates of the mixed alkalis respectively. These may serve as a few examples of many ingenious and highly useful commercial assay methods devised by Dale. During the last four or five years Mr. Dale's health had been failing, but his interest in the later developments of all branches of chemical industry had never flagged in spite of this. His loss will be greatly felt in the business with the interests of which he has been so long intimately connected. Very few chemists connected with the papermaking, calico printing and textile industries failed to apply at one time or another to him for counsel and advice, and never failed to obtain the assistance they desired. He died May 31st, 1889, and thus another of those great lights of former days, which have contributed to render illustrious the name of the Literary and Philosophical Society of Manchester, is removed, and we may truly say that whilst Joule stands pre-eminent in physical research, and Dalton in chemical theory, that John Dale, Dalton's pupil, takes rank as a typical representative of the successful application of chemical science to chemical industry.—W. S.

GASTON PLANTÉ.

M. GASTON PLANTÉ commenced his scientific life as laboratory assistant to Ed. Becquerel. Later, he became chemist to the firm of Christoffe et Cie. The study of galvanic polarisation, commenced in the laboratory of Becquerel, led to the publication of a series of papers since issued in a collected form. These "*Recherches sur l'Electricité*" deal mainly with the development of storage batteries, with which the name of Planté must always be associated. He died at Paris, at the age of 55, on the 24th of May last. To the Academy of Sciences he has bequeathed a sum of money sufficient for the establishment of a prize of 3,000 francs, which will be awarded every second year to some distinguished French electrician. His house and large gardens at Bellevue, near Paris, he has left as a place of retreat for indigent *savants*.—W. W. H. G.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements in Centrifugal Fluid Separating Machines. W. Bergh, London. Eng. Pat. 4698, March 27, 1888. 8d.

THE improvements described in this specification refer more particularly to the suspension of the separator drum and its

carrying spindle. The bottom of the spindle is fitted with a cone centre which runs on a hard bearing in an adjustable footstep carried on the bedplate of the machine; the usual method in such machines is to carry the entire weight of this revolving portion from the upper bearing by means of a collar or similar device. The friction due to the ordinary method is hence eliminated, and the machine is practically frictionless.—C. C. H.

Improvements in Means for Expelling Liquid from and Compressing Sludge and other Semi-Fluid or Plastic Substances. J. Price, London. Eng. Pat. 8491, June 9, 1888. 6d.

See under XVIII. B., page 563.

An Improved Method of Straining or Filtering Fluids, and Apparatus therefor. J. G. Lorrain, London. Eng. Pat. 9667, July 3, 1888. 6d.

IN Eng. Pat. 6813 of 1886 (this Journal, 1887, 501), the inventor described a form of filtering medium consisting of a number of spheres of elastic material resting on each other, the interstices between the points of contact of the spheres forming the filtering spaces. These could, of course, be rendered smaller and hence a finer degree of filtration secured by compressing the spheres so as to diminish the size of the spaces or interstices. In the present instance the patentee proposes to apply the same media to centrifugal machines. The higher the speed the greater the compression of the spheres and the finer the degree of filtration, and *vice versa*. The degree and rate of filtration is thus dependent entirely upon the speed of rotation.—C. C. H.

Improvements in or relating to Lids for Drums and other Vessels and for Holes in Sheet-Metal Articles. J. Johnson and R. G. Brook, St. Helens. Eng. Pat. 10,526, July 20, 1888. 8d.

THIS invention has for its special object the sealing of holes in vessels containing "caustic grease, oil," or other matter, but can be applied to fixing lids over holes in any description of sheet-iron vessel. The lid has three projections on its inner face, two of them being plain, and secured to the lid. The third is placed diametrically opposite to them, and is moveable in dovetailed guides, or cheeks secured to or made solid with the lid. This moveable projection (or button) can be moved externally, either by a bar or key working in a slot, or other means. In fixing the lid, it is placed over the hole, and the fixed projections being forced under the rim, the moveable projection is then shifted until it presses against the rim and secures the lid.—E. S.

Improvements in Apparatus for Evaporating, Concentrating, and Distilling Liquids. W. R. Watson and R. A. Robertson, Glasgow. Eng. Pat. 11,485, August 9, 1888. 1s. 3d.

THIS invention is for improved apparatus acting on the same principle as that described by Yaryan, Eng. Pats. 14,162, of 1886, and 213 of 1888 (this Journal, 1887, 39, and 1888, 313). The improvements consist principally in the arrangement of the pipes by constructing them in a manner to provide for both the entry and discharge of the liquid under treatment at the same end of the apparatus. This enables the sets of tubes or coils being fixed to the shell or casing at one end only, allowing the other end of the tubes to freely expand and contract. It also admits of the whole series of tubes being readily withdrawn, whilst it obviates the necessity of external pipe connexions between the several concentrating vessels. The improvements are applicable to single-effect as well as to multiple-effect apparatus. The specification is accompanied with five sheets of drawings.—B.

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Luck, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	½d.
Above 8d., and not exceeding 1s. 6d.	1d.
" 1s. 6d., " " 2s. 4d.	1½d.
" 2s. 4d., " " 3s. 4d.	2d.

Improvements in Apparatus for Evaporating, Concentrating, and Distilling Liquids. W. R. Watson and R. A. Robertson, Glasgow. Eng. Pat. 17,809, December 6, 1888. 8d.

The inventors here propose another improvement in apparatus of this class, by using double tubes, one within the other, having a central and an annular passage between their sides. The liquid is led into the annulus and the heated vapour or steam through the centre part. The tubes are grouped in series, and both liquid and vapour pass through them in a constant stream regulated by slides and valves, and the operation may be completed in one or more series of tubes according as single or multiple effect is desired.—B.

Improvements in and relating to Ammonia Engines and to Apparatus Connected therewith. J. H. Campbell, New York, U.S.A. Eng. Pat. 3873, March 5, 1889. 8d.

Aqua ammonia is placed in a boiler to which heat is applied to liberate the ammonia gas held in solution by the water. The ammoniacal gas then passes to and operates the engine, and the exhaust gas re-saturates partially spent aqua ammonia (previously drawn from the boiler) before it is returned to the boiler. This saturation is effected by cooling the partially spent aqua ammonia and bringing it into contact with the exhaust ammonia gas or vapour which it absorbs, increasing the degree of saturation of the ammonia solution, which is then returned to the boiler for the repetition of the operation. The improvements comprised in this specification consist in the methods and apparatus (1) for fully re-saturating the weak ammoniacal solution used by diffusing it in the form of spray through the exhaust vapour from the cylinder. This is accomplished by subjecting it and the unabsorbed vapour to further steps of absorption, and in disseminating the heat set free at each step by means of a cooling fluid. (2) In drawing off any vapour in excess of saturation of the spraying fluid after the fluid has been used for absorbing the exhaust vapour, enforcing final absorption by pressure. (3) In controlling any excess of pressure in the boiler without wasting any of the ammonia contained in it. (4) Working a secondary engine in conjunction with the main engine, both using the same absorbing apparatus. (5) Lubricating the cylinder and valves of the steam chest by injecting ammonia-solution under "boiler pressure" from the boiler. (6) Preventing foreign matter from passing from the boiler to the absorbing jet by means of a suitable strainer in the connecting pipe. The patentee makes 16 claims.—E. S.

Improvements in Travelling Platforms, Beds, or Trucks for Kilns or Ovens for Drying, Burning, Baking, and similar Operations. J. C. Fellner and C. Ziegler, Boekenheim, Germany. Eng. Pat. 6938, April 25, 1889. 11d.

In this invention the difficulties attending the proper lubrication of the platform wheels, owing to the high temperature to which the lubricating material is exposed, are obviated by constructing the travelling platform in such a way that the friction of rollers is substituted for that of bearing-axes; while at the same time, the concussion of the separate sections is avoided, and the use of buffing apparatus is greatly reduced. For this purpose the travelling platform is carried on two sets of paired, flanged wheels and rollers of different diameters, fixed on the same axle, and arranged on an endless chain and running on rails. The smaller (or outer) set only runs on the railway, the larger (or inner set) merely supporting the travelling platform, each platform having rails on the under side corresponding to the gauge of the larger wheels, on which they rest. By duly proportioning the diameters of the two sets of wheels, the advance of the platform may be made to bear any desired proportion to that of the rollers. As all the sections of the platform necessarily move simultaneously, further arrangements are made for effecting their removal and introduction, from or to the kiln, independently of each other. Full details are shown in the three drawings attached to the specification. The inventions are protected by four claims.—E. S.

II.—FUEL, GAS, AND LIGHT.

A Rapid Method for the Examination of Fire-Places. G. Lange. Zeits. f. angew. Chem. 1889, 240—242.

F. FISCHER has made an examination of fire-places and of the methods for judging of their efficiency. Theoretically Fischer's method is most accurate, but in practice it entails too much work and requires too much time. Lange thinks that the same end can be obtained by a simple determination of the carbonic acid in the fire-gases and their temperature. Whatever the composition of the coal or coke used as fuel, 1 kilo. of carbon forms 1·854 cubic metres of carbonic acid at 0° C. and 760 mm. pressure. The determination of carbonic acid in the fire-gases shows the amount of oxygen and nitrogen mixed with it, or if n volume per cent. be the amount of carbonic acid, then $100 - n$ represents the volume per cent. of oxygen plus nitrogen, or—

$$\text{for 1 kilo. of carbon} = 1\cdot854 \frac{100 - n}{n} \text{ cubic metres of O and N.}$$

If t^1 = temperature of fire-gases; t = temperature of air; c = specific heat of 1 cubic metre of CO_2 (up to $150^\circ \text{C.} = 0\cdot41$, $150^\circ\text{--}200^\circ \text{C.} = 0\cdot43$, $200^\circ\text{--}250^\circ \text{C.} = 0\cdot44$, $250^\circ\text{--}300^\circ \text{C.} = 0\cdot45$, $300^\circ\text{--}350^\circ \text{C.} = 0\cdot46$); and c^1 = specific heat of 1 cubic metre of O or N (about 0·31), then the loss of heat in fire-gases for each kilo. of carbon burnt, expressed in calories, is $L \cdot H$ (loss of heat) = $1\cdot854 (t^1 - t) c + 1\cdot854 (t^1 - t) \frac{100 - n}{n} c^1$. The calorific value of 1 kilo. of carbon is equal to 8,080 calories, consequently the formula $\frac{L \cdot H}{8,080}$ indicates the percentage of loss of heat by the fire-gases. An example will best illustrate the mode of applying the formula. On examining the fire-gases from a small stove it was found, in the morning, that they contained 7·8 per cent. of CO_2 , and their temperature was 221°C. The temperature of the air was 6°C. In the afternoon the carbonic acid gradually decreased from 5·4 to 2·8 per cent. of CO_2 , on an average, to 3·7 per cent. of CO_2 , with a temperature of the gases at 178°C. , the temperature of the air being 8°C.

For the work of the morning the loss of heat amounted to:—

$$\begin{aligned} L \cdot H &= 1\cdot854 (221 - 6) \times 0\cdot43 + 1\cdot854 (221 - 6) \frac{100 - 7\cdot8}{7\cdot8} \times 0\cdot31 = 1,635 \text{ calories or percentage of} \\ L \cdot H &= \frac{100 \times 1,635}{8,080} = 20\cdot2 \text{ per cent.} \end{aligned}$$

For the work of the afternoon the loss of heat amounted to:—

$$\begin{aligned} L \cdot H &= 1\cdot854 (178 - 8) \times 0\cdot43 + 1\cdot854 (178 - 8) \frac{100 - 3\cdot7}{3\cdot7} \times 0\cdot31 = 2,676 \text{ calories or percentage of } L \cdot H = \\ &= \frac{100 \times 2,676}{8,080} = 33\cdot1 \text{ per cent.} \text{—S. H.} \end{aligned}$$

Firing with Liquid Fuel. L. Loew. Dingl. Polyt. J. 272, 364—375.

THE author points out that the employment of liquid fuel dates from the early ages (440 to 441 B.C.). It is only within comparatively recent years that any appreciable advance has been made in rendering it capable of taking the place of solid fuel, and for obvious reasons it is in America and Russia that the most favourable results have been obtained. Crude petroleum is unsuited for the purpose of fuel owing to its low flashing point. In the Caucasus the raw product is first exposed two or three days to a gentle heat, which removes the dangerous and more volatile portions of the oil. This is, moreover, advisable, since the thinner the oil the greater the amount of fuel used up for a given calorific effect; also the flame produced is very long.

Petroleum residues are very suitable for fuel, and are used almost exclusively for that purpose on steamers of the Caspian and Black Sea.

Residues from the distillation of lubricating oils, being very cheap, are employed as fuel, and the same applies to shale oil.

On the average 1 kilo. of petroleum can evaporate 13.75 kilos. of water when burnt under suitable conditions, whereas 1 kilo. of coal will only evaporate 7 kilos.

Experiments were further made with crude creosote, oil-gas, tar, and resinous products, with a view to determining their value as fuel. They all burn well when certain precautions are taken. Paraffin oil being too expensive for industrial purposes, was not included in the following experiments, which serve to show the relative amount of various fuels necessary to distil a certain quantity of oil. In this case the relative amounts of fuel consumed were:—

	Brown Coal.	Coal.	Crude Creosote.	Gas Tar.
	Kilos. 800	Kilos. 338	Kilos. 208	Kilos. 230
Costing	Marks. 3.6	Marks. 6.93	Marks. 5.96	Marks. 6.90

Resinous products from tar and oil are not advantageously burnt alone, since they fetch a better price as asphalt, &c.

The author describes the spray-apparatus employed in these trials, for the details of which the original paper must be referred to. It is stated that the evaporating power of liquid fuel is greater than with solid fuel.

Regarding the quantity of heat that can actually be utilised, this only amounts to 80 per cent. of that represented by the evaporating power, with solid fuel, 20 per cent. being lost. This is due to the loss of heat with solid fuel, being four times greater than with liquid fuel. Complete combustion of solid fuel is only attained at the cost of the developed heat, since the excess of air necessary exerts a cooling effect. On the other hand, with good spray firing of liquid fuel, no excess of air is required for complete combustion, and the chimney emits nothing but the products of combustion.

Again, the effective power of a boiler is far higher when heated with liquid rather than with solid fuel, the relative values being from 0.5—0.62 for the former to 0.8 for the latter. Formule are given for calculating the size of a spray-apparatus required for firing a boiler where the quantity of coal consumed by the same is known.—A. R.

Dowson Gas. E. Schilling. J. für Gasbeleucht., 1889, 424—432.

A NEW application of Dowson gas is its use in Schwabing to work a gas motor of 60 horse-power for the electric lighting of the streets. It is used in the gas industry under the name of "generator water-gas" for "half water-gas" for heating retort ovens.

The following are analyses of gases made by passing a current of air and aqueous vapour through a thick layer of red-hot carbonaceous matter:—

	1.	2.	3. Generator Water-Gas.		4.	5.	6.
	Munich Illuminating Gas.	Generator Gas from Coke.	(a.) Normal.	(b.) Excess of Water Vapour.	Dowson Gas.	Water-Gas.	A Mixture of 1 cb.m. Water-Gas and 1 cb.m. Generator Gas.
	Vol. proc.	Vol. proc.	Vol. proc.	Vol. proc.	Vol. proc.	Vol. proc.	Vol. proc.
Carbonic acid.....	1.6	1.5	8.8	11.2	6.0	2.7	2.2
Carbonic oxide.....	9.6	25.7	23.2	16.0	23.0	45.8	30.8
Hydrogen	49.6	Traces.	12.7	19.9	17.0	49.2	11.2
Marsh gas	30.7	..	..	..	2.0	0.3	..
Heavy hydrocarbons..	1.7	..	..	..	..	..	..
Nitrogen.....	3.8	69.8	55.3	49.9	52.0	1.0	55.8
	100.0	100.0	100.0	100.0	100.0	100.0	100.0

From the above analyses the equivalent of heat of these gases is easily calculated. The heat equivalents are given in the following table, and it must be noted that for the

hydrogen constituents the heat of combustion is calculated not as liquid water, but as aqueous vapour.

HEAT EQUIVALENT OF 1 CB.M.

	1.	2.	3. Generator Water-Gas.		4.	5.	6.
	Munich Illuminating Gas.	Generator Gas from Coke.	(a.) Normal.	(b.) Water-Gas Excess.	Dowson Gas.	Water-Gas.	Mixture of 1 cb.m. of Water-Gas and 4 cb.m. of Generator Gas.
	Cal.	Cal.	Cal.	Cal.	Cal.	Cal.	Cal.
Carbonic oxide.....	289	773	689	481	692	1,316	926
Hydrogen	1,316	..	337	528	451	1,305	297
Marsh gas	2,604	..	..	..	170	263	..
Heavy hydrocarbons..	1,170	..	..	..	..	..	..
Sum.....	5,379	773	1,026	1,009	1,313	2,884	1,223

From this table it is seen that Dowson gas has scarcely the fourth part of the heating power that illuminating gas has.

For the production of Dowson gas a small boiler with double walls is used and steam is generated continuously from it and superheated in the fire-box; this is introduced

at the same time with the necessary quantity of air for combustion under the grid of a generator. The generator shaft is filled with anthracite and is provided with a valve arrangement to prevent escape of gas when the fuel is added. The procedure is then like that for the preparation of water-gas. A part of the anthracite is first burnt to carbonic acid. The temperature must be sufficient to cause the reduction of this carbonic acid to carbonic oxide, as well as to decompose the water, thus forming hydrogen. The use of anthracite is necessary to produce a gas which by its condensation shall give the least possible amount of tarry matter. It is also necessary that the supply of air and vapour under the grid shall be as regular as possible. Coke cannot be used on account of the large quantity of ash it leaves. The generator has in its upper part an exit tube which is separated in two parts by a stop-cock arrangement. One is for the escape of the less valuable gas produced at first. The other leads the normal gas into a scrubber arrangement, which is divided into two parts. One in which the gas rises is filled with coke, over which runs a stream of water. The other contains dry coke. The gas goes from here into a receiver. One man is sufficient to work the little boiler, the generator, and the gas motor. The filling up of the generator shaft must be done regularly, since the regularity of composition of the gas is influenced by the height of the pile of combustible matter.

The Dowson gas apparatus is used in many places in Germany, while the water-gas apparatus has very limited application. The latter is produced first by passing air and then aqueous vapour through the generator; thus a mixture of generator and water-gas is formed which does not differ much in composition from Dowson gas, but the preparation of which is more complicated and expensive.

One disadvantage of Dowson gas is the large amount of carbonic oxide it contains, which amounts to about 23 per cent., almost $2\frac{1}{2}$ times as much as in illuminating gas, in consequence of which it is about three times as poisonous.

—A. J. S.

PATENTS.

Improvements in Apparatus for Making Gas. E. Brook and A. Wilson, Middlesbrough. Eng. Pat. 3949, October 12, 1876. (4th Edition.) 11d.

THE improved apparatus is a eupola-shaped furnace, either square or round in cross section, and which may be described as consisting, vertically, of two parts, viz., a cone-shaped retort above, and a combustion chamber below. This latter has a solid hearth upon which the ashes and clinkers accumulate. Air is blown (preferably with a steam injector) through a series of tuyeres a little above the hearth, and, at the level of the junction of the two vertical divisions of the apparatus, a series of lateral holes allow the escape of the gas produced to an annular space or channel surrounding the retort, whence it passes away to the point of consumption. It will be seen that by this arrangement the gas leaves the apparatus as soon as formed in the hot part of the furnace, and does not come into contact with the cool portion of the fuel, fresh supplies of which are introduced at the top of the generator by means of a suitable hopper. If preferred, the air blast may be introduced through a perforated channel in the solid hearth of the combustion chamber.—A. R. D.

Superheating Steam, and Making Heating and Illuminating Gas. B. Hunt, London. From T. S. C. Lowe, Morristown, U.S.A., and G. S. Dwight, Mount Clare, U.S.A. Eng. Pat. 173, Jan. 14, 1878. (2nd Edition.) 11d.

THROUGH a bed of fuel in a generator of the usual type hot air and superheated steam are blown alternately. While the former blast is on, the gaseous products evolved are taken to a chamber where they enter into combustion with a further supply of heated air here admitted, and whence they pass through a stack situated over the combustion chamber and packed with loose brickwork. Preferably two such stacks and chambers are attached to each generator. When the air blast has raised the fuel to incandescence, and the stacks

are also intensely hot, the air supply is cut off, and steam, superheated by traversing one of the stacks, is admitted in its place. The water-gas now produced is fixed by passing through the second heating stack, after leaving which its sensible heat may be utilised for steam raising or other purposes. When illuminating gas is required, petroleum or other suitable hydrocarbon is admitted at the top of the generator, where it becomes vaporised, and, mingling with the water-gas, is rendered permanent in the stack or fixing chamber. The specification is accompanied by three sheets of drawings.—A. R. D.

Improvements in the Generation of Water-Gas, and in Apparatus therefor. P. Jensen, London. From the European Water Gas Company, Stockholm, Sweden. Eng. Pat. 4907, November 9, 1881. (2nd Edition.) 8d.

ONE generator is used in connexion with two regenerators, which are in turn made intensely hot by the combustion therein of a portion of the water-gas produced in the process. While one regenerator is being thus heated, the other is being traversed by the steam supply, which is here so highly superheated that it is said to be already largely decomposed when it enters the generator, in the upper portion of which it meets a constant shower of coal dust automatically thrown in. After passing downward through the mass of fuel in the generator, one part of the issuing gas is conducted to the gasholder, while the other part goes to heat the regenerators as above mentioned. For the production of illuminating gas the addition of a suitable hydrocarbon is prescribed. The chief feature of this invention is that by operating as above described, and by making the regenerators sufficiently large, the production of water-gas is not intermittent but continuous, as the steam is so highly heated in the regenerators that the temperature of the fuel in the generator is never allowed to fall below the point most suitable for the required decomposition.—A. R. D.

Illuminating by Means of the Incandescence of Refractory Substances. W. H. Spence, London. From O. Fabnehjelm, Stockholm, Sweden. Eng. Pat. 5646, December 5, 1883. (2nd Edition.) 8d.

REFRACTORY oxides, such as those of magnesium, calcium, zirconium, and silicon (that of magnesium is generally preferable) are mixed, separately or together, with starch or gum so as to form a plastic mass. From this, wires, pins, or lamellae are formed by squeezing it through dies or by other suitable means, and are bent while still soft into any desired shape; they are then dried and strongly ignited. A number of them are fixed in a socket of iron or brass, preferably of U section, by inserting them in a mass of damp clay or magnesia filling the socket. The whole contrivance is termed a "comb." The sockets may be straight or curved, and provided with hooks or loops so that they may be attached to a support allowing them to hang in the flame which is to render the wires or pins incandescent. The whole is planned so that all parts may be readily replaced, as at the high temperature used the refractory material is slowly volatile. The socket may be dispensed with by making the wires or pins in the form of loops so as to hang on a simple metal wire or hook. The heating agent used is water-gas made in the ordinary way, and burnt from a common gas-burner, such as a fish-tail burner.

The patentee claims the manufacture of wires, pins, or lamellae from the above-mentioned refractory oxides, and the use of such oxides in such forms to produce light when heated by water-gas, "burning in the air at the ordinary pressure and under the ordinary conditions of the atmosphere."—B. B.

Improvements in the Method of Illuminating by Means of the Incandescence of Refractory Substances. O. Fabnehjelm, Stockholm, Sweden. Eng. Pat. 7573, June 22, 1885. (2nd Edition.) 11d.

THE patent is for improvements on the system of incandescent illumination set forth in Eng. Pat. 5646 of 1883 (preceding abstract), and refers especially to the construc-

tion and arrangement of the frames for carrying the material to be rendered incandescent. Thus needles of the refractory material (which may be magnesium, calcium, zirconium or silicon oxides, cyanite, kaolin, or quartz) may be made with one end thickened to form a head, so that they may be supported in a frame consisting of a perforated plate of metal, porcelain, or other suitable material. The frame or holder may be arched or made star-shaped, round, or polygonal, and the burner beneath it may be of similar design. Rods rising vertically from lugs at the side of the burner, and either straight or curved, serve to support the holder above the flame, and may be provided with a screw adjustment for raising and lowering it. In place of rods a glass chimney, cylindrical or bell-shaped, may be used, and the frame suspended from its upper end. For round or star-shaped burners a central rod may be employed. The burners are better made with a number of fine holes to allow the exit of the water-gas, rather than with annular or other slits, a more powerful light being thereby obtained.

For security in transit of such "incandescent pieces" or "combs" as are not best sent with their refractory needles, &c. separate from the frame, a special packing case with grooves to receive the "combs" is patented. (See also this Journal, 1886, 424.)—B. B.

Improvements in Purifying or Treating Coal Gas and other Gaseous or Liquid Products of Destructive Distillation, and in Part applicable in the Alkali Manufacture. A. Campbell, London, and W. Boyd, Glasgow. Eng. Pat. 10,186, July 13, 1888. 6d.

AFTER separating the tarry matter, the gas is passed through scrubbers down which is trickling water containing in suspension peroxide of manganese, which reduces the sulphuretted hydrogen and polysulphides to free sulphur. The manganese is re-oxidised and the ammoniacal liquor is either heated so as to drive off the ammonia and carbonic acid for the production of ammonium carbonate, or the gases may be passed into a solution of manganese sulphate, manganese carbonate being precipitated and ammonium sulphate produced. The manganese carbonate on ignition in air is converted into manganese peroxide. Or most of the carbonic acid is expelled and the residual ammoniacal liquor used for purifying more of the gas from carbonic acid; this may also be separated by passing the gas through a thin cream of black-ash waste, the sulphuretted hydrogen liberated being subsequently passed through the manganese scrubbers. The manganese is used over and over again until it contains a considerable proportion of free sulphur, when this is extracted by any suitable method. The fixed ammonium salt in the liquor from the tar condensers and also from the manganese scrubbers consists mainly of sulphocyanide, and this is obtained in the crystalline form by boiling down the liquor when sufficiently concentrated.—E. E. B.

Improvements in the Manufacture of Compressed Artificial Fuel. G. Frank, New York, U.S.A. Eng. Pat. 11,677, August 13, 1888. 6d.

ABOUT 50 parts by weight of coal dust or coal in a granular condition, and 40 of powdered calcined brick or similar earthy material, are mixed with 10 parts of tar or similar hydrocarbon matter, in a pug-mill heated by steam, pressed into moulds of any desired shape, allowed to cool and harden. For domestic use the sawdust of sandalwood or some other aromatic substance may be added, while for disinfecting purposes any suitable substances, "such substances being coffee beans, or anything possessing similar anti-septic and fragrant elements," may be employed.—B. B.

Improvements in Artificial Fuel. G. Frank, New York, U.S.A. Eng. Pat. 12,377, August 28, 1888. 6d.

NINETY-FIVE pounds of quicklime and 5 lb. of gypsum are mixed with 10 galls. of water, and added to a solution containing 2 lb. of lead acetate in 5 galls. of water; about 100 lb. of some carbonaceous substance, such as vegetable charcoal, coke or coal, in powder, is added to the mixture and incor-

porated by stirring. The pasty mass is then formed into blocks or cakes (which may be perforated) and dried.

It is claimed that the mineral ingredients cause the product to be coherent though porous, and improve its qualities as a fuel.—B. B.

Apparatus and Process for Manufacturing Gas. J. D. Averell, Brooklyn, U.S.A. Eng. Pat. 2914, February 19, 1889. 8d.

THE gas here referred to is to be made from wood and enriched with vaporised oil. The wood to be dealt with is placed in a metal cartridge case, having one end open. When filled the case is thrust into a retort with the open end to the rear. Steam introduced at the back of the retort softens and disintegrates the wood, thus aiding the distilling process. The gas here produced passes to a hydraulic main, where it is mixed with hydrocarbon vapours generated by distilling oil in a separate retort, preferably placed above the wood retorts.—A. R. D.

Improvements in the Method of and Apparatus for Converting Solid Fuel into Gaseous Fuel. W. J. Taylor, Chester, U.S.A. Eng. Pat. 4807, March 19, 1889. 8d.

THE main feature of this invention consists in maintaining a deep bed of ash below the incandescent fuel in the generator. Peep-holes are provided to enable this incombustible layer to be kept at a uniform level; and to facilitate the regular removal of ash and clinker, the base of the generator is made to rotate upon a central support.—A. R. D.

Improvements in the Trays or Grids of Gas-Purifying Apparatus. C. H. Turnbull, New Westminster, Canada. Eng. Pat. 5134, March 25, 1889. 6d.

THE tray consists of a number of strips of iron, wood, or other suitable material of elliptical cross section, kept parallel to and equidistant from each other by means of washers, through which pass tie-rods going from side to side of the tray. The strips are so placed that the longer axis of their elliptical cross section is at right angles to the plane of the tray.

By this arrangement any absorbent substance carried by the tray (e.g., lime for gas purification) presents a large surface to the gases it is intended to absorb; the tray is also stiffer than it would otherwise be. One of the uses to which it can be put is the removal of tar from gas by allowing the crude gas to stream through the requisite number of trays, placed one above the other, and kept wet by a stream of water from the top.—B. B.

Improvements in Apparatus for the Manufacture of Illuminating or Heating Gases. W. M. Cosh, Baltimore, U.S.A. Eng. Pat. 5181, March 26, 1889. 8d.

THE improved apparatus consists of a generator having on either side a firebrick superheater surmounting a combustion chamber. Each superheater is connected both to the upper and lower portions of the generator, communication being controlled by suitable valves. As will be seen, the apparatus may be used in a variety of ways, but the following *modus operandi* is preferred:—Steam is admitted at the top of the highly-heated superheaters, and after passing downwards through these, is caused to travel upward through the mass of incandescent fuel in the generator. When the lower portions of the fuel have fallen in temperature below the point suitable for decomposition, the course of the current is changed, and the superheated steam is caused to enter the generator at the top and pass downwards through the fuel. When the decomposition again begins to slacken, steam is turned off, and an air-blast is introduced at the bottom of the generator. The products of incomplete combustion passing to the combustion chambers of the superheaters, meet there a supplementary supply of air, find their way upwards through the brickwork, when the apparatus is again brought to the temperature necessary for the decomposition of steam. Means are provided for the introduction of naphthalene when an illuminating gas is required.

—A. R. D.

Improvements in the Manufacture of Artificial Fuel. A. J. Boulton, London. From H. G. Weber, Atlantic, U.S.A. Eng. Pat. 5389, March 29, 1889. *Id.*

COAL dust or waste coal is mixed with ground oil-cake, the resulting mass moulded into blocks, balls, or other suitable shape, and allowed to dry. The proportions depend on the nature and condition of the materials. It is claimed that the oil-cake serves to hold the particles of coal together, to facilitate their ignition, and to yield much heat from its own combustion.—B. B.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Occurrence of Paraffin in Crude Petroleum. E. A. Partridge. J. Franklin Inst. 1889, 479—484.

It is well known that the paraffin obtained by the distillation of petroleum residues is crystalline, while that obtained directly (as in the filtration of residuum) is amorphous. Ozokerite differs but slightly from paraffin, the main difference being want of crystalline structure in it as found crude. As crystalline paraffin could be obtained from ozokerite by distillation alone, it has been supposed to be engendered in the process. Recently, however, crystalline paraffin has been obtained from ozokerite by extraction with amyl alcohol, and in the same way, by repeated treatment of petroleum residues with amyl alcohol, a substance melting at 59° can be obtained which cannot be distinguished from ordinary paraffin. The action of amyl alcohol is probably the same as that effected by distillation, viz., a partial separation of colloid substance. These facts point to the conclusion that crystallisable paraffin exists ready formed in both petroleum and in ozokerite, but in both cases other colloidal substances prevent its crystallisation.—D. B.

PATENT.

Improvements in and Apparatus for the Distillation of Tar and the like. F. Lennard, East Greenwich, Eng. Pat. 7334, May 17, 1888. *Id.*

IN this invention the distillation is effected in a continuous manner, and it is claimed, more economically and efficiently than hitherto. The patentee causes the tar for distillation to pass in films or streams of small depth over surfaces heated by means of an oil-bath. To ensure the effectual working of the still, the tar, before entering, should be heated sufficiently, so that the distillation commences immediately the tar is admitted into the still. The volatile products are collected as they arise, and the pitch passes off at the outlet. Steam is injected into the still to facilitate the operation. For details of the apparatus and its mode of working, the specification and drawings must be consulted.

—D. B.

IV.—COLOURING MATTERS AND DYES.

The Separation of Certain Red Shades of Acid Violet into Acid Magenta and Acid Violet. R. Meldola. Dyer, 1889, 21—22.

ACID violets of a red shade are produced by the alkylation of acid magenta. The alkylation is, however, not complete, and the author has devised a process of separation which is as follows:—A known weight is dissolved in hot water, and after cooling, the colouring matter is precipitated by basic lead acetate and filtered, and the precipitate (A) repeatedly washed with cold water till the washings (B) are colourless.

The precipitate (A) is decomposed by ammonium carbonate, the lead carbonate filtered off, and the colouring matter in the filtrate estimated by evaporation and weighing the residue. The washings (B) are made acid with dilute sulphuric acid, then alkaline with lime, filtered to remove calcium sulphate and evaporated to dryness. The dry residue is treated repeatedly with hot alcohol, which extracts the lime salts of the violet colouring matters, leaving that of the acid magenta undissolved. The shade of the precipitate (A) and the two portions of the washings (B) can be ascertained by dye trials.

The author points out that it is necessary for dyers to remember that mixed colouring matters such as the above, if used in successive dyeing, are almost certain to give variations in the degree of redness and brilliancy.—R. L. W.

On some Derivatives of Resorcinoldisulphonic Acid. F. Uzer. Monatsh. 9, 1127—1131.

To prepare *nitrosoresorcinoldisulphonic acid*, 100 grms. of potassium resorcinoldisulphonate are dissolved in 400 cc. of water. The solution is acidulated with 15 cc. of glacial acetic acid, and 20 grms. of potassium nitrite are added. The mixture, which becomes dark violet, is poured, after some hours' standing at a moderate temperature, into ice water, when violet crystals of potassium nitrosoresorcinoldisulphonate separate, soluble in hot water, insoluble in alcohol, exploding on heating, and yielding precipitates with most metallic salts. On oxidation in alkaline solution with hydrogen peroxide or with a solution containing 2 per cent. of potassium permanganate, the nitroso-compound is converted into the nitro-compound. Its aqueous solution turns dark red on addition of ferric chloride. Treated with fuming nitric acid, styphic acid is formed. On boiling the nitrosoresorcinoldisulphonic acid with tin and hydrochloric acid, an amido-compound is formed; the yield is 80 per cent. of the theoretical one. On addition of nitrous acid to this body, the solution is first coloured green, turning into a greenish-yellow and into orange on concentration, the solution yielding, on cooling, orange crystals. It has not the properties of a diazo body, but seems to be an azo colouring matter.—A. L.

On an Easy Method for Preparing Leuco-Malachite Green. M. Nencki. Monatsh. 9, 1148—1149.

Forty grms. of benzaldehyde, 100 grms. of dimethylaniline, and 40 grms. of 93 per cent. alcohol, are heated on the water-bath in a flask with reversed condenser and holding about 2 litres. A small separating funnel connected with the flask contains 65 grms. of phosphorus oxychloride which are allowed to run gradually into the mixture in the flask. The violent reaction is moderated by shaking the contents of the flask. After adding the phosphorus oxychloride the reaction is completed by heating for about half an hour on the water-bath, or until bubbles cease to rise to the surface. The mixture is dissolved in hot water, and an excess of caustic soda added after cooling. The oily base which solidifies after a short time is recrystallised from alcohol. It is perfectly white and pure. This method gives a nearly theoretical yield.—A. L.

On a New Dihydroxy-naphthalene. A. Claus. J. Prakt. Chem. 39, 315—317.

DAHL'S γ - β -naphthylamine sulphonie acid is, according to Forsling's researches, $C_{10}H_7(NH_2)(SO_3H)$ [$NH_2:SO_3H=1:1'$] (this Journal, 1887, 72). He bases his conclusions on the preparation of a dichloronaphthalene obtained from it, melting at 48° C. The author prepared a hydrazine sulphonie acid, and from this an α -naphthalenesulphonie acid, so that there is no doubt left that the sulphonie group is in the alpha position.

By boiling the diazo-compound of Dahl's acid a β -naphtholsulphonie acid is obtained, which on fusing with caustic soda yields a β - γ - α -dihydroxynaphthalene [the letter γ is used to indicate that it is not yet definitely known which alpha position the sulphonie group is in]. The dihydroxynaphthalene melts at 134°—135° C., is with difficulty

soluble in cold alcohol and chloroform, easily in ether, benzene, and acetone, and crystallises best from benzene in short prisms. It reduces silver nitrate especially in a solution of ammonia. Ferric chloride produces a blue coloration, disappearing, however, at once, and a colourless precipitate separates, changing to a copper-red on addition of more ferric chloride. The alcoholic solution of the dihydroxy-compound does not show fluorescence. Chromic acid produces on heating a black precipitate. The dihydroxy compound forms a diacetyl compound, melting at 73° C.

On heating β -naphthol- γ - α -sulphonates with phosphorus pentachloride a chloronaphthol and a dichloronaphthalene are obtained, the former melting at 128° C., the latter at 48° C., and therefore identical with Forsling's dichloronaphthalene.—A. L.

On the Diamidobenzophenones. H. Wichelhaus. Ber. 22, 988—989.

DIAMIDOBENZOPHENONE from rosaniline is said to be identical with the alpha-compound obtained by Städel and Pauer. All their properties correspond with the exception of their melting points, which were observed at 172° C. and 237° C. To become clear as to this difference, diphenylmethane was converted, according to Städel and Pauer's method, into dinitrodiphenylmethane (melting point 183° C.), then by oxidation into dinitrobenzophenone (melting point 189° C.), and finally by reduction into diamidobenzophenone, melting at 237° C., the same temperature at which the diamidobenzophenone obtained from rosaniline, melts. Thus the complete identity of the two compounds is established. This ketone is easily reduced in an alcoholic solution by sodium amalgam, forming a carbinol, melting at 98° C., with difficulty soluble in neutral solvents, easily, however, in acids. Both compounds form tetrazo colouring matters, useful for dyeing cotton.—A. L.

Synthesis of Rosanilines from Amidobenzophenones and Aromatic Amines in the Presence of Halogen Carriers. O. Mühlhäuser. Dingl. Polyt. J. 271, 592—596.

THE author, after reconsidering the theoretical aspect of the formation of dyes from amidobenzophenones, gives a historical sketch of their production. A table is appended in which the most important of these dyes are enumerated, along with the substances from which they are prepared. "The Badische Anilin und Soda Fabrik" and the "Actiengesell. f. Chem. Ind. Basel" chiefly manufacture: tetramethyldibenzyl-, tetraethyldibenzyl-, pentamethyl- α -naphthyl-, and tetraethyl- α -naphthyl-pararos-aniline, and they are known under the names of Benzyl Violet B, 2 B, Victoria Blue 4 R and 2 B respectively.

For the production of these dyes equal molecules of amidobenzophenone, amine, and halogen carrier are mixed together. In many cases the reaction takes place with only a slight rise in temperature. In certain cases, however, a violent reaction must be prevented by cooling or addition of indifferent solvents, e.g., aromatic hydrocarbons. With other mixtures, again, it is necessary to heat to 100° to bring about the desired reaction. It is always advantageous to have an excess of aromatic amine in order to keep the mixture as neutral and fluid as possible.—A. R.

On the Preparation of Rosanilines from Aromatic Acid Chlorides and Tertiary Amines. O. Mühlhäuser. Dingl. Polyt. J. 272, 44—46.

By the action of acid chlorides on tertiary monamines in the presence of substances favouring condensation, dyes belonging to the rosaniline group are formed. The author gives a historical sketch of the numerous processes for the production of these colouring matters by the above method. Since 1883 the "Badische Anilin und Soda Fabrik" and the "Gesellschaft für Chemische Industrie" (Basel) have manufactured hexamethyl- and hexa-ethylpararos-aniline, also trimethyltriphenyl-pararos-aniline on the principles of O. and E. Fischer's acid chloride process.

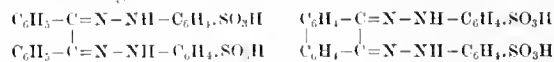
To prepare substituted rosanilines of symmetrical constitution, e.g., hexamethyl- or trimethyltriethylrosaniline,

carbon oxychloride is made to react on the tertiary base in presence of the chloride of zinc, iron, or aluminium. The acid chloride which is first formed reacts on the excess of tertiary base with production of the corresponding colouring matter.

When it is a question of preparing substituted rosanilines of which only two-thirds of the substituted groups are symmetrical, e.g., pentamethylphenyl- or tetramethyldiphenyl-rosaniline, carbon oxychloride is allowed to react on the tertiary amine to such an extent only, that the reaction stops with the formation of the acid chloride; this is effected by using no condensing substance or only a very weak one. On then treating the reaction product, which consists of an acid chloride, an amine and its hydrochloride with dilute caustic soda, the chloride is hydrolysed. Brine and unchanged amine may be removed by decantation or filtration, and the amidobenzoic acid is now obtained from the solution by precipitating with hydrochloric acid. After drying, the acid is reconverted into its chloride with PCl_5 , and the chloride in its turn is acted upon by the required amine in presence of aluminium chloride. Excess of amine may then be removed by steaming or by boiling with hydrochloric acid.—A. R.

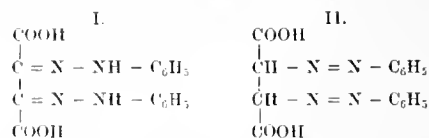
Tartrazines and Azo-Dyes. R. Meyer. Mittheil. des K. K. Tech. Gew.-Museums, 1889, 49—55.

DYESTUFFS of the tartrazine class have been obtained by substituting, on the one hand, phenylhydrazine sulphonic acid by its homologues and the naphthylhydrazine sulphonic acids, and on the other hand, substituting dihydroxytartaric acid by such double ketones as benzil and phenanthraquinone. The dyestuffs, formed from benzil and phenanthraquinone by condensation with phenylhydrazine sulphonic acid, have the following constitutions:—



In the phenanthraquinone compound two of the benzene rings are directly united in addition to being connected through the $-\text{C}-\text{C}-$ group, which fact finds expression in the reddish-yellow colour of the dyestuff, the benzil dyestuff being a pure yellow.

The tartrazines closely resemble the mixed azo-dyes, as the constitution of the two classes of bodies show:—



I. being the ordinary formula of the osazone of dihydroxytartaric acid or of unsulphonated tartrazine; II. that of a mixed azo-dye. It is possible that the first formula represents an unstable compound which at the moment of formation undergoes a molecular change and becomes constituted as in the second type. This is supported by the fact discovered by Zincke that the hydrazone of α -naphthoquinone is identical with benzene-azo- α -naphthol. Again, the author finds that the hydrazone of mesoxalic acid prepared by E. Fischer is identical with benzene-azomalonic acid obtained by saponifying the product of the action of diazobenzene chloride on the sodium compound of diethylmalonic ether. Japp and Klingemann, also, find the benzene-azo-propionic acid prepared by them identical with Fischer's hydrazone of pyruvic acid. Further, A. Bernthsen points out that the hydrazone of acetylaldehyde has all the properties of an azo-dye. Then again, whilst Japp and Klingemann have proved that benzene-azo-acetone is a hydrazone compound and not an azo-body, Claisen and Baeyer showed that certain singular compounds behaved, in certain reactions, more like azo-bodies. In the present state of knowledge it is impossible to fix the constitution of these bodies, the mixed azo-dyes and the hydrazones, with certainty, for they almost appear to be substances so susceptible of molecular change as to react as azo-dyes in some cases and as hydrazones in others.

—E. B.

PATENTS.

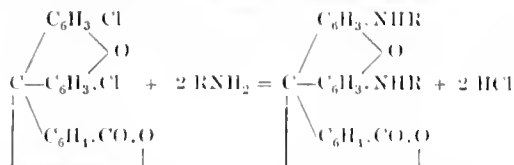
Preparing Colouring Matters for Dyeing and Printing. J. H. Johnson, London. From H. Caro, Mannheim, Germany. Eng. Pat. 5305, December 29, 1879. (3rd Edition.) 6d.

This patent describes the manufacture of Naphthol yellow S (see also this Journal, 1882, 63). It consists chiefly of the sulphonic acids of dinitro- α -naphthol, and is prepared by the action of nitric acid upon the sulphonic acids of α -naphthol which are produced by the action of sulphuric acid on α -naphthol in such a way as to produce higher sulphonation products than the monosulphonic acid. By the action of nitric acid, these sulphonic acids and more especially a trisulphonic acid of α -naphthol are converted into nitrosulphonic acids, and chiefly into sulphonic acids of dinitro- α -naphthol.

The sulphonation is performed by means of fuming sulphuric acid, and from time to time a sample is taken from the mixture, dissolved in an excess of nitric acid and diluted with water. If much precipitate be formed and the filtered solution give little or no precipitate on the addition of caustic potash, the action of the sulphuric acid must be continued either by raising the temperature or adding more sulphuric acid. The sulphonation is complete when a sample of the naphthol sulphonic acids after treatment with nitric acid remains clear on the addition of water, and gives with caustic potash an abundant precipitate of the potassium salts of the dinitronaphthol sulphonic acids. The whole melt may then be similarly treated with nitric acid, or the sulphonic acids may be first purified by conversion into their alkaline salts, then separated or not by crystallisation and treated directly with nitric acid. The nitrosulphonic acids thus obtained are converted into their soluble calcium salts, which by the action of alkaline carbonate yield the corresponding alkaline salts. The following quantities are given for working the patent. 10 parts by weight of α -naphthol are mixed with 20 parts by weight of fuming sulphuric acid containing 25 per cent. of sulphuric anhydride, and the mixture is kept well stirred at 40° to 50° C. until a sample is soluble in water. 18 parts of fuming sulphuric acid of 70 per cent. anhydride are then added at the same temperature, and the mixture is kept well agitated until a sample gives the reaction with nitric acid described above. The melt is then diluted with 75 parts of water and gradually mixed with 25 parts of nitric acid of sp. gr. 1.38. The temperature of the mixture is not allowed to rise above 50° C. After standing 12 hours in the cold, chiefly a monosulphonic acid of dinitronaphthol crystallises out and is converted into the potassium, sodium or ammonium salt. The mother-liquor is treated with an excess of caustic lime, and the soluble calcium salts thus produced are decomposed by means of alkaline carbonates with the formation of the corresponding alkaline salts, preferably for commercial purposes into the potassium salts. The patentee claims:—
1. The preparation of a trisulphonic acid of α -naphthol or of such sulphonic acids of α -naphthol, which upon treatment with nitric acid will retain one or more of their sulphonic groups and become changed into nitrosulphonic acids and chiefly into the sulphonic acids of dinitronaphthol described.
2. The preparation of nitrosulphonic acids of α -naphthol, and chiefly of the sulphonic acids of dinitronaphthol by the action of nitric acid upon the above described sulphonic acids of α -naphthol as described.—T. A. L.

Improvements in the Production of Colouring Matters. C. D. Abel, London. From the Farbwerke vorm. Meister, Lucius and Brüning. Höchst-on-the-Maine, Germany. Eng. Pat. 9600, July 2, 1888. 6d.

This patent describes the production of the dyestuff "Rhodamine" from fluorescein chloride (Bayer, *Annalen*, 183, 18) by acting on it with primary and secondary amines. The reaction takes place according to the following equation:—



Fluorescein chloride is obtained by the action of phosphorus pentachloride on fluorescein and yields red colouring matters when treated with the following amines:—mono-ethylamine, diethylamine, mono-methylamine, dimethylamine, *m*-amido-dimethylaniline, *m*-amido-diethylaniline, *m*-amido-dimethyl-*o*-toluidine, *m*-amido-diethyl-*o*-toluidine, *m*-amido-mono-methylaniline, *m*-amido-monoethylaniline, *o*-toluidine, xylylidine, ψ -cumidine. The following amines yield reddish violet colouring matters:—aniline, monomethylaniline, monomethylamine, α -naphthylamine, phenylhydrazine, *m*-amido-dimethyl-*p*-toluidine, *m*-amido-diethyl-*p*-toluidine. Violet colouring matters are obtained from diphenylamine, benzidine, *p*-phenylene diamine, *m*-phenylene diamine, β -naphthylamine, *p*-toluidine. Paramido-diphenylamine yields a blue colouring matter. The reaction is not confined to ordinary fluorescein chloride, but also takes place with the chlorine and bromine compounds of fluorescein chloride. The method of application is described in the two following examples:—

(1.) 3.7 parts of fluorescein chloride are heated with 1.9 parts of aniline, and 3 parts of zinc chloride to 210° C. for one hour. The melt is dissolved in alcohol containing hydrochloric acid, or in 7 parts of concentrated sulphuric acid, at a temperature of about 60° C. On pouring the solution into water the dyestuff is precipitated and is then filtered off, washed and dried. (2.) 5 parts of fluorescein chloride are heated in an autoclave with 4 parts of diethylamine hydrochloride, 5 parts of sodium acetate (or 1.6 parts of lime), and with or without zinc chloride and alcohol, of each of which 5 parts, for 12 hours to 200° C. The colouring matter is extracted by means of alcohol containing a sufficient quantity of hydrochloric acid, the alcohol is distilled off and the residue purified by dissolving it in very dilute hydrochloric acid and precipitating the dyestuff by salt.

—T. A. L.

Improvements in the Manufacture of Methylene-blue and allied Colouring Matters. J. Y. Johnson, London. From The Badische Anilin und Soda Fabrik, Ludwigshafen-on-the-Rhine, Germany. Eng. Pat. 10,314, July 16, 1888. 6d.

By the action of alkalis on Methylene red or preferably by treating *p*-amidodimethylaniline with oxidising agents and thiosulphuric acid, one of the compounds obtained is a well crystallised substance possessing acid properties and capable of reacting analogously to *p*-amidodimethylaniline. Its formula is $\text{C}_{16}\text{H}_{11}\text{N}_2\text{S} \cdot \text{SO}_3\text{H}$. When equal molecules of this body and of dimethylaniline are oxidised in a neutral aqueous solution, a green crystalline indamine is obtained almost insoluble in water and having the composition $\text{C}_{16}\text{H}_{10}\text{N}_2\text{S}_2\text{O}_3 + \frac{1}{2} \text{aq}$. On heating this with a solution of zinc chloride or of a cupric salt it is converted into Methylene-blue. The method of working the process is as follows:—6 parts by weight of dimethylaniline are dissolved in about 18 parts by weight of hydrochloric acid of sp. gr. 1.16, and to this is added a solution containing 3.8 parts of sodium nitrite in 6 parts of water. The nitrosodimethylaniline hydrochloride thus formed is reduced by adding about 30 parts of the above hydrochloric acid, and then in small quantities about 10 parts of zinc dust. The solution of *p*-amidodimethylaniline hydrochloride is then diluted with 250 parts by weight of water, and any free acid neutralised by means of an alkali. 16 parts of sulphate of alumina and 13 parts of sodium thiosulphate are added, and immediately afterwards a solution of 5 parts of potassium bichromate in 60 parts of water is run in quickly, forming the compound $\text{C}_{16}\text{H}_{11}\text{N}_2\text{S} \cdot \text{SO}_3\text{H}$. The substance is not separated, but is treated with a solution containing 6 parts of dimethylaniline dissolved in 6 parts of hydrochloric acid and 6 parts of water, and the whole is shortly afterwards

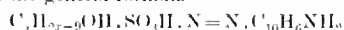
oxidised by running in 14 parts of potassium bichromate dissolved in 160 parts of water, the whole being thoroughly agitated. The green crystalline indamine separates out and is converted into Methylene-blue by boiling it for half an hour with about 50 parts by weight of a solution of zinc chloride of sp. gr. 1.5. On cooling, crystals of Methylene-blue separate out, which may be purified by solution in water and precipitation by salt. The quantity of potassium bichromate in the second oxidation described above is about one-third more than is actually required. The excess is necessary in order to prevent the formation of leuco-compounds in the subsequent operation. Homologous compounds to the dyestuff above described are obtained by employing diethylaniline or methylethylaniline in place of dimethylaniline. Colouring matters allied to Methylene-blue are obtained by substituting the equivalent amount of aniline, *o*-toluidine, methylethylaniline or diethylaniline for the 6 parts of dimethylaniline mentioned in the second stage of the process described above. The amine which has yielded the best result is *o*-toluidine.—T. A. L.

Manufacture of Brown Colouring Matters which Dye Cotton without the use of a Mordant. C. D. Abel, London. From The Actien Gesellschaft für Anilin Fabrikation, Berlin, Germany. Eng. Pat. 10,653, July 23, 1888. 6d.

THESE colouring matters are obtained by the action of the sulphonic acids of diazo-compounds on the orange colouring matter obtained by combining tetrazo-diphenyl first with one molecule of salicylic acid and acting with the intermediate compound thus formed on one molecule of resorcinol. 47 kilos. of this orange colouring matter are dissolved in 4,000 litres of boiling water and 25 kilos. of caustic soda of 40° B. When cool, 20 kilos. of *p*-diazobenzene sulphonic acid suspended in 600 litres of water are slowly added. The sparingly soluble colouring matter separates out, and the precipitation is completed by the addition of salt. The same substance is obtained if the intermediate product from one molecule of tetrazo-diphenyl and one molecule of salicylic acid acts on the colouring matter obtained by the action of molecule of *p*-diazobenzene sulphonic acid on one molecule of resorcinol. To obtain the colouring matter according to this method, 19.5 kilos. of benzidine are dissolved in 48 kilos. of hydrochloric acid and 800 litres of water and diazotised by 6.9 kilos. of sodium nitrite; the diazo solution is added to a solution of 15 kilos. of salicylic acid, 30 kilos. of sodium carbonate, 14 kilos. of caustic soda of 40° B., and 1,200 litres of water, and the whole mixture is then stirred into a solution containing 36 kilos. of the colouring matter from *p*-diazobenzene sulphonic acid and resorcinol in 1,000 litres of water. The mixture is then allowed to stand for 24 hours, when it is heated and the colouring matter precipitated by salt, filter-pressed, and dried. Yellowish-brown shades are obtained by using *m*-diazobenzene sulphonic acid in place of the para-compound, whereas naphthionic acid gives redder shades. The substitution of toluidine for benzidine makes no important change in the shade.—T. A. L.

Improvements in and relating to the Manufacture of Colouring Matters. H. H. Lake, London. From K. Oehler, Offenbach-on-the-Main, Germany. Eng. Pat. 10,845, July 26, 1888. 6d.

THE diazo-compounds of the amido-phenol and amido-cresol sulphonic acids combine with α -naphthylamine to form azo dyestuffs of the general formula—



These azo-compounds can be re-diazotised and combined with α - and β -naphthol sulphonic acids to form new tetrazo dyestuffs.

21.5 lb. of sodium amido-*p*-phenol-sulphonate and 7 lb. of sodium nitrite are dissolved and poured slowly into an excess of hydrochloric acid. When the diazotisation is complete, a solution of 20 lb. of α -naphthylamine hydrochloride is added, and the reaction accelerated by heating to 40°–50°. The precipitate, which has the composition $C_6H_3(OH)(SO_3H) = N.C_{10}H_6NH_2$, forms dark green

crystals dissolving in ammonia with a brownish-orange and in concentrated sulphuric acid with a violet colour. It is insoluble in water, and, after filtering off and washing, it is dissolved in a moist state in 10 lb. of ammonia of 17 per cent., 7 lb. of sodium nitrite are added, and the whole poured into hydrochloric acid cooled to 0°. The diazotisation is complete when the blackish flakes which first form change to a pure brown, and the whole is then poured into an alkaline solution of 38 lb. of β -naphthol disulphonic acid R. (Ger. Pat. 3229). The dyestuff forms as a black precipitate, and is purified by crystallisation from water. Its solution in concentrated sulphuric acid is blue. It dyes wool violet to violet-black according to the strength. In place of the R. salt 28 lb. of Schaeffer's sodium β -naphthol sulphonate or of sodium α -naphthol sulphonate may be employed with the formation of similar dyestuffs. Homologous colouring matters are obtained by substituting the sulphonic acids of amido-*o*-cresol and amido-*p*-cresol for the amido phenol in the process described above. The patent contains a table giving the reactions with various reagents of the dyestuffs obtained from these substances. The dyestuffs are said to be very fast to light.—T. A. L.

The Production of New Colouring Matters. W. G. Thompson and W. H. Claus, Manchester. Eng. Pat. 14,836, October 16, 1888. 6d.

THIS invention describes the production of colouring matters by acting with diazo- or tetrazo-compounds on decoctions of cutch, quercitron bark, logwood, and fustic. By the action of the diazo-compounds of benzene and its homologues, amido-azo-benzene, α - and β -naphthylamines and the sulphonic acids of all the foregoing and phenylene diamine on decoctions of cutch, quercitron bark and logwood, colouring matters are obtained which dye wool and mordanted cotton and are more especially useful for cotton printing. The shades vary from yellow to brown. The following is an example of the method for obtaining the colouring matter from toluidine and cutch. 107 lb. of toluidine are dissolved in 1,800 lb. of water containing 230 lb. of hydrochloric acid of 30° Tw., and diazotised by the addition of 73 lb. of sodium nitrite in 200 lb. of water. After one minute 280 lb. of cutch dissolved in 1,000 lb. of water are added, and the colour is salted out, filtered, and dried. The colouring matters from diazotised benzidine, toluidine, and benzidine disulphonic acid combined with the above wood extracts are said to be rather insoluble. 92 parts of benzidine when diazotised combine with 280 parts of solid cutch, 240 parts of logwood extract of 51° Tw., 400 parts of quercitron extract of 51° Tw., or 280 parts of fustic extract of 51° Tw. If intermediate compounds be formed by using only half the above quantities of the extracts, these can be further combined with amines, phenols, and their sulphonic acids, forming a variety of shades. (See also this Journal, 1888, 619.)—T. A. L.

Improvements in the Preparation of Nitro- and Amido-phenols from the corresponding Anides. A. Deninger, Dresden, Germany. Eng. Pat. 16, January 1, 1889. 6d.

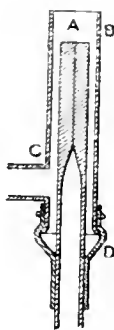
WHEN a salt of diazobenzene is heated in an aqueous solution in presence of nitrous acid, *o*-nitro-phenol is obtained. If, however, the mixture is allowed to decompose spontaneously, the product formed is *p*-nitro-phenol. From *o*-toluidine are produced respectively *o*-nitro-cresol [$CH_3.OH:NO_2 = 1:2:3$] with a melting point 69°, and *p*-nitro-cresol [$CH_3.OH:NO_2 = 1:2:5$] with a melting point 96°; *p*-toluidine yields *p*-nitro-cresol [$CH_3:NO_2:OH = 1:3:4$], melting point 34°. Naphthylamine forms nitro-naphthol, melting point 128°, benzidine yields dinitrodiphenol, melting point, 260°, and toluidine gives dinitrodieresol, melting point 270°, when similarly treated. The following is the method of applying the invention:—600 grms. of crude sulphuric acid are mixed with one litre of water and 250 grms. of aniline and cooled to 15°. A solution is then prepared containing 750 grms. of sodium nitrite in one litre of water, and one-third of this solution is added slowly in order to diazotise the aniline. The remainder is then added quickly and sufficient sulphuric acid stirred

in under constant agitation to raise the temperature of the mixture to 70°. Considerable frothing takes place, and, after cooling, the mixture is filtered, the black residue on distillation with steam yielding 60 per cent. of *o*-nitro-phenol. The *p*-nitro-phenol remains behind, and is extracted by means of boiling water, yielding about 16 per cent. In order to obtain a larger yield of the para-compound the diazotisation must be performed at a temperature below 10°, and after treating as described above is allowed to stand for some days at 15°–20°. The reduction of the above nitro-compounds is performed by means of tin and hydrochloric acid, or by sulphuretted hydrogen and ammonia.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

An Artificial Silk. De Chardonnet. Compt. Rend. 108, 961–963.

COTTON or the sulphited pulp of young wood is treated with nitric acid, and then dissolved in a mixture of ether and alcohol—38 to 42. This collodion is placed in a copper vessel and forced by air pressure through capillary glass tubes, the outlets from which are surrounded by water. In the figure, A shows the glass tube, the lower end of which dips



into the collodion; B is a second tube enveloping the first, and receiving a supply of water by the opening C. The collodion, forced through the orifice A, solidifies as it comes into contact with the water, forming a thread which is seized by a clip and carried forward to the bobbins in the usual way. It is stated that the cellulose is denitrated by soaking it in a bath of nitric acid of sp. gr. 1.32, the temperature of which is allowed to fall slowly from 35° to 25° C. At the end of this process the cellulose has become gelatinous, has lost its explosive properties, and very readily absorbs colouring matters and salts. In density, breaking strength, and elasticity it compares very favourably with natural silk, and in lustre even surpasses it.—A. R. D.

PATENTS.

Improvements in Apparatus and Means for Cleaning Vegetable Fibres. A. Figge, London. Eng. Pat. 4887, March 31, 1888. 8d.

THE apparatus consists of a vessel fitted with electrodes, in which a perforated drum revolves. The drum contains the materials to be treated, and the vessel contains lukewarm water and a small quantity of blood. When a current of electricity is passed between the electrodes a fermentation or putrefaction of the blood is set up which extends to the glutinous matter encasing the fibres, rendering it readily soluble. In certain cases salt may be added to the liquid.

—E. J. B.

Improvements in Methods of and Apparatus for Utilising Peat Fibre. G. A. Cannot, London. From G. H. Beraud, Maestricht, Holland. Eng. Pat. 8742, June 14, 1888. 1s. 3d.

THIS invention relates to the utilisation of the fibre of peat by spinning it into threads either alone or mixed with a small quantity of wool, cotton, or other fibrous material, and manufacturing it into textile fabrics which can be used for a variety of purposes, such, for example, as cloth, wrappers for meat, fish, and food stuffs, soles for boots, chest protectors, screens, curtains, &c. The material is first broken up into fibres and freed from dirt by treatment in a beating engine of special construction. It is then converted into tow by another machine called a breaking engine, after which it may be spun into thread. The above processes may be preceded by a chemical treatment of boiling in alkaline solutions. Or it may be soaked for 6–12 hours in a 5 per cent. sulphuric or hydrochloric acid solution, after which it can be bleached with chlorine or sulphurous acid. The specification contains 15 drawings of the various machines and apparatus employed.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Utility of Good Commercial Glycerin. Dyer, 1889, 24.

COMMERCIAL glycerin, which is usually from 1.16 to 1.25 specific gravity, is much used in the dyeing industry as a solvent for many aniline dyes, also as an antiseptic in solutions which contain albumen, casein, and other substances, for which purposes it is not necessary to use the white glycerin except for delicate colours, when it must be absolutely free from mineral matter. It can also be used with bleaching materials to prevent the penetrating odour, and bleaching can then be performed in the driest weather with open windows without the goods becoming stiff or brittle. It also acts as a preventive of "stock stains" in goods which are warehoused a long time. A mixture for such use is the following:—Dextrin, 10 lb.; glycerin, 24 lb.; sulphate of alumina at 1.5 specific gravity, 2 lb.; and water, 51 pints.—R. L. W.

Removing Starch from Cotton. Dyer, 1889, 26.

IN order to remove starch completely from too heavily dressed cotton, which has to be subsequently dyed, use is made of the decomposition which starch undergoes by the action of malt extract. For 10 lb. of yarn a chilled bath containing 3 oz. of malt and 3 oz. of glycerin is prepared, and the cotton after "wetting out" worked in this till free from starch.—R. L. W.

The Composite Indophenol-Indigo Vat. A. Kertész. Chem. Zeit. 13, 626–627.

THIS article is a criticism on a paper previously published by Noelting in the same Journal (this Journal 1889, 189; see also 1889, 282).

A series of experiments on the large scale were undertaken by the author with a view to obtaining data for an exact comparison of the relative costs of the composite and pure indigo vats. The concentrated composite vat was made according to the directions given. As a preliminary trial showed that the indophenol tended to float about on the surface of the vat and so escape reduction, it was made into a paste with hot water before being mixed with the ground indigo. A good quality of Bengal indigo, containing 62 per cent of colouring matter, was used. Two vats were prepared as follows:—No. 1 vat was set with 33 lb. of indigo costing 165s.; No. 2 vat was set with 22 lb. of indigo and 7 lb. of indophenol, together costing 142.3s. 172 pieces = 9,753 yards of cloth, were dyed in No. 1 vat, against 165 pieces = 9,309 yards, in No. 2 vat. There was consequently a gain equal to 11 per cent. of indigo with the composite vat.

This amount is below that stated to be gained, namely 25 per cent., but is still considerable. But the relative costs of reduction have yet to be taken into account. In the case of the new vat, owing to the necessity of preserving the vat as long as possible, the cost is comparatively high. Of the vats now in use, namely, that of lime and zinc dust, the caustic soda and zinc dust, and the sodium hydrosulphite vat, the first two require renewing more frequently than the latter, which is therefore preferred whenever it is desired to keep the vat; and this being especially the case with the composite vat, the hydrosulphite method of reduction is selected and modified to suit the special case.

As far as can be judged from a comparative dye-trial lasting five days, the new vat keeps in better condition than the sodium hydrosulphite vat, but not so well as a vat made with lime, caustic soda, and zinc dust, and the manipulation of the goods is rendered slightly more difficult through the workmen requiring to wear india-rubber gloves on account of the strong alkalinity of the vat.

The costs of reduction with the different vats are as follows:—

Lime and zinc dust	4½	per cent. of the value of the indigo.
Caustic soda and zinc dust 5½	"	"
Sodium hydrosulphite	9½	"
Composite vat	15½	"

The composite vat, as stated above, effects a reduction of cost equal to 14 per cent. of indigo, but when the extra cost of reduction is deducted from this percentage, only a gain of 4½ per cent. is realised by the new vat as against the hydrosulphite, and little or no gain against the other vats.

The shades obtained with the composite vat are rather more purplish than those of pure indigo; washing or exposure to light renders them slightly duller than the latter. Indophenol can be detected on the fibre by boiling with sodium hydrate of 14° to 18° B., and adding ether to the solution; pure indigo dissolves in the ether with a pale blue colour, indophenol colours it violet.—E. B.

Tolylene Orange. F. V. Kallab. Mittheil. des K. K. Tech. Gew. Museums, 1888, 114—120.

TOLYLENE orange is the name of a mixed tetrazo-dye produced by combining cresolcarboxylic acid and tolylene-diamine sulphonic acid with tetraxiditoly. It is sold in two shades, G(TOG) and R(TOR).

The commercial product is the sodium salt. It appears as an orange-brown powder tolerably easily soluble in water. Its aqueous solution is rendered brighter in colour by the addition of a little caustic soda; further addition produces an orange-brown precipitate. Concentrated sulphuric acid dissolves the dye with a violet colour.

Tolylene Orange G(TOG), is the first orange substantive dye which appeared in the market. It yields shades fast to soap, and ranging from the most delicate "ivories" and "creams" through the whole scale of buffs, down to full shades of orange closely resembling chrome orange, but possessing advantages over the latter in not being tarnished by hydrogen sulphide, and not injuring the feel of the cloth. Again, the shades are faster to acids than chrome orange, and faster to light than the reds of the substantive class. The dye is very suitable in calico printing for the production of pad buffs and creams, and is strongly recommended as a substitute for iron buff, especially for padding over colours liable to be injured by this colour. Chrysamine, which has been in use some time as a substitute for iron buff, is not as red as the latter, and no satisfactory method of overcoming this deficiency is known. The various methods in use, such as leaving the pink stain uncleaned on cloth printed with alizarin colours, mixing caustic soda with the chrysamine, and adding magenta or benzopurpurin to the padding colour, all have their drawbacks. Tolylene orange, again, is not so sensitive as chrysamine to the action of copper salts or metallic copper. It is best applied in a wooden dye-bath along with soap and phosphate of soda, the water being first softened by boiling with soap, and the scum removed. In dyeing full shades on cloth printed with fast colours, the

bath may be boiled; in the case of cloth printed with aniline colours the temperature should not exceed 45°. 8—10 minutes' dyeing will suffice for printed cloth, plain cloth should be worked at the boil for a longer time. In the case of medium and pale shades, it is preferable to pad either by padding or printing machine since the dye is apt to be too rapidly, and consequently unevenly, absorbed from a dye-bath. The following receipt is given for a medium pad shade: 2 parts of Tolylene orange G are dissolved in 1,000 parts of boiling water containing 20 parts of sodium phosphate, and 5 parts of soap. The solution is then mixed with 1,000 parts of gum tragacanth paste (1:20), and boiled for 15 minutes, then strained and padded. The pieces are passed through a Mather and Platt's steam aniline ager or steamed for a short time, washed and finished.

The steaming can be dispensed with in many cases, and the pieces finished after lying for a few hours.

A printing colour is made by mixing starch paste, gum tragacanth paste, tolylene orange G, and glycerin. The calico is printed, steamed for an hour, and washed in a cold bath containing 3 per cent. of ground chalk. The colour is not very fast to soap, but is suitable for many purposes, such as linings for example.

Discharge effects are obtained by printing a thickened mixture of stannous acetate for white, and Persian berries, alizarin, Methylene blue, Alizarin blue, logwood, along with suitable mordants, and stannous acetate for coloured patterns.

Tolylene orange acts as mordant for basic dyes, and a variety of compound shades can thus be obtained. Care must be taken that the material dyed with the Orange is well rinsed before the basic dye is applied.

Linen and jute dye similarly to cotton; China grass and hemp take a redder shade. Animal fibres, dyed under the same conditions as the vegetable fibres, are coloured more yellow than the latter. Silk dyes well in baths of boiled-off liquor "broken" with acid. Wool is dyed for an hour at the boil in a bath containing 10 per cent. of sodium sulphate; the shades obtained are fast to milling.

Tolylene Orange R, in general resembles the G shade, but gives redder shades, which are, however, scarcely so fast. Salmon shades are obtained by using only a little of the dye, larger quantities give shades like chrome-orange which has been strongly lined or topped with magenta. Tolylene orange R is applied in the same way as the G shade.—E. B.

PATENTS.

Improvements in Apparatus for Printing on Fabrics.
J. Kerr, Church. Eng. Pat. 9124, June 22, 1888, 8d.

This invention relates to the construction of duplex printing machines, and enables two sides of a fabric to be printed simultaneously without the use of central cylinders or bowls, or blankets, when so desired the impressions on the two sides of the fabric being made to exactly coincide.

One or more pairs of printing rollers are provided, the individual pairs being placed opposite one another. The fabric to be printed is passed between the pair or pairs of rollers so as to be in contact with each roller of the pair, or all the rollers at the same time. The rollers may print the same pattern on each side, or different patterns may be printed on the two sides. In patterns printed with one colour, one pair of rollers can be used, but in printing with more than one colour, the number of rollers will correspond with the number of colours. Both sides of one fabric, or one side of each of two fabrics placed back to back can be printed with the same or different patterns.

The arrangement of the pairs of rollers is such, that the "nips" are in parallel planes to each other, in this respect differing from ordinary printing machines, wherein the centre lines of the "nips" radiate towards the centre of the bowl. Two drawings are given.—E. B.

Improvements in Linings for Bleaching Kiers, Vats, Dye Tanks, and other Analogous Receptacles. R. P. Frist, Wilmington, Delaware, U.S.A. Eng. Pat. 18,773, December 22, 1888. 6d.

BLEACHING kiers have formerly been made of wood, or of iron lined with wood, galvanised, or even enamelled. These methods of lining are open to objection. The objections are overcome by lining the kier or tank with chemically prepared or treated fibre such as "celluvert" (a product described in Eng. Pat. 9319 of 1885, this Journal, 1885, 751), vulcanised fibre, parchment fibre, and like products resulting from the treatment of vegetable fibres with acids or acid compounds. Of these materials, "celluvert" is preferable, since, after the lining has been in use some time, a skin or enamel is formed on it. The fibre is impervious to moisture; steam does not affect it, whereas wood becomes soaked, swells, and warps.

The prepared fibre lining, moreover, is of much less thickness than a wood lining, so that it detracts much less from the capacity of the kier. The lining is preferably made in the form of slabs, which may be secured to the kier or tank in any suitable way, for example, by means of bolts passing through the shell, and lining of the kier, and having inside the kier cap-nuts, made of, or covered with cellulvert, &c., of sufficient size to cover a slot or enlarged opening in the lining, which allows for the slight expansion, and contraction of the same.—E. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Researches on the Thionic Series. Berthelot. Compt. Rend. 108, 773—779.

THE author has determined the heats of formation of the acids of the thionic series by oxidising their potassium and sodium salts with a solution of bromine in potassium bromide. Complete conversion into sulphuric acid takes place in a few minutes with hyposulphurous, trithionic, tetrathionic, and pentathionic acids, but in the case of dithionic acid, oxidation takes place so slowly that the method is useless. The author deduces the heats of formation of these thionic acids from the number of calories evolved during the oxidation, making due allowance for the heats of formation of sulphuric acid, of water, and of hydrobromic acid, together with the heat of solution of bromine in potassium bromide, the heat of neutralisation of the thionic acid, and the heat disengaged by the saturation of an equivalent of potash or soda with sulphuric acid. Below are the calories disengaged during the formation of the molecular weight of each acid in grms.

	Cal.
$S_2O_3 \cdot H_2O$	79.4
$S_3O_3 \cdot H_2O$	207.8
$S_4O_3 \cdot H_2O$	211.4
$S_5O_3 \cdot H_2O$	205.2
$S_6O_3 \cdot H_2O$	215.8

It will be noticed that in each case the proportions approximate to 40 calories for each equivalent of oxygen directly united with the sulphur atom. This is also the case with sulphurous, sulphuric, and persulphuric acids.

—A. R. D.

The Action of Alkalis on the Acids of the Thionic Series. Berthelot. Compt. Rend. 108, 925—930.

THIS communication is intended to supplement the author's note (preceding abstract) on the heats of formation of the acids of the thionic series. He now describes the behaviour of these acids with an excess of alkali in dilute solution. Conversion into sulphites and thiosulphates (hyposulphites) take place with evolution of heat. The re-arrangement of the molecular groups of the thionic acids really involves an absorption of heat, but this absorption is more than

counterbalanced by the heat of neutralisation of the increased number of acid molecules produced. His results lead him to advance the theory that the thionic acids should be considered as derivatives either from thiosulphuric (hyposulphurous) or sulphurous acids or from both, by the elimination of molecules of water.—A. R. D.

On the Solubility of some Salts. H. Le Chatelier. Compt. Rend. 108, 801—803.

THE author still maintains the impossibility of a vertical tangent to the curves of solubility in the case of calcium chloride. He also complains that B. Roozeboom (this Journal, 1889, 391) has in his calculations neglected the change of volume that accompanies the solution of the salt, and which at the point of fusion, he contends, will materially influence the results. He thinks, however, that Roozeboom and himself are nearer of accord than may at first appear, especially if the former will assent to the proposition that with every abrupt change in the nature of the solvent there is a correspondingly abrupt change in the behaviour of the curve. Roozeboom has already completely accepted the opinion advanced by the author, that a sudden change in the behaviour of the curve of solubility corresponds necessarily to every sudden change in the state of a solid salt, which undergoes solution.

Roozeboom had complained that the author had attributed a too great degree of precision to his experiments. He considers that on a subject so delicate, theory alone can lead to positive conclusions. His formula, which claims absolute rigorousness, contains a denominator holding good to the point of fusion of $CaCl_2 \cdot 6H_2O$ and giving consequently an infinite value for the angular coefficient of the tangent. The author cannot accept this view; he has great confidence in the experiments, but much less in the rigorous formula, which they, in fact, only approach.

Roozeboom neglects in his calculations, as being infinitely small, the change of volume accompanying solution of the salt. But on arriving at the fusing point, this neglected quantity becomes infinitely large in proportion to that which has been preserved, and the formula loses its applicability. (*Études sur les Conditions de l'Équilibre*, B. Roozeboom, Compt. Rend. 108, 22 and 218.)—A. R. D.

On the Oxides of Manganese obtained in the Wet Way. A. Gorgeu. Compt. Rend. 108, 948—951.

HYDRATED protoxide of manganese held in suspension in a mother liquor containing excess of manganese salt absorbs oxygen with the formation of the saturated bibasic manganite $MnO_2 \cdot 2MnO$. Further absorption of oxygen goes on slowly at ordinary temperature till the acid manganite of the formula $MnO_3 \cdot MnO$ is arrived at. Neutral aqueous solutions of manganous salts grow turbid on exposure to the air, the amount of deposit varying inversely with the degree of concentration. From solutions of chloride, sulphate, and acetate it has the composition $MnO_3 \cdot MnO$; from the nitrate, $3MnO_2 \cdot 2MnO$. Probably this deposit is due to the action of oxygen upon the salts already somewhat dissociated by the fact of their solution in water. Iodine (dissolved in potassium iodide) acts very feebly upon hydrated manganous protoxide and upon the carbonate. Upon salts of manganese with acetic and the stronger acids it has no action at all. Chlorine and bromine behave much more energetically, oxidising the protoxide and decomposing the carbonate with ultimate formation of the dioxide. A considerable time is required to effect complete oxidation owing to the formation of intermediate manganites of manganese, which are less susceptible to the influence of the oxidising agent.—A. R. D.

A New Determination of the Specific Gravities of Solutions of Ammonia. G. Lunge and T. Wiernik. Zeits. f. angew. Chem. 1889, 181—183.

GRÜNEBERG (this Journal, 1889, 390—391) lately published a new table of the specific gravities of solutions of ammonia, which table appears to agree very closely with that published years ago by Wachsmuth. The tables of both investigators

are, however, based on determinations performed at different temperatures, and if the necessary corrections are introduced into Wachsmuth's table, who took 12° C. as the normal temperature, it will be found that the agreement with Grüneberg, although still good, is no longer very close. Lunge and Wiernik now made a large number of experiments, in which the specific gravities and actual percentages of ammonia in ammoniacal liquors were determined with the greatest possible care. From these determinations a table was calculated, which agrees very well with Wachsmuth's, corrected for a temperature of 15° C., whereas Grüneberg's figures are a little too low, as will be seen by the comparison of these tables:—

Specific Gravity.	Carius, 14° C.	Grüneberg, 15° C.	Smith, 11° C.	Wachsmuth, corrected for 15° C.	Lunge and Wiernik, 15° C.
0.880	..	35.50	..	35.42	35.60
0.885	35.65	33.50	..	33.64	33.67
0.890	33.35	31.40	..	31.86	31.73
0.895	31.10	29.50	30.4	30.08	30.03
0.900	29.00	27.70	..	28.34	28.33
0.905	27.10	26.00	..	26.64	26.64
0.910	25.20	24.40	24.4	25.02	24.90
0.915	23.40	22.85	..	23.40	23.35
0.920	21.65	21.30	..	21.80	21.75
0.925	20.00	19.80	20.3	20.26	20.18
0.930	18.40	18.35	..	18.74	18.64
0.935	16.90	16.90	..	17.20	17.12
0.940	15.45	15.45	15.6	15.69	15.63
0.945	14.05	14.00	..	14.22	14.17
0.950	12.65	12.60	12.7	12.80	12.71
0.955	11.25	11.20	..	11.35	11.32
0.960	9.90	9.80	9.8	9.98	9.91
0.965	8.55	8.40	..	8.62	8.59
0.970	7.25	7.05	7.2	7.27	7.31
0.975	6.00	5.75	..	5.97	6.05
0.980	4.75	4.50	4.6	4.71	4.80
0.985	3.55	3.30	..	3.48	3.55
0.990	2.35	2.15	2.3	2.26	2.31
0.995	1.08	1.05	..	1.17	1.14
1.000	0.00	0.00	..	0.00	0.00

Carius' table, which for a long time enjoyed a high reputation for correctness, must now give way to those of his successors, who although working independently, arrived at very nearly the same results.

The authors publish a further table, which will be found very useful.

TABLE OF THE SPECIFIC GRAVITY OF SOLUTIONS OF AMMONIA AT 15° C.

Specific Gravity at 15° C.	Per Cent. NH ₃	One Litre contains Grammes of NH ₃	Correction of the Specific Gravity for ± 1° C.
1.000	0.00	0.0	0.00018
0.998	0.45	4.5	0.00018
0.996	0.91	9.1	0.00019
0.994	1.37	13.6	0.00019

Specific Gravity at 15° C.	Per Cent. NH ₃	One Litre contains Grammes of NH ₃	Correction of the Specific Gravity for ± 1° C.
0.992	1.84	18.2	0.00020
0.990	2.31	22.9	0.00020
0.988	2.80	27.7	0.00021
0.986	3.30	32.5	0.00021
0.984	3.80	37.4	0.00022
0.982	4.30	42.2	0.00022
0.980	4.80	47.9	0.00025
0.978	5.30	51.8	0.00023
0.976	5.80	56.6	0.00024
0.974	6.30	61.4	0.00024
0.972	6.80	66.1	0.00025
0.970	7.31	70.9	0.00025
0.968	7.82	75.7	0.00026
0.966	8.33	80.5	0.00026
0.964	8.84	85.2	0.00027
0.962	9.35	89.9	0.00028
0.960	9.91	95.1	0.00029
0.958	10.47	100.3	0.00030
0.956	11.03	105.4	0.00031
0.954	11.60	110.7	0.00032
0.952	12.17	115.9	0.00033
0.950	12.74	121.0	0.00034
0.948	13.31	126.2	0.00035
0.946	13.88	131.3	0.00036
0.944	14.46	136.5	0.00037
0.942	15.04	141.7	0.00038
0.940	15.62	146.9	0.00039
0.938	16.22	152.1	0.00040
0.936	16.82	157.4	0.00041
0.934	17.42	162.7	0.00041
0.932	18.03	168.1	0.00042
0.930	18.64	173.4	0.00042
0.928	19.25	178.6	0.00043
0.926	19.87	184.2	0.00044
0.924	20.49	189.3	0.00045
0.922	21.12	194.7	0.00046
0.920	21.75	200.1	0.00047
0.918	22.30	205.6	0.00048
0.916	23.03	210.9	0.00049
0.914	23.68	216.3	0.00050
0.912	24.33	221.9	0.00051
0.910	24.99	227.4	0.00052
0.908	25.65	232.9	0.00053
0.906	26.31	238.3	0.00054
0.904	26.98	243.9	0.00055
0.902	27.65	249.4	0.00056
0.900	28.33	255.0	0.00057
0.898	29.01	260.5	0.00058
0.896	29.69	266.0	0.00059

Specific Gravity at 15° C.	Per Cent. NH_3	One Litre contains Grammes of NH_3	Correction of the Specific Gravity for $\pm 1^\circ \text{C}$.
0.884	30.37	271.5	0.00060
0.892	31.05	277.0	0.00060
0.899	31.75	282.6	0.00061
0.888	32.50	288.6	0.00062
0.883	33.25	294.6	0.00063
0.884	34.10	301.4	0.00064
0.882	34.95	308.3	0.00065

—S. H.

The Specific Heat of Sulphuric Acid of Various Strengths.
F. Bode. *Zeits. f. angew. Chem.* 1889, 244—245.

THERE exists for the specific heat of hydrated sulphuric acid, a formula by Marignac, viz. :—

$$C = 18n + 8.58 + \frac{334.8}{n} - \frac{2882}{n^2} + \frac{7262}{n^3},$$

in which $C = p \cdot c$ the molecular heat ;

p = the molecular weight of the solution ;

c = the specific heat of the solution per unit of weight ;

n = the number of molecules of water per molecule of SO_3H_2 .

This formula gives accurate results from a certain point, and the results found by calculation agree with those found by experiment. Marignac's formula is, however, only applicable if n , that is the number of molecules of water, be known, and the author therefore calculated a more generally useful table, where the specific heat can be read off directly, after the specific gravity of the sulphuric acid at 15° C. is ascertained.

$^{\circ}\text{B}$ at 15° C.	Specific Gravity.	Specific Heat.	$^{\circ}\text{B}$ at 15° C.	Specific Gravity.	Specific Heat.
66	1.842	0.3315	35	1.320	0.67
63	1.774	0.38	30	1.263	0.73
60	1.711	0.41	25	1.210	0.78
55	1.615	0.45	20	1.162	0.82
50	1.539	0.49	15	1.116	0.87
45	1.453	0.55	10	1.075	0.90
40	1.383	0.60	5	1.037	0.95

The specific heat increases with a rise of temperature.

—S. H.

PATENTS.

Improvements in Purifying or Treating Coal Gas and other Gaseous or Liquid Products of Destructive Distillation, and in part applicable in the Alkali Manufacture.
A. Campbell, London, and W. Boyd, Glasgow. Eng. Pat. 10,186, July 13, 1888. 6d.

See under 11., page 534.

Improvements in the Reduction of Hydrogen Sulphide for the Production of Sulphur therefrom. A. B. Thompson, London. Eng. Pat. 17,183, November 26, 1888. 6d.

THE hydrogen sulphide is reduced to sulphur by means of the fumes obtained by the decomposition of nitrates or nitric acid. Sufficient air must be admitted to reoxidise the nitric oxide formed by the reaction to nitrogen peroxide, and the process then goes on continuously. Drawings are given to show how the operation can be carried out in conjunction with the process patented in 1887 (this Journal, 1888, 626).—E. E. B.

Improvements in the Manufacture of Acetic Acid.

M. Cannon, London. Eng. Pat. 5224, March 26, 1889. 6d.

CRUDE acetic acid is digested with about 3 per cent. of either binoxide of manganese, manganate of soda or other manganate, or permanganate of potash or other permanganate. An equivalent amount of sulphuric or other acid is added to decompose the acetate produced by the decomposition of the oxidant, and the digested acid is distilled, the first 10 per cent. and the last 5 per cent. being rejected. The acetic acid thus produced may be still further purified by repeating the process with 1 per cent. of one of the above oxidising agents. The manganese is recovered from the residue in the still and is used over again.—E. E. B.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

PATENT.

Improvements in the Manufacture of Plate Glass. P. Simon. Sulzbach, Germany. Eng. Pat. 6393, April 15, 1889. 6d.

THE object of this invention is to obtain rolled plate glass with a smooth and even surface. The glass is pressed between rollers with their surface waved, the wave running parallel to the axes of the said rollers, and the wave of the one roller when they are in motion passes in the hollow of the other, so that the space between the two rollers remains constant, and the plate will not receive varying thicknesses. By means of pins or punches attached to the rollers the glass may be perforated if required. Drawings are attached to the specification.—C. X. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Portland Cement. Candlot. Bull. Soc. d'Encouragement l'Ind. Nat. 1889, 212—229.

CANDLOT'S paper has been accepted by the chemical committee of the society through H. le Chatelier, of whose report the following is an abstract. The chief object of the author has been to examine the various methods of testing Portland cement, already in use. These are comprised in the determination of (1) chemical composition, (2) fineness, (3) density, (4) speed of setting, (5) tensile strength. Taking these *seriatim* we find :—

(1.) The ultimate composition of a cement may vary within tolerably wide limits without affording any criterion of quality. The only three points that can be thus used, are the percentage of insoluble matter, which in the case of cements of good quality does not exceed 1 per cent.; the loss on ignition (water and carbon dioxide), which if greater than 3 per cent., indicates that the cement has undergone sufficient alteration to appreciably diminish its strength; and the presence of sulphides in notable amount, which points to adulteration with blast-furnace slag.

(2.) Candlot considers that all particles which refuse to pass through a sieve with 900 meshes per square cm. are inert; those passing one of silk have a marked influence on the early stages of hardening, while those of intermediate size ultimately become hydrated and harden as perfectly as the finest, but take a considerable time in so doing. It therefore appears that this test is of value intrinsically, but it is also important on account of the bearing it has on others of the tests usually made, such a *density* and *speed of setting*.

(3.) A careful distinction must be drawn between absolute and apparent density; the former is that of an isolated particle, while the latter is the weight of a given measure of

the cement. The former varies within very narrow limits (3.108 for cement from under-burnt yellowish clinker, and 3.154 for that from well-burnt black clinker, being the extreme figures quoted), and is of little use in judging quality. The latter must obviously be taken under standard conditions of filling the measure, as otherwise enormous variations will occur. It is found that the apparent density increases with the coarseness of the sample examined, and it is this fact that has given rise to the fallacy that a low density is characteristic of an under-burnt cement; under-burnt cement is soft, and becomes more finely divided by a given amount of grinding than a well-burnt one, and it is this greater fineness that causes it to have a low apparent density. Density, real or apparent, is therefore dismissed as of but slight value.

(4.) An arbitrary method of determining the beginning and end of the setting is inevitable. Vicat's needle, which is a point 1 mm. in area loaded with 300 grms. is commonly used. The influence of various conditions and circumstances was studied.

- (a.) *Rise of temperature* much hastens the setting; the alteration is most marked with slow setting cements.
- (b.) Decreasing the *proportion of water* used for tempering quickens the setting; it is on this account that neat cement sets more quickly than when mixed with sand, because in the latter case more water is needed for a given weight of cement.
- (c.) Soluble *foreign salts*, such as calcium chloride, sulphate, and nitrate, retard setting; sodium chloride is without influence; sea water forms calcium sulphate and chloride by the action of the magnesium salts it contains on the lime of the cement, and therefore also lessens the speed of setting. Under-burnt cements are most affected in this respect.
- (d.) *Fine grinding* quickens the setting to a slight extent, more so with fresh than with sea water.
- (e.) *Exposure to air*, involving as it does the absorption of water and carbon dioxide, considerably retards the setting.

From this it appears that the speed of setting is so easily altered by comparatively slight causes that its determination is of little value as a means of judging the quality of the cement. Moreover, Portland cement of good quality may set in any time from 10 minutes to 10 hours according to its method of manufacture (the very quick-setting variety is, of course, specially made to replace ordinary quick-setting cements). The chief reason, therefore, for examining samples in this respect is to ascertain whether they be suited for the work in which they are to be used.

(5.) Tests in compression approach more nearly than those in tension to the conditions obtaining in practice, but are little used on account of the difficulty of making them and the costliness of the apparatus necessary. Candlot has confined his attention to tensile tests, and points out many sources of uncertainty. For instance, it is customary to make the tests in sets of six, and as the figures given by these often vary widely, to adopt certain arbitrary rules which may differ among themselves; thus some operators return the mean of the whole, others that of the three strongest, others again the highest value of the six. Further the tensile strength of the cement, whether neat or mixed with sand, is not the same per unit of sectional area for briquettes of all sizes; it appears rather to be proportional to the perimeter of the section.

The maximum strength of a cement is not usually reached until at least a year has elapsed after its setting; normally, the limit once reached is invariable; certain cements, however, show a retrograde tendency, especially such as contain an excess of lime or are under-burnt. Even a good cement, if very finely ground, mixed with sea water, and tested neat, will generally reach a maximum strength between the third and sixth month, but this is a phenomenon of a different order altogether, for it does not occur if the cement be mixed with sand or tested in compression. Candlot's figures show that the usual 7 and 28 days' tests fail to give any but an imperfect idea of the final strength of the cement.

The quantity of water used is without influence if it vary not more than 20 per cent. of its total amount; beyond this limit a decrease in strength occurs. There is usually a perceptible difference between cement mixed with soft and sea waters, but its direction and amount cannot be reduced to any rule. The influence of temperature on the final strength is doubtful, as is also that of the environment in which the briquettes are kept, *e.g.*, in moist or dry air, or under water. Cement ganged on an absorbent surface, such as a plaster slab, and left there for 24 hours before immersion, shows a much higher tensile strength than when a non-porous plate has been used, if tested after a fairly short period has elapsed; in the long run this difference tends to disappear. The kind of sand used and the proportion adopted are also noteworthy factors.

Besides all these, which are external conditions, and apply equally to good and bad cements, there are certain intrinsic properties of cements which influence its tensile strength. First with respect to the *composition*: an over-limed cement will show a high tensile strength to begin with, but will be apt to retrograde; if over-clayed on the contrary, it will be at first somewhat weak, but will not thus deteriorate afterwards. Secondly, *burning*: under-burnt cement of normal composition will set rapidly and attain its maximum strength in the first month. Thirdly, *fineness*: this is without influence on the final strength if the cement be tested neat, but if mixed with sand the finer cement will be considerably the stronger.

From these facts one is forced to conclude that the determination of the tensile strength does not define the quality of a cement with any great precision.

To supplement these methods of testing it has been proposed to allow the briquettes to harden under water at 80°–100° C., instead of at the ordinary temperature. This, Candlot condemns, but Chatelier is of opinion that it is useful, especially in discriminating between cements of really good and thoroughly bad quality; over-limed cements are detected by the deterioration they suffer.

Finally, Chatelier comments on the discouraging state of things indicated above, and suggests that reform is much needed in our methods of testing. It is of no interest to know the tensile strength of cement that is to be used in compression when no certain relation exists between the two. He lays down the following rules with which, among others, a cement of good quality should comply:—

- (1.) It should possess a fair but not necessarily high strength, when tested mixed with sand and in compression.
- (2.) It should be capable of adhering with sufficient firmness to ordinary building materials such as brick and stone.
- (3.) It should not disintegrate spontaneously or crack or swell.
- (4.) It should not disintegrate under the influence of perfectly dry air or frost.
- (5.) It should, if intended for marine work, resist the action of magnesium salts as far as possible.—B. B.

Basic and Fire-proof Stones from Basic Slag. Dingl. Polyt. J. 272, 17.

THE *Hüstener Gewerkschaft* (Hüsten, Westphalia) proposes as a binding material for basic and fire-proof stones the phenolates of the alkalis and alkaline earths (Ger. Pat. 46,237, Nov. 24, 1887), of which the phenols have been obtained by the dry distillation of coals, brown coal, peat, or wood. The tar from these materials is distilled, and the tar oils thus obtained are separated in the usual way into phenols and hydrocarbons.

The first (carbolic acid or creosotes) are then stirred to a thin paste with the alkali or alkaline earth selected. The mass becomes warm, and before it can cool and harden, the fire-proof materials are mixed with it. In a few hours the mixture hardens, and it must at once be brought into the desired position, and form just like cement. The purer the phenols employed, *i.e.*, the more carefully the neutral oils are removed, the harder and more durable is the moulded mass. Those materials, which in the roasted condition possess basic properties, *e.g.*, limestone, marble,

dolomite, magnesite, &c., may, after burning and suitably pulverising, be worked up with the phenols at once, to yield a plastic mass capable of being moulded, and which on cooling also hardens like cement.—W. S.

The Influence of Sugar on the Hardening of Cements.
Stammer. *Dingl. Polyt. J.* 271, 266—278.

A SERIES of experiments have been made on the influence of additions of sugar on the hardening of cements, by H. de Parsons and H. Hobart Porter on behalf of the American Society of Civil Engineers. The chief results obtained were that the addition of sugar or molasses delayed the setting of the mortar, the retardation being greater when molasses was used, but when certain proportions were not exceeded the strength of the mixture was greater than that of the pure cement. Less than 2 per cent. of sugar must be added to Portland cement, and less than 1 per cent. to Roman cement, otherwise the mortar will not hold together.

The following diagrams show graphically the results of the experiments. The abscissæ represent the duration of

Fig. 1.

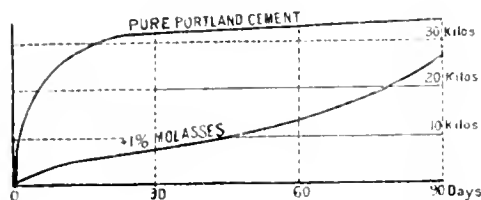


Fig. 2.

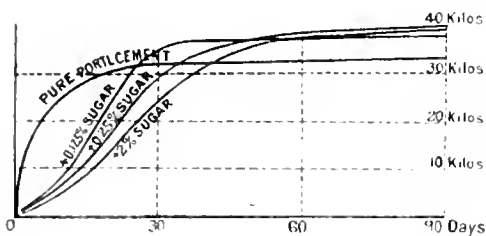
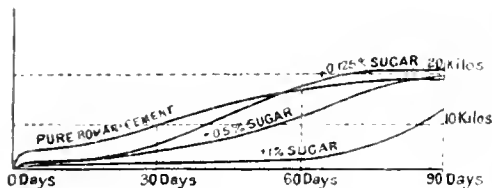


Fig. 3.



the hardening in days, and the ordinates the breaking strain in kilos. The sugar appears to have no chemical action on the other materials, crystals of it being easily detected on the broken surfaces. The authors are of opinion that the increased binding power of the cement brought about by the addition of sugar is due more to mechanical than chemical causes, as the presence of the sugar retards the setting of the cement, and consequently favours the completion of the chemical reactions involved in that process.—W. M.

X.—METALLURGY.

Progress in the Iron Industry. W. Kuort. *Dingl. Polyt. J.* 272, 1—18.

A MODIFICATION of the Bessemer process by Carlsson (Sweden), which yields a product containing about 0.2 per cent. of carbon and 0.02 per cent. of silicon, is described.

—A. R.

Extraction of Zinc in Shaft Furnaces. W. Koyort. *Dingl. Polyt. J.* 272, 268—272 and 312—319.

THE extraction of zinc in shaft furnaces is a question which requires a satisfactory solution. For a number of years many attempts have been made to improve the shaft furnace process. In 1878, Binon and Granddils in Stolberg made the attempt to use a zinc oven with upright retorts. They aimed at making the old Cornithian method continuous. The materials containing zinc were heated with reducing agents by gas in reduction spaces in the form of shafts, which were filled above, and emptied below.

The zinc shaft furnaces of Henri Harmet have above and below an apparatus for leading off the zinc vapours. The volatile products are led through two long cylindrical upright chambers in which the reduction of carbonic acid to carbonic oxide, and traces of zinc oxide to metallic zinc is completed. Westman, in the year 1881—85, used two shaft furnaces supplied with coal, and one for preparing briquettes of ore and coal. Through both the first shaft furnaces generator gas was passed, by the combustion of which in the regenerating chambers sufficient heat was produced to reduce the ore to metal. Quaglio, Pintsch, and Lentz obtained, in the year 1884, a patent for a furnace construction which consists in the arrangement of two shaft ovens connected by a canal, into one of which the air is introduced, and from the other the products of the reaction are withdrawn, this constantly being reversed. The discoverers indicate that the principle of their discovery consists in reducing the carbonic acid into carbonic oxide, so that the apparatus forms at the same time a carbonic oxide generator, in which the units of heat formed by the combustion of carbon to carbonic oxide, otherwise lost, are made use of, and the carbonic oxide is used as a heating gas. Rigaud uses likewise a double shaft furnace. One shaft is upright, and is charged in the usual way with ore and fuel. The other has an inclined position, and is in combination with the first under the hearth; it is only charged with coal. Metallic vapours come off with the gases escaping from the hearth, oxides probably being reduced also. Its temperature is only so high that the metallic vapours are condensed, and the liquid metal runs down the side channels, and is collected in an outside receiver. Steger considers the preparation of zinc in shaft furnaces possible if enough heat is produced for the reduction, and the zinc produced led over in an atmosphere of carbonic oxide into the cooled receiver for condensation in the liquid form. Steger has tried to find out whether by regulating the air current, and the supply of coal, the percentage of carbonic acid in the gas may be reduced so low that its action is immaterial. One of the most important conditions for producing an atmosphere rich in carbonic oxide consists in securing the highest possible temperature in combustion, attained by means of a highly heated blast. With a blast temperature of about 1,200° C., only a trace of carbonic acid is formed with the carbonic oxide. Clerc uses a blast heated nearly to the melting point of iron on a cold mixture of zinc oxide and charcoal powder. The zinc is driven forward as zinc dust, and at first flakes of zinc oxide are formed. Steger recommends now, horizontal shaft ovens, a detailed description of which is given. In these furnaces the zinciferous material mixed with coal is added from above. The furnaces are then brought to a full red heat by a very hot blast, and then the coal reduces the zinc from its ores. The chief question now is how to obtain the least possible quantity of carbonic acid, and have all the oxygen of the blast converted into carbonic oxide. Continuous working is not possible with these furnaces. Horizontal ovens are also preferable for sanitary reasons.

Just recently a method of Eichorn's has appeared. Eichorn's method resembles Westman's in the choice of apparatus, but differs essentially in principle. Eichorn heats the oxides produced by the reduction of the carbonic acid again to a temperature sufficiently high to reduce them. (Berg-und Hütten. Zeit. 1888, Nos. 43 and 44.) For this purpose two shaft furnaces filled with coke are used, by which the temperature is produced by hot blasts. These coke furnaces serve to store up heat, and for reduction, while the Westman gas producers are only for condensation. Eichorn's method can be used not only for the production of zinc, but also all those metals and metalloids which are separated in the form of vapour from their compounds on account of their low boiling points.

A new method of reduction by aid of heat stored up before in the reducing carbon has been introduced with the water-gas process. Eichorn says that this cannot be used in connexion with the ordinary shaft furnace process, but can replace the process in which vessels are used in the furnace, as no vessels, less handwork, and less coal are used. Since the heat stored up in the coke is only limited, it must be renewed in a proportionally short time. The working should be in alternate periods of reduction (which is also a period of hot blast), and of storing up of heat, being charged every $\frac{1}{2}$ —1 hour. Practically this method can only be used for the reduction of gases, vapours, and solids in such fine clouds of dust that they are carried away with a stream of gas. Eichorn is now examining the applicability of this method to the preparation of sulphur from SO_2 , and zinc from finely-divided zinc oxide. If the behaviour of the oxygen compounds of these elements on being reduced with coal is compared, then the following numbers are produced by 1 kilo. of each substance:—

Compound 1 kilo.	Heat necessary for the decomposition of the compound.	Heat formed by burning the O of the compound from C to CO.	Difference of the two foregoing Nos.	Carbon combined with, by the oxygen of the compound.
Cal. H_2O	Cal. 3,222	Cal. 1,600	Cal. 1,622	Kilo. 0.0666
SO_2	1,110	900	210	0.3750
ZnO	1,043	355	688	0.1481

As a sufficient amount of heat is not produced by the combustion of the oxygen in the compounds, the requisite quantity must be supplied by burning coal in air. With the hot blast only the combustion of carbon to carbon monoxide comes into account, and 1 kilo. of carbon produces $2,400 - 824 = 1,576$ available cal., if the gases escaping have a temperature of 500°C . From this can be calculated the amount of carbon theoretically required as follows:—

1.6958 kilo. of C for 1 kilo. H_2O .
0.5082 " 1 " SO_2 .
0.5816 " 1 " ZnO .

or,

23.7412 kilo. of C for 1 kilo. H.
1.0164 " 1 " S.
0.7285 " 1 " Zn.

The lowest possible temperature of reduction for sulphurous acid and water vapour is about 500° . Since, however, with the production of water-gas only carbon monoxide, and not carbon dioxide, should be formed with the hydrogen, in the practical working the temperature must be about $1,200^\circ$. This temperature corresponds to the reduction temperature for zinc oxide, so that the relations are the same in the three cases. The apparatus for the decomposition of sulphur dioxide and zinc oxide is essentially the same as that for the decomposition of water vapour. It consists of a roasting or shaft furnace in which the ore is roasted or melted down; this is connected with the two shaft furnaces charged with coke, and these with a receiver for condensation. Apparatus of the same size as for the water-gas process is used. The carbon required for 1 kilo. SO_2 is shown by calculation to be 0.874 kilo. Lead, silver, and copper in the zinc ores can be obtained

by this process. Hänisch and Schroeder have recently succeeded in absorbing the sulphurous acid from the roasting furnace gases, and condensing it to liquid sulphurous acid free from water.—A. J. S.

The Influence of Copper on the Tensile Strength of Steel.

E. J. Ball and A. Wingham. Iron and Steel Institute Spring Meeting, 1889.

THE iron rich in copper was produced by melting pig iron, and then adding to the molten metal oxide of copper. The carbon and silicon acted as the reducing agents for the cupric oxide, and the copper was thus introduced into the iron by a "reaction" and not by simple solution. A metal was obtained of the following composition:—

Cu = 7.550 per cent., C = 2.720, Mn = 0.290,
Si = 0.036, P = 0.130, S = 0.190.

The metal was bright, white in colour, crystalline, and very hard, but it did not offer any great resistance to impact. Varying quantities of it were then melted down with the basic Bessemer steel previously mentioned. The products of these fusions were allowed to cool very slowly. Test-pieces, 1 inch by $\frac{3}{4}$ inch by $\frac{3}{16}$ inch, were then cut, and submitted to tensile tests in a multiple lever-testing machine, the test-pieces being first carefully annealed.

The following table shows the percentages of copper and carbon in the metals tested, and the results of the tensile tests of the various specimens:—

Test-Piece.	Copper.	Carbon.	Tensile Strength.
No. 1	Per Cent. .847	Per Cent. .102	Tons per Sq. In. 18.3
2	2.124	.217	36.6
3	3.630	.380	47.6
4	7.171	.712	56.0

The elongations observed, however, were as follows:—Test-piece (1), 10 per cent.; (2), 5 per cent.; (3), 5 per cent.; (4), showed no visible extension, or the extension was but very slight. It will be observed that the tensile strengths of the specimens containing copper are greater than those of the specimens in which no copper is present. Some of the specimens, comparatively poor in copper and carbon, appeared to forge fairly well, both cold and hot. The principal effect that the presence of copper appears to exert on iron and steel is to render it extremely hard. From a general consideration of the results of the experiments it would seem that within certain limits copper does not prejudicially affect the mechanical properties of steel.

—A. J. S.

The Manufacture of Basic Open-Hearth Steel. J. H. Darby.

Iron and Steel Institute Spring Meeting, 1889.

ONE experimental steel furnace used was of five tons capacity, and above the regenerator chamber of the "Batho type" there were no end blocks, gas and air being conveyed from the chambers in wrought-iron pipes lined with brickwork; the air was admitted at right angles to the gas-pipes and above them, so as to bring the flame well on to the metal. This furnace gave considerable trouble. Sufficient heat could not be obtained; the refractory material in the gas and air tubes often required repairs. This furnace was abandoned when it was proved that phosphoric pig could be manufactured into good soft steel by treatment on a dolomite hearth. The next work tried by the author was that of designing and then building four 12-ton and afterwards two 20-ton furnaces. Each furnace was provided with a separate chimney, ordinary butterfly reversing valves of ample size, and regenerator chambers of large capacity. The furnace proper is composed of two wrought-iron sides, supported by H iron buck-staves, well braced together at the top and bottom. The ends are left open; holes are cut in the plates for the three doors on the front side of the

furnace, and another hole is made at the back for the tap-hole plates. The plates are also cut away to allow air to circulate for cooling purposes under the furnace bottom and bridge plates. The silica blocks at each end of the furnace are built in the usual manner. The roof is level from block to block; the ends, however, are well inclined to bring the flame down on the metal. On the iron plates for holding the dolomite hearth fire-bricks are placed, so that no part of the basic hearth when finished is more than 15 inches thick. As soon as all the brickwork is dry, hard burnt dolomite, well ground and mixed with a little anhydrous tar as will make it stick together when compressed, is rammed with hot irons until the desired shape of the hearth is built up; the tap-hole is made by a round piece of wood, which is left in and burnt out as the furnace heats up. The shrunk dolomite or basic material is brought up to the bottom of the doors and to an equal height all round. On it a layer of about two inches of chrome ore, also ground fine and mixed with tar, is rammed to act as a neutral separator between the acid and the basic portions; chrome ore is also rammed in between the silica blocks and the basic hearth. The side walls and jambs are built on the chrome ore. The roof is then put on and the furnace heated up, at first with a coal fire. When the furnace is properly dried and heated the hearth will become very hard; the tap-hole should be cleaned out and then filled with dry, ground, basic material for several inches. This should be well pushed up against a scraper held from the middle door. Anthracite coal is then rammed in, and the outside of the tap-hole is covered with damp sand. The charge may now be introduced. The author uses 80 per cent. of pig and 20 per cent. of scrap. Limestone is usually charged in sufficient quantity to make a basic slag from the first scrap and pig follow. When sufficiently hot, additions of iron ore and limestone are made at intervals during about five hours. The first sample is taken, and from its appearance and fracture it is judged if sufficient ore has been added. If so, as much as possible of the unspent oxide is reduced in the slag by reacting on the remaining impurities, lime additions being made from time to time. The hammered sample rapidly improves. The edges which were rough at first become smooth and free from cracks; the surface of the sample is clean, and when the charge is ready it will bend over into four thicknesses without any indication of cracking. Ferro-manganese is then added and the charge is tamed. Any kind of iron ore may be used in the steel furnaces, providing it contains a low percentage of silica. The 20-ton furnaces make from 180 to 200 tons of ingots per week, or 23·3 cwt. per hour, exclusive of Sundays. After experience in the manufacture of over 60,000 tons of basic open-hearth steel, the author has never seen red, short material in the usual soft quality. An average analysis of the soft steel is as follows:—

C = ·12 per cent., P = ·03, S = ·018, Si = nil, Mn = ·400.

This steel gives about 24·5 tons tensile strain per square inch and 15 tons elastic limit, with an elongation of 31 to 33 per cent. in eight inches.—A. J. S.

Alloys of Nickel and Steel. J. Riley. Iron and Steel Institute Spring Meeting, 1889.

THE author has shown that the composition of the alloy can be as effectually controlled in the open-hearth furnace as in the crucible. It can be made in any good open-hearth furnace working at a fairly good heat. The charge can be made in as short a time as an ordinary "scrap" charge of steel—say about seven hours—and its working does not demand so much care as is required in working many other kinds of charges. If the charge be properly worked, nearly all the nickel will be found in the steel, almost nothing is lost in the slag. The ingots are clean and smooth in appearance on the outside, but those richest in nickel are a little more "piped" than are ingots of ordinary mild steel. Any scrap produced can be re-melted in making another charge without loss of nickel. No extraordinary care is required when reheating the ingots for hammering or rolling. If the steel has been properly made, and be of correct composition, it will hammer and roll well, whether it contains little or much nickel. Some tables of tests of

steel with varying contents of nickel are given. In one case the addition of 4·7 per cent. of nickel raised the elastic limit from 16 up to 28 tons, and the breaking strain from 30 up to 40·6 tons, without impairing the elongation or contraction of area to any noticeable extent. In another case somewhat similar results were found with an addition of only 3 per cent. of nickel, combined with an increase of the carbon to 0·35 per cent. In two cases, one containing 2·0 per cent. of Ni, 0·90 per cent. of C, and 0·50 per cent. of Mn, the other 4·0 per cent. of Ni, 0·85 per cent. of C, and 0·50 per cent. of Mn, there was extreme hardness, due in part to the large quantity of carbon present, but also to the presence of nickel in addition. The quality of hardness obtains as the nickel is increased, until about 20 per cent. is reached, when a change takes place, and successive additions of nickel tend to make the steel softer and more ductile, and even to neutralise the influence of carbon. In the 25 per cent. nickel steel there are some peculiar and remarkable properties. In the unannealed specimen the breaking strain is high and the elastic limits moderately so, but in the annealed piece, while the breaking strain remains good, the elastic limit is very greatly reduced down to one-third of the breaking strain. Again, in both cases, the ductility as shown by the extension before fracture is marvellous, reaching 40 per cent. in 8 inches. Another feature is that this elongation is nearly uniform throughout the piece. The whole of the series of nickel steels up to 50 per cent. nickel take a good polish and finish, with a good surface, the colour being lighter with the increased additions of nickel. The steels rich in nickel are practically non-corrodible, and those poor in nickel are much better than other steels in this respect. The 1 per cent. nickel steel welds fairly well, but this quality deteriorates with each addition of nickel. The 25 per cent. nickel steel, with its peculiar properties of high breaking strain, great ductility, and comparatively low elastic limit, is extremely well adapted for all operations involving considerable deformation—for instance, for deep stamping and flanging—whilst its non-corrodibility will render it invaluable for a great number of purposes. In the region between 25 per cent. and about 5 per cent. of nickel are an abundance of possibilities as yet comparatively unknown, in which I expect will be found materials for tool steel equal, if not superior, to anything at present known.—A. J. S.

PATENTS.

Improvements relating to the Extraction of Aluminium from Substances containing the same. C. Netto, Dresden, Germany. Eng. Pat. 4228, March 21, 1887. 11d. (Amended Specification.)

IN the previous specification (this Journal, 1888, 217) the inventor states that "the decomposition commences at once and is completed in a few moments." He now substitutes the word "minutes" for "moments." Also, in the sentence "After the decomposition is terminated, the aluminium is never united into a coalescent lump" the word "never" is replaced by "seldom."—O. H.

Improvements in the Amalgamation of Gold and other Ores, and in Apparatus employed therein. A. E. Donkin, Rugby. From R. Donkin, Thames, New Zealand. Eng. Pat. 8303, June 6, 1888. 6d.

THE invention consists of a method for producing a constant supply of sodium amalgam, and bringing this in contact with the ore to be treated. At the bottom of a suitable non-conducting cell a layer of quicksilver is placed, which forms the electrolytic cathode. Above the quicksilver is poured a saturated solution of a sodium salt—preferably chloride of sodium—and into this is placed a carbon anode. The quicksilver and the carbon are connected to the terminals of a dynamo, or other suitable appliance for generating a current of electricity, so that, on the passage of the current, chlorine is liberated at the anode and sodium at the cathode. The sodium amalgamates with the mercury, and by making holes and fixing pipes in the sides of the cell below the level of the mercury, it may be connected

directly with the main body of mercury in an amalgamator, settler, or amalgamating pan. By a suitable contrivance the mercury may be made to circulate so that a regular supply of the sodium amalgam is distributed.—H. S. P.

Improvements in Plating Metals with Aluminium and Producing Alloys therefor. L. Q. Brin, Paris, France. Eng. Pat. 8746, June 14, 1888. 6d.

A COMPOSITION is made by fusing alumina or a clay rich in alumina with about half its weight of borax, finely powdering the mass so obtained, and mixing it with oil or water. The metal articles to be coated are cleaned with acid, coated with this paste, dried and heated in a reverberatory furnace until the material of the coating is melted. It is stated that aluminium is thus set free, and that it unites with the surface of the metal and spreads thereon as tin in the operation of tinning.

A reducing atmosphere of nitrogen, cyanogen, carbonic oxide, or preferably of ammonia, is employed, by which means it is also maintained that "the retort or apparatus wherein the ammonia is generated also serves as a condensing chamber for the surplus aluminium vapours generated in excess from the heated flux, which vapours in the presence of the nascent ammonia become reduced to the metallic state. This pure metal is therefore collected at the same time as the operation of making the alloys, and can be employed for enriching the alloy or for other purposes."—A. W.

An Improved Process of Producing Aluminium Bronze and other Alloys of Aluminium. L. Q. Brin, Paris, France. Eng. Pat. 8747, June 14, 1888. 6d.

PIECES of metal, such as copper, steel, or iron, &c. are first "moistened with water," then mixed with a quantity of aluminium hydrate or rich aluminiferous clay, borax, and salt, and melted in refractory crucibles. It is stated that aluminium bronze or steel is produced. The operation is accelerated by passing into the crucibles reducing gases, such as ammonia, &c. "in the nascent state."—A. W.

Improvements in the Manufacture of Sodium and Potassium. W. G. Forster, London. Eng. Pat. 9391, June 27, 1888. 4d.

INSTEAD of using solid carbonaceous matter to reduce caustic soda or potash the patentee introduces coal gas or carbonaceous vapour or other reducing gas or vapours through a perforated pipe immersed in the fused alkali. The metal is distilled over and condensed in the usual way.—H. S. P.

Improvements in Tempering or Hardening Steel and Iron. G. Theodossieff, St. Petersburg, Russia. Eng. Pat. 9457, June 28, 1888. 6d.

GLYCERIN is used in tempering steel, cast steel or cast iron. The specific gravity of the glycerin may be varied between 1.08 and 1.26 at 15° C. by adding water, according to the composition of the steel. The quantity of glycerin should be from one to six times greater in weight than the weight of the pieces to be plunged in it, and its temperature may be varied from 15° to 200° C., according to the hardness of the metal. The harder the steel to be tempered the higher should the temperature be, and for a mild steel a low temperature should be used. To increase the quenching power of the bath, various salts may be added to the glycerin solution. Thus, when a hard temper is wanted, proto-sulphate of manganese may be added in quantity varying from 1 to 34 per cent. of the liquid, or from $\frac{1}{4}$ to 1 per cent. of sulphate of potassium. For a softer temper 1 to 10 per cent. of chloride of manganese and 1 to 4 per cent. of chloride of potassium may be added. The principal advantages to be derived from these methods are—(1.) The temperature of the aqueous solutions of glycerin may be varied within wide limits, the boiling point of pure glycerin being 29° C. (2.) Owing to the fact that solutions

of glycerin in water dissolve most salts that are soluble in water, its quenching properties may be readily varied, by dissolving such salts in the bath, to suit the kind of metal to be tempered, and the degree of temper required.—H. S. P.

Improvements in the Manufacture of Aluminium and its Alloys. J. A. Stephan and R. Southerton, Birmingham. Eng. Pat. 10,266, July 16, 1888. 6d.

"EMERY Alum Clay" or any other material rich in alumina, such as a mixture of emery and an alum, preferably ammonia alum, is heated in a crucible, and a current of hydrofluoric acid gas passed through it. When the mass has changed from the spongy to the pasty state, the current of gas is stopped, and the temperature raised till the metal flows.

If four parts of a mixture of equal quantities of emery and ammonia alum be added to 100 parts of hematite iron ore, and the whole melted in the blast furnace in the usual manner, "aluminium pig steel" is produced.—A. W.

An Improved Method or Process of Covering Articles of Iron with Lead. W. R. Lake, London. From Velthuisen and Co., Frankenthal, Germany. Eng. Pat. 11,022, July 30, 1888. 6d.

THE article of iron or steel is first cleaned (preferably by steel brushes), then roughened by a sand-jet blower, washed over with a soldering liquid, and plunged into a bath of molten lead. While in the bath the article is brushed with steel brushes to ensure intimate contact between the lead and the iron. The layer of lead thus obtained is too thin to protect the iron from the action of acids, and the article is subjected to a second operation. If it be a plate of iron or steel it is fixed horizontally, with a narrow rim or border placed round it, and it is then washed over with soldering liquid, heated to about 400° C., and molten lead is poured over its surface and uniformly distributed. The height of the rim determines the thickness of the layer of lead. The whole is then again heated to a temperature above the melting point of lead, and the surface again brushed with steel brushes. The plate is then allowed to cool, care being taken during the cooling of the sheet iron or plate to keep the layer of lead as long as possible above the melting point of lead, by fresh additions of small quantities of molten lead. In the case of articles such as pipes, boilers, or similar vessels, a suitable "core" or easing is provided, and after treating the surface with soldering liquid and heating to 400° C., the space between the article and the "core" is filled with molten lead. The whole is then again heated above the melting point of lead, and finally allowed slowly to cool, the lead again being kept as long as possible in a molten state.—H. S. P.

Improvements in the Utilisation of Waste Pickle from Tinning and Galvanising Works where Hydrochloric Acid is used for Pickling. H. J. Kirkman, Swansea. Eng. Pat. 16,247, November 9, 1888. 6d.

THE iron is precipitated from the waste liquor, previously rendered clear, if necessary, by subsidence or filtration, by means of lime, limestone, chalk, gas liquor, ammonia, sodium hydrate or sodium carbonate. The precipitated iron is washed and dried and may then be ignited for making pigments, or mixed with sawdust for purifying gas.—E. E. B.

A Process for Decomposing Commercial Nickel and its Salts and Galvanically Coating Objects with pure Nickel. G. Krüss, Munich, Germany. Eng. Pat. 1418, January 25, 1889. 6d.

As a result of his researches the patentee finds that metallic nickel contains on an average only about 98 per cent. of real nickel and 2 per cent. of another element, irrespective of the known technical impurities, which differs from nickel in its properties and in the nature of its compounds. This element he designates "X" in the specification. It is impossible to purify the nickel in one operation, as the combinations of X are soluble in nickel salts. It is necessary

to repeat several times one or more of the operations based upon the following behaviour of the neutral chloride of the element X:—(1.) It gives a combination with alkali soluble in water when treated with concentrated alkali lyes or melted with caustic alkali. The white hydroxide, however, is very slightly soluble in excess of weak alkali. (2.) It is incompletely precipitated by oxalic acid either hot or cold, but more completely by oxalate of ammonium after short standing at a low temperature. A large excess of the latter precipitant redissolves the precipitate. (3.) It is not precipitated by fixed alkali lyes, ammonia, ammonium oxalate, or oxalic acid, even at high temperatures, if the solution contains organic acids, such as acetic, citric, &c., whereas the soluble double oxalate of nickel is decomposed on heating under the same conditions. Again, when the solution of X is brought into contact with a metal more electro-positive than nickel, such as zinc, it is not reduced even on warming. These properties are all more or less altered or concealed in the presence of a large excess of nickel salts. Thus the white hydroxide of X is not precipitated at all by ammonia if more than 70 per cent. of the dissolved substance consists of nickel salt.

To separate nickel from X the neutral solution is mixed with ammoniacal oxalate of ammonium till the precipitate is redissolved, and is allowed to stand for some time, whereby white basic oxalate of X is precipitated. Repeated additions of ammoniacal oxalate of ammonium are made at intervals until after long standing no more precipitate is produced. The blue liquid is then evaporated, the residue ignited and dissolved in hydrochloric acid. The chloride solution is concentrated and solid caustic soda, up to five times the weight of chloride present, is added, the pasty mass being kept melted for a short time. When cold it is broken up and dissolved in small pieces in ice-cold water, care being taken that the temperature does not rise above 10° C. The sodium compound of X is dissolved while the nickel remains insoluble. After decanting and washing, the residue is dissolved in a weak mineral acid or in acetic acid, a quantity of citric or other organic acid is added, and, after heating, the pure hydroxide of nickel, free from X, is precipitated with soda solution; or the pure oxalate of nickel may be produced by precipitating the boiling organic acid solution with ammonium oxalate.

In lieu of this, however, the original solution, or any of the solutions produced above, may be decomposed and pure nickel obtained by warming with zinc dust or cuttings. The necessity of repeating any or all of the above treatments is regulated by the quantity of X originally present.

The purified nickel is well suited for nickel plating, as it gives a coating lighter in colour and more like silver than that heretofore obtained, which is generally of a brownish-yellowish hue, owing to the presence of the so-called element X.—A. W.

Improvements in the Manufacture of Metal Alloys. S. McColley Godfrey, New York, U.S.A., and J. B. Allen, London. Eng. Pat. 2031, February 5, 1889. 6d.

THE idea is to produce the metal to be alloyed from its ore in the same crucible and by the same operation as that in which the alloy is made. The ore of one metal is placed in a crucible, covered with a flux, and the other metal is poured on to this, whereby the first metal is reduced and alloys "in a uniform manner" with the second.—A. W.

Improvements in the Treatment of Steel. C. Jones, Derby. Eng. Pat. 4956, March 21, 1889. 4d.

STEEL scrap (e.g., railway-carriage and other carriage springs) after being cleaned by immersion in dilute sulphuric acid and subsequent washing in boiling water, are dipped first into oil or grease and then into soot. The scrap is then packed with powdered gas coke in a metal box, and heated in a furnace for 30 hours or more, at about 1,400° F., then withdrawn and allowed to cool slowly. The scrap may then be melted into blocks or ingots which can be rolled, welded, hammered or otherwise treated in the usual way.—H. S. P.

Improvements in the Manufacture of Ingot Iron or Steel and the Simultaneous Production of a highly Phosphoric Slag. J. H. Darby, Brynbo. Eng. Pat. 5667, April 2, 1889. 4d.

IN the basic open-hearth process of steel-making, instead of introducing limestone along with the charge, as is usual, the patentee introduces a quantity of slag from a previous charge. He finds by experiment that, to 10 tons of metal, consisting of 7 tons of phosphoric pig and 3 tons of scrap, about 10 cwt. of slag is a suitable quantity to add. When this is melted the additions are made in the usual way, except that instead of introducing limestone with the iron ore, a further addition of slag is made. The process is then continued to completion with limestone and iron ore or limestone additions alone. It is not generally necessary to use lime, as the slag on the surface is usually sufficiently basic from the beginning of the operation. The furnace linings, &c., are therefore not cut away by lime dust so rapidly as when lime additions are made, and the resultant slag is richer in phosphoric acid than ordinary basic slag.

The purification of pig iron and simultaneously of ferruginous phosphatic slag has already been patented by Fwynham (Eng. Pat. 1796 of 1886; this Journal 1887, 43), and the inventor makes no broad claim to the use of the principle involved, but only so far as regards the method of procedure above described.—H. S. P.

Improvements in the Production of Aluminium. C. M. Hall, Oberlin, Ohio, U.S.A. Eng. Pat. 5669, April 2, 1889. 8d.

THE fluorides of aluminium and calcium are melted in a carbon-lined crucible, alumina is dissolved in the fused mass, and the whole then submitted to a current of electricity. Carbon electrodes are used, or if an alloy be required the negative electrode is made of the metal to be alloyed. Any alkaline earth fluoride can be used, and sodium fluoride and calcium chloride may also be added to the bath. The best mixture is that which corresponds to the formula CaAl_2F_6 . The advantage of continuity is obtained by replenishing the bath with fresh additions of alumina.—A. W.

Improvements in the Production of Aluminium and Alloys thereof. C. M. Hall, Oberlin, Ohio, U.S.A. Eng. Pat. 5670, April 2, 1889. 8d.

THIS specification is similar to the above except that the double fluoride of aluminium and potassium or sodium is used as the bath in which to dissolve the alumina. In this case any alkaline earth fluoride may be present, and it is stated that the presence of lithium fluoride in the bath increases its power of dissolving alumina.—A. W.

Manufacture of Compressed Compound Blocks of Substances containing Iron and Carbonaceous Matter and the use of such Blocks in the Production of Cast Steel and Ingot Iron. L. Imperatori, Milan, Italy. Eng. Pat. 7132, April 29, 1889. 6d.

IRON ores, iron oxides, slags rich in iron, &c., are reduced to powder and mixed in suitable proportions with ground charcoal, coke, or anthracite, and the mixture is moistened with water, well stirred to render it uniform, and then stamped or pressed in moulds, into blocks. These blocks, after drying, may be melted in a reverberatory furnace to produce ingot iron or cast steel, or they may be used in the Martin process. Directions are given as to varying the composition of the blocks, to suit the kinds of ores used and the manner of smelting employed.—H. S. P.

Improved Method of and Apparatus for Condensing Zinc Vapours and Collecting the Metallic Zinc therefrom. E. Walsh, St. Louis, U.S.A. Eng. Pat. 7181, April 30, 1889. 8d.

IT is known that the temperature at which zinc oxide reduces is about 1,300° F., while metallic zinc distils at a temperature about 100° lower. In the metallurgical process of making zinc in a cupola furnace, the zinc vapour passes from the furnace mixed with a considerable quantity of carbonic acid, which, at the temperature of distillation, has an oxidising

effect upon it. The patentee has found that carbon has no effect upon carbonic acid at temperatures lower than 1,300° F., but at temperatures between 1,400°—1,500° carbon converts carbonic acid into carbonic oxide, which has no action upon zinc vapour. By passing the mixture of carbonic acid and zinc vapour, heated to between 1,400°—1,500° F., over carbon the carbonic acid is converted into carbonic oxide, and the whole of the zinc may be condensed in a cooler part of the apparatus. The apparatus described in the patent consists of a eupola furnace near the top of which a condensing chamber projects. This chamber consists of a round flue, and it is filled with the carbonaceous matter required to reduce the carbonic acid. The carbon is fed in through a hopper or opening near the cooler end of the condenser, and it is forced along the condenser by a plunger or a suitable screw arrangement. The zinc which distils falls through perforations in the cooler part of the condenser and is collected in a trough placed below. Drawings are given with the specification.—H. S. P.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

On the Difference of Potential at the Contact of a Metal with Salt of the same Metal. H. Pellat. *Compt. Rend.* 108, 667—669.

WHEN a metallic liquid, such as mercury, is allowed to flow into an electrolyte, a current is generally obtained when connexion is made by means of a wire between the metal which is flowing out and the metal of the same kind which has collected at the bottom of the vessel. If the former is insulated it very soon attains a fixed potential which sometimes differs considerably from the potential of the metal which is at rest at the bottom of the vessel; thus, in the case of mercury flowing into a solution of zinc sulphate, this difference of potential is equal to 0.52 volt. It can be measured by the usual compensation method, using a potentiometer and Lippmann's capillary electrometer. The author assumes that the quantity thus measured represents what he calls the normal difference of potential between the electrolyte and the metal which is at rest, and deduces from his experiments the following results:—

(1.) *The normal difference of potential between a metal and a solution of a salt of the same metal in contact with it is zero.* The metals employed were mercury and the fluid amalgams of copper and of zinc. These latter behave in a voltaic cell exactly like solid copper and zinc. Thus a cell consisting of amalgams of copper and of zinc in a solution of zinc sulphate has an E. M. F. of 0.985 volt; a Daniell cell consisting of sulphate of zinc, sulphate of copper, and amalgams of these metals, has an E. M. F. of 1.063 volt. But no difference of potential appears to exist between mercury and nitrate of mercury; and the largest difference of potential observed between a metal and its salt (in the case of zinc amalgam and zinc sulphate) was only 0.002 volt.

(2.) If we denote by P, M, and M' the metals which form the poles and each of the electrodes of a cell of the Daniell type, and by S and S' the salts of these metals in contact with them (salts of the same acid), then the E. M. F. of the cell necessarily is—

$$E = P | M + M | S + S | S' + S' | M + M' | P.$$

But by Volta's law $M' | P + P | M = M' | M$; and according to the law stated above (1) we have $M | S = S' | M' = 0$.

$$\text{Hence } E = S | S' + M' | M, \text{ or—}$$

The E. M. F. of a cell of the Daniell type is equal to the difference of potential of the two liquids in contact together with the difference of potential which would exist between the two metals forming the electrodes, if these were placed in direct contact.

Again, the E. M. F. of such a cell is proportional to the quantity of heat produced by the substitution (in a salt of the same acid) of the metal forming the anode instead of the metal forming the cathode. Therefore the difference of potential due to the contact of two metallic salts of the same acid, plus that due to the contact of the metals themselves, is proportional to the quantity of heat set free in the substitution of one of the metals for the other in a salt of the given acid.—D. E. J.

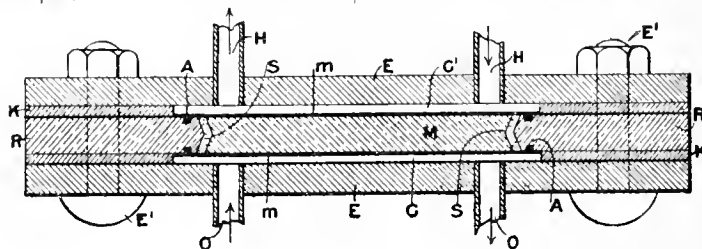
The Elmore Copper Depositing Process. Electrical Review, 24, 682.

THE process consists in depositing the metal from a copper sulphate solution upon a rotating mandril, a burnisher of agate having a few pounds pressure being in continual operation from one end of the cathode to the other. The effect of the burnisher on the physical character of the copper is remarkable, a very high tenacity and great malleability being imparted to the deposited metal. Wire is made from the copper cylinders by cutting from them spirally a continuous square strip, which is then drawn directly to the required diameter without remelting. The wire so obtained, compared with the usual standards, has an electrical conductivity of 102 per cent.—W. W. H. G.

PATENTS.

Improvements in Gas Batteries. L. Mond, Northwich, and C. Langer, London. Eng. Pat. 2411, February 17, 1888. 8d.

To overcome the difficulties incident to the old forms of gas batteries the use of a simple liquid electrolyte is abandoned in favour of a solid porous material which is impregnated with some liquid electrolyte. Plates of porous earthenware and plates of plaster of Paris have been found to be the most suitable absorbents. The porous substance used is brought into contact with the material, such as platinum black, having the power of occluding gas. Connexion between the poles of the battery and the occluding material is made by the help of very thin platinum, or gold foil or leaf perforated by very numerous and very small holes. The prepared plates are fixed in gas-tight chambers through which gases can be passed. When the gases are such as hydrogen and oxygen, which produce water on combination, it is advisable to employ them dry or hot so that the platinum black, or whatever occluding substance is used, may not become moist, which would have the effect of greatly diminishing the action of the battery. When hydrogen and atmospheric air are used it is found that all the water formed can be removed by simply passing an excess of air through the battery without previous drying or heating. By using at one plate of the battery air and at the other side "hydrogenic gases," produced by the action of steam upon incandescent coke, anthracite, iron, or in other ways, electricity may be produced at a very low cost. It is, however, very necessary to have the gases carefully purified and freed as much as possible from carbon monoxide. It is claimed that even when using hydrogen produced by the action of sulphuric acid on zinc these new gas batteries offer special advantages over ordinary galvanic batteries. The actual construction of the batteries differs in detail in accordance with the size desired, but the general principle followed will be understood from the figure which represents



the section of a very small battery consisting of a single plate of porous material M. This is fixed in a non-conducting frame (such as ebonite) R R by means of cement S¹ S. On both sides of the frame are narrow conducting strips A A which are joined to the battery terminals. The porous plate M having been impregnated with dilute sulphuric acid, is covered on both sides with the platinum or gold foil m m. This projects beyond the plates in such a way that it is in metallic connexion with the conducting strips A A, which are properly protected from the action of the electrolyte by paraffin or varnish. The perforated foil is made to adhere to the porous plate by gently rubbing over its surface, and is then covered with platinum black obtained by the reduction of platinum chloride in dilute alkaline solution by means of formic acid. Only about 0.2 gram. of the Pt. per sq. dem. of surface is required to give a good result. The platinum black is formed in a paste with dilute sulphuric acid, and then applied with a brush. Part of the black penetrates through the holes of the foil, and is hence in contact with the porous plate. To form narrow gas-tight cells G G¹, plates of india-rubber K K, and the end plates E E are used, which are held in place by the bolts E¹ E¹. The chambers G G¹ are put in communication with the gas-conducting tubes O O and H H. The chemical action consists in the decomposition of the sulphuric acid into, say, H₂ and SO₄. The hydrogen appears at the oxygen side and there, under the influence of the platinum black, forms water. The SO₄ travels to the hydrogen side, where sulphuric acid is again produced. To counteract the tendency of the accumulations of water and sulphuric acid it is advised to reverse from time to time the places of the oxygen and hydrogen.—W. W. H. G.

Improved Method or Process for Depositing Metals from their Salts. W. H. Beck, London. From A. Lévy, Paris, France. Eng. Pat. 8961, June 19, 1888. 6d.

The process consists in hanging the metal article, say of iron or copper, by means of a zinc wire in an acid or alkaline solution of the salt of the metal to be deposited, preferably the chloride or a double chloride; or the article to be coated may be placed in a rotating open-work box or cage of zinc or containing zinc immersed in the solution of the metallic chloride. Wire may be coated by causing it to pass over zinc pulleys immersed in the solution, or the salt, preferably the chloride, may be used. The specification states that the process is specially adapted to the deposition of aluminium and magnesium.—H. S. P.

Improvements in the Reduction of Zinc Oxides. C. A. Burghardt, Manchester. Eng. Pat. 9886, July 7, 1888. 6d.

The object of the patent is to obtain a pure quality of zinc free from the impurities contained in ordinary zinc, such as iron and manganese. The process consists in depositing the zinc from a solution of zinc oxide in caustic soda, by means of an electric current. The anodes and cathodes are of pure zinc, and are placed in a tank or cistern divided by porous partitions into compartments, so that each compartment contains, in alternate order, an anode or a cathode. The tank is filled with the alkaline solution of zinc oxide, and into each anode-compartment an excess of zinc oxide is placed. On passing a current of electricity the zinc may be deposited upon the zinc cathode while fresh oxide is taken into solutions at the anode, so that by keeping up the supply of oxide the operation may be continued until the accumulation of the impurities from the oxide or the formation of sodium carbonate (from the air) interferes with the action of the cells. The specification also provides for the agitation or circulation of the liquid if needed, or for its heating by a steam coil or otherwise, as for instance by the use of a hollow anode, through which steam may be passed, or by making a steam coil the anode.—H. S. P.

Improvements in and Apparatus for obtaining Copper and other Metals from Solutions of the Salts of same. W. P. Thompson, Liverpool. From A. Rovello, Turin, Italy. Eng. Pat. 12,208, August 24, 1888. 8d.

A series of Daniell's cells on a large scale are constructed by dividing the vats by means of vertical porous diaphragms, and in which the electro-negative elements consist of cast or wrought iron plates instead of zinc, unless zinc sulphate is a desideratum. The copper liquor is poured in a continuous stream through a funnel to the bottom of the compartment containing the copper cathode, and a weak solution of a salt of the same metal as the anode is simultaneously run into the compartment containing the anode. The two plates are connected by a metallic rod, electrical action takes place, and the copper solution is deprived of its metal in its passage upwards from the bottom to the top of the tank. Any arrangement can be used, but drawings are given of an apparatus which ensures a small internal resistance. The same can be used for the electrolysis of zinc solutions, in which case the cathodes are zinc plates, the anodes, iron, and the pole rods are connected with a dynamo. The advantage in the case of copper is the small consumption of iron as compared with the present precipitation process.—A. W.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Specific Gravity of some Fats and Oils. C. A. Crampton. Amer. Chem. J. 11, 232—236.

THE author has determined the specific gravity and co-efficient of expansion of a number of fats and oils, of which the following are the results:—

Description.	Mean Coeff. of Expansion Absolute.	Calculated.			
		Sp. Gr., $d = \frac{+15.5^\circ}{+4^\circ \text{ C}}$ Apparent.	Sp. Gr., $d = \frac{+40^\circ}{+4^\circ \text{ C}}$ Apparent.	Sp. Gr., $d = \frac{+50^\circ}{+4^\circ \text{ C}}$ Apparent.	Sp. Gr., $d = \frac{+100^\circ}{+4^\circ \text{ C}}$ Apparent.
LARDS.					
1. Leaf lard rendered in laboratory, U.S. Department of Agriculture	*0007649	*91181	*89679	*89065	*85997
2. Intestinal lard rendered in do. do.	*0007761	*91157	*89635	*89014	*85907
3. Head lard rendered in do. do.	*0007729	*91336	*89816	*89195	*86094
4. Squire's pure lard, made by J. P. Squire and Co., Boston, Mass.....	*0007147	*91206	*89700	*89085	*86012
5. Cassard's pure lard, made by Cassard and Co., Baltimore, Md.	*0007560	*91341	*89238	*89848	*86191

Description.	Mean Coeff. of Expansion Absolute.	Calculated.			
		Sp. Gr., + 15° 5' + 4° C. Apparent.	Sp. Gr., + 40° + 4° C. Apparent.	Sp. Gr., + 50° + 4° C. Apparent.	Sp. Gr., + 100° + 4° C. Apparent.
LARDS—continued.					
6. Armour's compound lard, by Armour and Co., Chicago, Ill.....	*0007708	*91458	*89940	*89320	*86222
7. Do. do. do. do.	*0007751	*91378	*89232	*89854	*86121
8. Fairbank's compound lard, by Fairbanks and Co., Chicago, Ill.	*0007685	*91515	*90900	*89382	*86289
LARD STEARINS.					
1. Lardstearin used in Armour's compound lard	*0007780	*90965	*89453	*88836	*85750
2. Lard stearin used in Fairbank's compound lard.....	*0007700	*90959	*89461	*88850	*85792
BEEF FAT AND OLEOSTEARINS.					
1. Pure beef fat from testicle, obtained from Prof. S. P. Sharpless	*0007773	*91141	*89620	*88998	*85888
2. Oleostearin used in Armour's compound lard.....	*0007681	*90714	*89223	*88615	*85572
3. Oleostearin used in Fairbank's compound lard	*0007792	*90647	*89138	*88523	*85444
4. Cotton-seed stearin, obtained from Prof. D. Wesson .	*0007976	*92884	*90317	*89671	*86463
COTTON-SEED OILS.					
1. Crude cotton-seed oil from Prof. D. Wesson.....	*0007724	*92016	*90486	*89862	*86739
2. Crude cotton-seed oil from Southern Cotton Oil Trust	*0007491	*92200	*90708	*90099	*87054
3. " Summer yellow " do. do. do.	*0007838	*92063	*90514	*89880	*86716
4. " Summer white " do. do. do.	*0007833	*92055	*90497	*89861	*86681
5. " Winter yellow " do. do. do.	*0008327	*92191	*90553	*89885	*86542
6. " Winter white " do. do. do.	*0007921	*92179	*90612	*89972	*86774
7. Refined cotton-seed oil used in Armour's compound lard	*0007973	*92150	*90573	*89930	*86714
OLIVE OILS.					
1. Pure olive oil from Z. D. Gilman, Washington, D.C. .	*0007953	*91557	*89995	*89351	*86168
2. Pure olive oil from Prof. S. P. Sharpless	*0007829	*91505	*89965	*89337	*86194

—J. W. L.

A New Product of the Soap Industry. R. Meyer. Mittheil. des K. K. Tech. Gew.-Museums, 1889, 55.

A NEW product, known as "soap meal," made by O. Korschelt of Zittau, was analysed, with the results given below:—

	Per Cent.
Fatty anhydride	84.20
Soda	9.66
Sodium chloride, sodium sulphate, lime	3.26
Water (directly determined = 2.08)	2.88
	100.00

The soap appears as a yellowish-white powder, dry to the touch, easily soluble in water. It is quite free from uncombined alkali or fat.—E. B.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

PATENTS.

Improvements in the Treatment or Preparation of Paper, Cardboard, Paper-pulp, Papier Maché, and other Fabrics and Metals, to render the same impervious to the Action of Acids, Water, Air, Mineral Oils, and other Liquids or Gases. G. D. Aria, London. Eng. Pat. 8981, June 19, 1888. 6d.

See under XIX., page 565.

An Improved Varnish-removing Compound. E. Oates, Paris, France. Eng. Pat. 10,301, July 16, 1888. 6d.

TWENTY lb. of solution of caustic soda of 40° B., 1 lb. of potato starch, and 20 pints of water are introduced into a closed boiler. The mixture is thoroughly agitated, which effects spontaneous heating of the same with conversion into a gelatinous mass. This is treated with 57½ pints of water and 1½ lb. of potato starch to form a total weight of 100 lb. of final product. This composition constitutes the most concentrated type of varnish remover, and may be reduced with water to any desired percentage of alkali if required.—D. B.

An Improved Paint-removing Compound. E. Oates, Paris, France. Eng. Pat. 10,365, July 17, 1888. 4d.

THE paint remover is prepared by introducing 50 lb. of caustic soda solution of 40° B. and 8 lb. of Iceland moss into a closed boiler, and after thorough stirring, heating the liquid gently to boiling, at which point it is maintained for an hour. When completely cold, 100 lb. of caustic potash are added to the mixture, which is then again heated up to boiling. It is now left to cool, and treated with a quantity of potato starch in the proportion of from 6 to 8 per cent. of the mass.—D. B.

Improvement in the Production of White Lead or Carbonate of Lead, and the Apparatus therefor. R. W. E. MacIvor and F. A. Darlington, London; G. Paul, Edinburgh; and J. Allan, London. Eng. Pat. 10,426, July 18, 1888. 6d. (Amended Specification.)

LEAD oxide is mixed with a solution of an alkaline acetate (preferably ammonium acetate), and carbon dioxide driven

through the mass. White lead is formed which, when the action is complete, can be filtered off and the solution of the alkaline acetate used in effecting the conversion of a fresh quantity of lead oxide.

The chief alterations in the specification are the insertion of the names of co-patentees, and the withdrawal of the claim to use compounds of lead other than the oxide (this Journal, 1888, 846).—B. B.

Improvements in Anti-corrosive Compositions and Materials for Ships and other Structures, and in the Method of applying the same. R. Turnbull, Newcastle-upon-Tyne. Eng. Pat. 10,601, July 21, 1888. 6d.

THE object of the patent is to prevent corrosion in the holds and ballast tanks of iron and steel vessels. A coating of "paraffin" or "spirits of naphtha," Trinidad pitch, marine or fish glue, or one of shellac varnish, or of a varnish composed of Stockholm pitch and solvent "naphtha," is first applied cold; it is followed by one of asphaltum "tempered with Stockholm pitch and coal tar, marine glue, and paraffin wax," applied hot; the surface is then covered with calico, linen, or tough paper, which adheres to the last coating and prevents the succeeding one running into it; this latter is composed of asphaltum, coal-tar, and Portland cement, applied hot, and serves as a wearing surface.—B. B.

A New Paint for Stones, Plaster, and the like. F. Wendling, Munich, Germany. Eng. Pat. 10,757, July 25, 1888. 6d.

ZEOLOTIC minerals, such as Natrolite, Epidote, Chlorite, Idocrase, Apophyllite, are mixed in such proportions that the resulting mass has a composition approximating to 10—12 of silica, 2½—4 of alumina and ferric oxide, 1½—3 of lime and magnesia, 2—5 of soda and potash, 3 to 8 of water, all reckoned in equivalents, and then incorporated with sufficient suitable pigment to give them the desired colour.

Failing these, silicates of suitable composition may be prepared from a mixture of quartz, kaolin, lime and alkalis, and used in their stead. In using the patented material it should be mixed with about six times its volume of milk of lime of 22° B., and the surface to which it is to be applied should be previously moistened with water. Instead of using milk of lime, caustic lime may be added to the dry pigment, provided it be packed in air-tight vessels.—B. B.

Improvements in making a White Pigment of Lead and in Apparatus therefor. J. B. Hannay, Loch Long. Eng. Pat. 1282, January 24, 1889. 8d.

GALENA or any other lead ore is mixed with sulphur or a suitable sulphide, unless there is already sufficient sulphur in the ore to convert the whole of the lead into sulphate, and is then heated in a furnace until the lead volatilises. The fumes and combustible gases are passed into a chamber where the fumes are oxidised and the gases burnt; these are then drawn through a flue in which much of the lead sulphate is deposited, and finally forced by means of steam injectors into a wet fume condenser containing sulphuric acid, preferably a condenser similar to the one described in Eng. Pat. 16,290 of 1886.—E. E. B.

Improvements in Treating or Purifying Sulphate of Lead. J. B. Hannay, Loch Long. Eng. Pat. 1434, January 26, 1889. 4d.

SULPHATE of lead made by any process involving volatilisation is purified by treatment with dilute sulphuric acid. After washing or filtering, the sulphate of lead is obtained in a practically pure condition.—E. E. B.

An Enamel or Paint having Disinfecting Properties. L. E. Audés, Chur, Switzerland. Eng. Pat. 5792, April 4, 1889. 6d.

RESINS or copals are "picked," sifted, and powdered, and then stirred with three times their weight of water for three

hours at 10° C., allowed to stand for 48 hours, and the resulting deposit of purified resin collected in thick sacks, dried at 120° C., powdered, spread out on a well-ventilated drying floor at 18° C., and kept there for 28 days "to increase the solubility of the pulverised resin by the absorption of ozone." The product is digested for 24 hours with a solvent composed of methyl and ethyl alcohols, "formic ether," camphor, and oil of turpentine, in a boiler provided with a stirrer and heated by steam. The solution is then agitated for 48 hours with ½—2 per cent. of boric, carbolic, and salicylic acids separately or together, passed through a filter kept hot by steam, allowed to stand six weeks, and mixed with pigments inert with respect to the other ingredients.—B. B.

Improvements in Treatment of Gum Copals, Gum Resins, and other Gums for the Manufacture of Varnishes and other Solutions for Coating Surfaces, and for other uses. G. H. Smith, London. Eng. Pat. 6581, April 17, 1889. 8d.

THE object of this invention is to purify gums and render them suitable for the manufacture of varnishes. The process is of special utility for the treatment of the harder kinds of gum, as it increases their solubility, effecting this object without exposing the material to the action of heat sufficiently high to be injurious to the gums. The method consists in subjecting the gums to the action of the vapours of volatile solvents prior to their being dissolved in solvents of the same or like character to produce solutions of gums. By this process they are rendered tractable to the solvent action of the solvent liquids. The process is fully described in the patent, the specification being accompanied by two sheets of drawings illustrating the apparatus employed.—D. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENTS.

A New or Improved Process for Unhairing Skins and Pieces of Skins. P. Puech, Mazamet, France. Eng. Pat. 10,362, July 17, 1888. 6d.

AFTER describing the process of unhairing skins by means of a depilatory and by stoving, the patentee states that by these processes the value of the wool is much depreciated. According to this invention, the skins, after the cleansing of the wool, are dried, and then passed through a shearing machine. To produce thoroughly-washed wool, the skins are soured with warm water and soda crystals, and beaten before drying, which causes the wool to stand erect and dry straight.—B. H.

An Improvement in Tanning. J. Rivage and J. B. Matrod, Paris, France. Eng. Pat. 10,482, July 19, 1888. 4d.

ACCORDING to this invention, "alumina hydrate jelly" is applied to the tanning of hides, principally sheep, goat, or calves' skins. After tanning with vegetable substances, the skins are cleansed by hot water till free from soluble and fatty matters. "They are then agitated with an excess of alumina hydrate in solution or suspension in water until they can absorb no more."—B. H.

Improved Method of Treating Hides, Skins, or Scraps, in Liquids. C. W. Cooper, Brooklyn, U.S.A. Eng. Pats. 5674 and 5762, April 2, 1889. 8d.

IN these two patents are claimed respectively the apparatus for and the process of treating hides, skins, or scraps in

water or other liquid. An inner tank having a "slatted" bottom, and provided with perforations near the top, contains the material to be treated. This tank is enclosed on the bottom and sides by an outer tank, which is filled to a suitable height with water or other liquid. Air or other gas is then blown in at the bottom of the inner tank, and by its ascent through the liquid, agitates and exposes the material to the action of the liquid. Drawings are given, and for particulars of the plant, the specifications must be consulted.

—B. H.

XV.—AGRICULTURE, MANURES, Etc.

Experiments upon Putrefaction and the Formation of Farm-Yard Manure. J. Reiset. *Compt. Rend.* **108**, 779—785.

DETAILS are here given of the results of the experiments referred to in *Compt. Rend.* **108**, 708. 10,687 grms. of horse-dung mixed with milk of chalk, was found, at the end of 21 days, to have absorbed 209.5 grms. of oxygen, of which 192.3 grms. went to form carbonic acid. A disengagement of nitrogen took place, equal to 5.46 per 1,000 parts of oxygen consumed. 1,500 grms. of beef, cut into slices, mixed with chalk, and moistened, absorbed in 33 days 38.08 grms. of oxygen, of which 37.63 grms. went to form carbonic acid. Nitrogen was disengaged equal to 21.77 per 1,000 of oxygen consumed. In the third experiment 30 grms. of beef cut into long shreds absorbed 1.46 grms. of oxygen, with a disengagement of nitrogen equal to 59.5 per 1,000 of oxygen consumed. Complete putrefaction took place in 12 days, at the end of which time oxygen had ceased to be absorbed, and the shreds of beef were almost black.—A. R. D.

The Influence of Carbonic Oxide on Germination. G. Linossier. *Compt. Rend.* **108**, 820—821.

SOME months ago the author stated that carbonic oxide exercised a very feeble influence on the phenomena of germination, having only a retarding effect even when present in the proportion of 79 per cent. This has been disputed by C. Bernard, according to whom 17 per cent. of carbonic oxide is sufficient to arrest germination. The author thought that this discrepancy might be due either to the diminution of the oxygen tension in Bernard's experiments, or to his carbonic oxide having been imperfectly freed from carbonic acid. With a view to test this, he has made a large number of experiments with cress and lettuce seeds in varying mixtures of oxygen, nitrogen, and carbonic acid. The influence of the last-named gas did not begin to show itself till it reached 10 per cent.; and even though its effect was rather more pronounced when added to the air without a corresponding addition of oxygen, still the results throw no appreciable light on the cause of the discrepancy.—A. R. D.

History of a Field newly laid down to Permanent Grass. Sir J. B. Laws. *J. Roy. Agric. Soc. Eng.* [2] **25**, 1—24.

TWO acres of the Rothamsted estate laid down to grass in 1856 have been cropped of hay each year. The average crop was 1 ton 14½ cwt. of hay over the whole period of 23 years. The balance sheet shows an average profit of 2*l.* 8*s.* 7*d.* per acre. The amount of nitrogen put on in the form of manure was 20 lb., that of phosphoric acid 14.9 lb., and that of potash 2 lb. per acre per annum in excess of that removed in the crops. Regarding the amount of nitrogen found in the soil in 1888, as compared with that found in it in 1879, and with that calculated to be present in 1856, there appears to have been an accumulation of

52 lb. per acre per annum, of which not more than 20 lb. had been added in manure, and the author again asks the question, whence does it all come from?—J. W. L.

Annual Report for 1888 of the Consulting Chemist, Roy. Agric. Soc. Eng. Journal [2] **25**, 346—353.

THE consulting chemist again calls attention to the prevalence of adulteration in linseed cakes, and bearing in mind the frequent cases of poisonous seeds observed among these impurities, to say nothing of the fact that they are as a whole of no value, he urges strongly the use only of pure feeding materials. Sorghum has been experimented with by 52 farmers at the invitation of the Agricultural Department during the past year. Owing probably to the wet season, only in six cases did the plant grow at all, and these were apparently a failure in respect of the full maturing of the plant. Two samples were examined, more especially for sugar, and while one contained nearly half a per cent., the other was destitute of this ingredient.—J. W. L.

Harvests increased by the Use of Ferrous Sulphate in 1887—1888. P. Marguerite-Delacharlonny. *Jour. de l'Agriculture*, 1889, 61—64 and 98—103. (Compare this *Journal*, 1889, 205.)

FERROUS sulphate has been found of benefit to vines, not only as regards their growth, but also as a protection against phylloxera, &c. Vines have succumbed to the attacks of such parasites, whilst neighbouring vines treated with ferrous sulphate have thriven. Mixed with compost it is found to exert a useful influence. In meadows where lucerne and clover were attacked by *cuscuta*, the latter have been eradicated and excellent crops of the useful plants obtained by dressings of 800, 400 and 200 kilos, of ferrous sulphate per hectare respectively. Other instances of large increases of these crops and of sainfoin are given. Examples of moss being destroyed and of a meadow being visibly improved in three days by ferrous sulphate are quoted. It is stated that cattle show a preference for fodder grown with ferrous sulphate. Potatoes have yielded crops of double weight by its use. The author has succeeded in obtaining largely increased yields of oats by using ferrous sulphate in quantities double those tried by Griffiths, who used 125 kilos. per hectare. With the exception of hemp and tobacco, other cultivated plants, such as sugar-beet, peas, roots, poplars, fruit-trees, &c., have yielded well in response to applications of ferrous sulphate.

Good results must not always be expected, as they are only obtained under favourable circumstances. The quantity used must not be either too large or too small, and must be applied at the right time—best when the plants are a few centimetres high and after rain; two successive dressings are recommended. The quantities vary from 65 to 500 or even 1,000 kilos. per hectare, according to the condition of the soil and kind of plant. Small quantities are suitable for sandy soils, heavy dressings for soils rich in lime.—D. A. L.

Suppression of the Potato Disease by Ferrous Sulphate. P. Marguerite-Delacharlonny. *Jour. d'Agric. Prat.* 1889, 126—130.

EXPERIMENTS have been made by Gaillot in France which confirm the results obtained by A. B. Griffith in England with regard to its killing the *Peroouspora infestans*. The experiments were made on two acres of fertile highly-manured clay soil; 12 rows of potatoes were planted, and when they were above ground and in rainy weather six alternate rows were watered twice with a 2.5 per cent. solution of ferrous sulphate, to the extent of 10 kilos. of the sulphate per acre. At harvest these rows yielded per acre 238 kilos. of good and 5 of bad tubers, whilst 183 kilos. of good and 27 of bad tubers were obtained from the rows not so treated. Moreover, the treated potatoes remained good, whilst 10 kilos. = 6 per cent. of the others, had rotted up to December 15. The increase by the use of ferrous sulphate would thus amount to 6,500 kilos. per hectare at a

cost of 60 francs for 1,000 kilos. of the salt. Other experiments give even more favourable results. (For mode of applying the sulphate see preceding abstract.) Compost should be watered with a 1 per cent. ferrous sulphate solution to kill fungi before putting on the land.—D. A. L.

Ash of the Seed Capsules of the Cotton Plant. Annual Report of the Connecticut Exp. Stat. 1887, 81.

ANALYSES of 10 samples gave the following numbers:—

	Minimum.	Maximum.
	Per Cent.	Per Cent.
Soluble phosphoric acid.....	0.4	2.8
Reverted " "	1.0	7.63
Insoluble " "	0.69	2.40
Potash soluble in water.....	12.54	32.79

The potash is not combined with chlorine. The ash is used as a manure and is excellent for the tobacco plant.—D. A. L.

Practical Application of Hellriegel's Researches with Leguminosae (Papilionaceae). A. Salfeld. Bied. Centr. 18, 239—244.

THESE experiments are interesting as the first practical application of Hellriegel's suggestion as regards the supply of nitrogen to *papilionaceae*.

The experimental soil is high-moor (this Journal, 1889, 469) of the usual North-west German type, $\frac{1}{2}$ metres deep, with an upper layer of sphagnum peat $\frac{1}{2}$ metres thick. The northern half of the experimental land was turned over three times, burnt twice, and in 1887 carried its first crop, rye, dressed with 4,000 kilos. of lime, 160 kilos. of potash, 120 kilos. of phosphoric acid, and 60 kilos. of nitrogen as ammonium sulphate and Chili saltpetre, per hectare, and yielded 47.12 centners of grain. The southern half, previously covered with dense growth of the heathers, *Erica vulgaris* and *tetralix*, was cleared by cultivating, burning, hoeing, and treating with lime, but in the spring of 1888, even after six repeated and careful attacks, undecomposed clumps of heather and peat-moss still remained, and, therefore, the outlook for the success of leguminosae on this part was less favourable than on the northern part.

An analysis of neighbouring moor-land in 1884 showed that it contained per hectare, 2,827 kilos. of nitrogen, 179 kilos. of potash, 484 kilos. of lime, and 172 kilos. of phosphoric acid; the nitrogen of the uncultivated moor is, however, in a very insoluble form. Plots of an *are* each were covered in October 1887 with 40 kilos. per hectare of the following soils:—1. Glauconite soil from uncultivated land containing 3.73 per cent. of potash in the dry matter; very clayey. 2. Kalenberger soil, taken from the surface of a clayey soil noted for the production of horse-beans. 3. Wier soil, clayey marsh soil from Holland; on analysis a similar soil yielded per cent. of dry soil, NO \cdot 21, K₂O \cdot 80, CaO 1.70, MgO 1.31, P₂O₅ 1.54, sand and clay 80.50. In addition, each plot, and also those receiving no soil, got 4,000 kilos. of calcined lime, 160 kilos. of phosphoric acid as basic slag, and 180 kilos. of potash as kainite. The plants were drilled on April 19—24, 1888. The plants developed considerably better on the Kalenberger and Wier soil plots than on the plots receiving the Glauconite soil or none at all, and were even better on the unpromising southern part than on the northern parts of the experimental ground. The differences grew more evident the nearer the plants approached maturity. Cold and wet weather from July 29 to August 7 threw things back considerably. The peas (both field and ordinary) were the first to show the benefit derived from the fertile soils, but the other plants showed up later, and the harvest results show best with those plants which were only injured by frost, rust, and wet, but not by beating down. The results on the northern portion were as follows:—

Plant.	Soil added.	Mean Yields.	
		Grain.	Straw.
		Kilos.	Kilos.
Field peas.....	Without ..	7.975	23.175
"	Wier	10.70	43.20
"	Kalenberger ..	5.60	37.90
Horse-beans and capucine peas	Without ..	6.20	14.65
" " "	Glauconite ..	4.20	10.35
" " "	Kalenberger ..	10.35	27.50
" " "	Wier	11.80	31.80
" " and lentils.....	Without ..	2.85	19.50
" " "	Glauconite ..	3.00	20.85
" " "	Wier	8.80	36.05
Peas (<i>Pisum arvense</i>).....	Without ..	3.30	28.55
" " "	Wier	3.90	31.45

The peas on the fertile soils grew too tall and were much fallen, so that pod formation was delayed, some of the field peas rotted on the ground before reaping, and the ordinary peas could not ripen. The lentils also suffered from overgrowth, for they were so close together that they did not mature. But in spite of bad weather, the increase obtained by the use of Wier soil, for example, was with horse-beans and capucine peas 90.3 per cent. on the grain and 117 per cent. on the straw, whilst with horse-beans and lentils the increase was 208.8 per cent. on the grain and 84.9 per cent. on the straw. These results were more than could be expected under the circumstances from newly cultivated high-moor. The use of Wier soil, in fact, even if it only lasts good one season would be profitable; as, however, 4,000 kilos. appear too much in some cases, experiments are being made with smaller quantities.

It is pointed out that the beneficial action of the fertile soils cannot be mechanical, because the equally clayey Glauconite soil was inactive, nor can it be attributed to the small proportion of ash constituents contained in them. Therefore it is assumed that the application of fertile soils suitable for the growth of peas and beans, contributes to high-moorland the means of enabling leguminosae to thrive upon it with only a limited supply of nitrogen in the soil.

—D. A. L.

Economical Merits of the Soltsien and the Kellner Methods for Removing the Bitter Alkaloid from Lupins. J. Kühn. Bied. Centr. 18, 244—246.

LUPINS treated by Soltsien's method are only eaten by cattle, horses, and asses after lying a long time on the drainers, but sheep and goats eat them after three days drying. But lupins treated by Kellner's method are eaten by all animals in the fresh moist state, and as much as 3½ lb. per 1,000 lb. of live weight have been included in the daily ration without injury to milking cows.

Both methods remove the bitter principle equally well, and both diminish the dry matter to the same extent. Therefore Kellner's method is to be preferred when a steaming apparatus is at hand, and Soltsien's under other circumstances. The injurious substance *Ikroten* is generally removed by both methods, but when the *ikroten* has become insoluble on account of the age and dryness of the lupins, Soltsien's is preferable to Kellner's method, and in fact when the latter method is used it is advisable to make test-feedings for many weeks before introducing this lupin fodder generally.

Ikroten is destroyed by high temperatures, and the author recommends steaming for many hours under 2 to 2½ atmospheres pressure in order to be sure of its destruction, for it is not destroyed by the temperatures developed either in making silage or brown hay or by drying at 100°. Treated lupins constitute a good fodder, and are a good crop for light soils; but such sorts only should be selected which submit readily to the treatment for removing bitter principles, and are subsequently eaten freely by farm animals, such sorts, for instance, as:—Blue lupin (*Lupinus angustifolius*), more especially the white seeded Blue, or White East Prussian lupin (*L. angustifolius*, var. *leukospermus*), and perhaps the white-seeded Yellow lupin (*L. luteus*, var. *leukospermus*). In harvesting, moderate-sized bundles should be arranged in

a conical heap with the pods inwards, and protected with a straw cover, so as to avoid loss by shedding. The straw and shells should be strewn in the cow-shed.—D. A. L.

The Action of Salt Water on Earth and Vegetation.
A. Stood. Landw. Versuchsstat. 1889, **36**, 113.

A SOLUTION containing more than 1 grm. of sodium chloride per litre is prejudicial to vegetation. The injury is not so apparent in a wet season, but during dry weather the salt solution rises in the ground by capillary attraction and becomes concentrated near the surface by evaporation, to the detriment of the plants.—G. H. B.

Comparative Value of Equal Quantities of Nitrogen as Ammonia and as Nitrate. J. Samek. Tyroler landw. Blätter, **7**, 1889, 14—15.

SOME of the results obtained with beet-root and oats were as follows:—

Manuring per Hectare.	Yield. Kilos. per Hectare		Profit.
	Roots.	Leaves.	
			Marks.
1. 64 kilos. of soluble phosphate and 30 kilos. of ammoniacal nitrogen	30,700	3,100	120
2. 64 kilos. of soluble phosphate and 30 kilos. of nitric nitrogen.	38,500	3,200	176
3. 64 kilos. of soluble phosphate without nitrogen	29,200	2,600	156
4. No manure	12,600	1,400	..
5. Privy drainage	39,700	4,400	242
6. 30,000 kilos. of stable manure ...	32,000	2,700	88

Manuring per Hectare.	Yield of Oats. Kilos. per Hectare.		Profit.
	Grain.	Straw.	
1. As above	39	3,200	Marks. 42
2. "	34	3,900	96
3. "	23	2,400	10
4. "	18	1,800	..
6. "	28	3,300	-14

In both cases the nitrate proved better than the ammonia. Potash produced a quite unimportant increase.—D. A. L.

Chili Saltpetre and Superphosphate for Oats and Wheat.
Roth. Sächsische landw. Zeits. **36**, 1888, 526—531.

OATS were sown on a light soil which had received no farmyard manure since 1884, and had carried sugar-beet in 1885, barley in 1886, and flax in 1887. Wheat, following sugar-beet, was grown in a field of the same soil, which had been dressed with stable manure in 1886, and had received the leaves and tops of the sugar-beet in 1887. Various quantities of nitrogen alone, and along with various quantities of phosphoric acid, were applied, but neither the oats nor the wheat were improved by the use of phosphates, whilst the Chili saltpetre proved remunerative. Some of the results were as follows:—

Manuring per Hectare.	Yield, Centners (50 Kilos.) per Hectare.			
	Oats.		Wheat.	
	Grain.	Straw, &c.	Grain.	Straw, &c.
Unmanured	56'00	70'18	47'63	73'09
64 lb. (German) of nitrogen as Chili saltpetre	74'18	82'91	56'00	99'27
96 " " " "	78'54	81'82	57'82	103'63
80 " " " "	74'91	80'00	56'36	121'82
270 " soluble phosphoric acid as superphosphate				
90 " " " "	46'54	68'36	48'36	84'00

—D. A. L.

Accurate Manurial Experiments with Barley. J. Hanamann. Oesterr.-Ungar. Zeits. f. Zuckerind. u. Landw. **17**, 1888, 574—578.

THESE experiments were conducted in order to ascertain the agricultural value of a light marly soil containing 93·8 per cent. of fine earth, which consisted of 80·8 per cent. of fine sand, and 19·2 per cent. of clay, and contained 2·72 per cent. of hygroscopic, and 2·8 per cent. of combined water, 2·9 per cent. of humus, and losing 8·42 per cent. on ignition. Both the soil and the fine earth yielded 0·088 per cent. of potash to cold 10 per cent. acetic acid, whilst cold 10 per cent. hydrochloric acid extracted in 24 hours 0·194 per cent. of potash from the soil and 0·776 from the fine earth. The barley seeds were carefully selected of uniform size and weight, and allowed to germinate on moist sawdust; they were then transferred to iron cylinders with holes at the bottom, containing 4 kilos. of the air-dried soil;

five seedlings being allowed to each cylinder. The pots were so arranged as to get plenty of sun, with facilities for sheltering in bad weather. Various manures were added to different cylinders, and although the season was a bad one, nevertheless the system of experimenting allows of trustworthy deductions being made from the results obtained. The barley was benefited to the greatest extent by dressings of nitric and phosphoric acids together, to a marked degree by nitric acid alone, scarcely by phosphoric acid alone, and not at all by potash either alone or in conjunction with the other fertilisers.

On this soil, therefore, potash is not required, but both soluble phosphates and nitrates are beneficial, and should be applied in the form of ammoniacal superphosphates or superphosphate and saltpetre.—D. A. L.

Results of Comparative Experiments with Basic Slag and Superphosphate. E. Meissl. Oesterr.-Ungar. Zeits. f. Zuckerind. u. Landw. **17**, 1888, 579—609.

EXPERIMENTS with basic slag and superphosphate were conducted at 35 places in Austria. The experimental fields were in all cases as level as possible and of the same condition, that of medium fertility (preferably the second year after moderate dressings of farmyard manure). The manuring per hectare was 20 kilos. of nitrogen, as ammonium sulphate, and 60 kilos. of soluble phosphoric acid, as dissolved bones, or 150 kilos. of phosphoric acid as basic slag. The manures were mixed with soil and sown broadcast in the autumn. The experimental plots were 1,500 square metres in extent, and were separated by a non-experimental strip 75 to 100 centimetres wide. The experimental crops were in 18 places wheat, in 13 rye, in the rest meadow herbage and oats. On the whole the basic slag plots yielded rather heavier crops than the superphosphate plots, and $2\frac{1}{2}$ parts of phosphoric acid in basic slag may be definitely regarded as equivalent to, at least, 1 part of phosphoric acid in the form of superphosphate. Moreover it is certain, in most cases, that for autumn manuring superphosphate may be replaced by finely pulverised basic slag in the above proportion. It is, however, pointed out that frequently, owing to local or accidental circumstances, the action of basic slag is not so good; also for spring dressings, when readily-assimilable phosphoric acid is required, it would not be profitable to use slag instead of superphosphate. The price of a kilo. of phosphoric acid is taken at about 22 pfennigs ($2\frac{2}{3}$ d.) in basic slag, and at 64 pfennigs (little less than $7\frac{3}{4}$ d.) in superphosphate.

—D. A. L.

Manuring for Beetroots. Dingl. Polyt. J. **271**, 266—278.

Quasthoff has tried experiments with a peculiar form of potassium salt as manure, especially for sugar beets, and has obtained very good results.

The author considers that the manurial effect of the potassium in inorganic salts is only developed by combining the sulphuric acid with lime.

The potassium salt is treated by wetting it with milk of lime and then drying it or mixing it with some other dry substance, so that it can be spread over the ground. Other salts besides the sulphate can be similarly treated, and in general it is found that the addition of lime sets free the potash, and in consequence of this excellent results are obtained; in the case of beets the extra yield has amounted to 65 per cent.

The following conclusions have been drawn from experiments on the application of sulphate of iron as a manure for sugar beets:—

- (1.) The yield was increased from 5 to 30 per cent. according to circumstances.
- (2.) The application should be made during rain or when the ground is wet.
- (3.) When a solution is employed, 65 kilos. per hectare are sufficient, but not when the dry powder is spread out. According to the quality of the soil, 100 to 300 kilos., or even more, can be spread out without any bad effect.
- (4.) The increased yield affects the total solid matter as well as the sugar content of the beet.
- (5.) Along with sulphate of iron the usual chemical manures should also be used.
- (6.) The sulphate of iron, mixed with 5 or 10 times its weight of earth or sand, should be spread out after the beets have been thinned.—W. M.

An Error accompanying the Estimation of Nitrates in Soils, &c. M. Giunti. Le Stazioni. Speriment. Agrar. Italiana, **15**, 3—15.

See under XXIII., page 572.

Boric Acid in Plants. C. A. Crampton. Ber. **20**, 1072—1076.

See under XXIII., page 569.

XVI.—SUGAR, STARCH, GUM, Etc.

On the Methods for Estimating Starch. A. v. Asboth. Chem. Zeit. **13**, 594 and 611.

See under XXIII., page 574.

The Examination of Abnormal Beetroots. Deutsche Zuckerind. 1889, 600.

CHASSEX examined beetroots which gave in the manufacture a lower yield than was expected, while no reason could be assigned for this loss of sugar. It appears that a sugar was present which gave a right-handed rotation in the polariscope, but did not undergo inversion on treatment with hydrochloric acid. This substance was precipitated by basic acetate of lead. When abnormal losses in the manufacture occur, denoting some error in the analytical methods, it is recommended to supplement the usual estimation by the polariscope by the inversion method of Herzfeld, which includes a preliminary clarification of the alcoholic extract of the roots by means of lead acetate. This will eliminate the abnormal substance before inversion.—G. H. B.

Xylose and Wood-Caoutchouc. H. J. Wheeler and B. Tollens. Ber. **22**, 1046.

THE authors have extracted from beech-wood, by means of 5 per cent. caustic soda solution and precipitation with alcohol and hydrochloric acid, wood-caoutchouc corresponding in properties to Thomson's substance.

Both substances yield on hydrolysis Koch's wood-sugar or xylose. Xylose closely resembles arabinose and turns the plane of polarisation, though much more feebly, to the right. Like arabinose, it gives no levulinic acid, but a considerable amount of furfuralamide. Its phenylosazone derivative has the formula $C_{17}H_{20}N_4O_3$, and according to Raoult's molecular weight method it has the formula $C_5H_{10}O_3$. With phloroglucinol and hydrochloric acid it gives, like arabinose, the well known cherry-red colouration.

—J. B. C.

Compounds of Raffinose with Bases. A. Beythien and B. Tollens. Ber. **22**, 1047.

LIKE cane-sugar, raffinose forms compounds with bases, some of which are less soluble in water or alcohol than raffinose itself.

Di-strontium raffinosate, $C_{18}H_{32}O_{16} \cdot 2 SrO$, is obtained by boiling for some time a strong aqueous solution of its constituents, or more quickly by adding alcohol.

Sodium raffinosate was obtained, containing from 7—8 per cent. of sodium, and less, according to the proportion of soda employed.

Eight per cent. of sodium corresponds to the composition of di-sodium raffinosate, and, in conjunction with other facts, points to the formula $C_{18}H_{32}O_{16} + 5 H_2O$ for raffinose. Barium, calcium, and lead raffinosates were also prepared. The authors will shortly publish their results in this direction, as well as the results of other researches on raffinose, and phenylosazones and their melting points.

—H. T. P.

Maize, and the Preparation of Crystallised Cane Sugar therefrom. J. H. Washburn and B. Tollens. Ber. **22**, 1047—1048.

ALTHOUGH cane-sugar has been shown to be present in maize, it has hitherto not been separated in a state of purity. The authors extracted maize-flour with alcohol and added magnesia or lime. They also employed the strontium precipitation method. In this manner the authors succeeded in obtaining crystals of pure cane-sugar from Baden maize, and also, but in larger quantity, from American sweet maize. Full information regarding this subject, as well as a quantitative examination of sweet maize in various stages of ripeness is given in another paper.—H. T. P.

A Hexyliodide from Sorbite. C. Hitzemann and B. Tollens. Ber. **22**, 1048.

ONE of the authors was unable to obtain sorbose from the juice of the service-berry, but a considerable quantity of the juice deposited crystals of sorbite. The crystals contained 9 per cent. water, corresponding to the formula $C_6H_{14}O_5 + H_2O$. By the action of hydriodic acid and phosphorus on sorbite, a small quantity of hexyl iodide, $C_6H_{13}I$, boiling at $168^\circ C.$, was obtained. This proves that sorbite belongs to the six carbon atom series.—H. T. P.

The Preparation of Gluconic Acid. A. Heffter. Ber. **22**, 1049.

MERCUROS gluconate is obtained by boiling an aqueous solution of glucose with yellow mercuric oxide as long as reduction takes place. After filtration and cooling, the salt is deposited in large white needles having a silky lustre. The reaction seems to be a quantitative one. The needles are insoluble in alcohol, difficultly soluble in cold water, easily soluble in hot water. At $100^\circ C.$, the crystals turn grey, and continued boiling with water causes the separation of mercurous oxide. Gluconic acid is obtained as a slightly yellowish syrup by decomposing the above salt with sulphuretted hydrogen.—H. T. P.

Notes on Mannose. E. Fischer and J. Hirschberger. Ber. **22**, 1155—1156.

A SHORT time ago, Reiss (this Journal 1889, 406) communicated his discovery of a new sugar—seminose—obtained by the hydrolysis of a particular variety of cellulose existing in many seeds. It forms a hydrazone bearing great similarity to the phenylhydrazone of mannose (this Journal 1889, 296 and 297) and gives a precipitate with basic acetate of lead. In a former paper the authors state that mannose gives no precipitate with this reagent. On this ground Reiss bases his conclusion that seminose is distinct from mannose. On reinvestigating the subject, the authors find that mannose does give a precipitate with basic acetate of lead. In dilute solution the precipitation takes place slowly, quickly in strong solutions. The precipitate is slightly soluble in cold water, more soluble in hot water. Mannos-oxime was also prepared. It is easily soluble in warm water, almost insoluble in alcohol. When quickly heated it melts at $184^\circ C.$ with decomposition, heated slowly, the melting point is $176-180^\circ C.$ Reiss finds 176° to be the melting point of the oxime of seminose, gas being given off. The phenylhydrazone of mannose when nearly pure melts at $188^\circ C.$, with decomposition; when quite pure and quickly heated it melts at $195-200^\circ C.$ The seminose compound melts at $185-186^\circ C.$ On these grounds the authors are of opinion that seminose is identical with mannose.—H. T. P.

A Process for Purifying Refinery Washings and other Sugar Syrups by Means of Fatty Acids, to the Exclusion of By-products. F. Harn. Chem. Centr. 1889, 330.

DRINKING the concentration of sugar juices, and after the addition of char, the organic and inorganic impurities present are so concentrated as to interfere with the crystallisation of the sugar. The author describes a process whereby these hurtful results are avoided. Experiments made on a large scale have shown that the addition of a small quantity of fatty acid (about $\frac{1}{2}$ per cent. of the total mass) serves the purpose. The fatty acid combines with the alkalis and alkaline earths, and so prevents their influence on the sugar. The raw syrup obtained by the process yields these impurities as a mud.

The author describes the following applications of his process:—

(1.) In refineries where raw sugar only is employed. (2.) In refineries where sugar is extracted from molasses, and this introduced into the raw sugar solution. (3.) In working with beet, with and without the addition of saccharate of lime.

When working the process on the large scale it is possible to obtain the sugar syrup as pure, even if raw syrup has

been added, as in working without the addition of raw syrup, and the product may be worked up for immediate consumption or as raw sugar. The after products only make their appearance if the operation is stopped, so that the last raw syrup cannot be re-introduced into the general working.—A. L. S.

A Decolourising Powder for Dark-coloured Liquids, especially for Inverted Molasses and Sugar Solutions; also for Fuel Oil, Wood Spirit, Glycerin, Crude Spirit, Acetic Ether. A. Gawalowsky. Chem. Centr. 1889, 331.

THIS powder is prepared from the residues obtained in the manufacture of ferrocyanide of potassium by treating them with 100 per cent. of hydrochloric acid for two days, then well washing and treating with 100 per cent. of a 20 per cent. solution of soda, and afterwards well washing and drying. The original material yields 50—60 per cent. of the absorption powder. Dark-coloured syrups and sugar solutions, especially those obtained in the determination of raffinose by the inversion method, are made almost as colourless as water by its use, and this without affecting their rotative power.—A. L. S.

The Diffusion Process in Java. Stammer. Dingl. Polyt. J. **271**, 266—278.

IN Vonopringo, in Java, the diffusion process has been successfully applied to the extraction of sugar from the sugar cane. Lime was added to the diffusion cylinders, and the juice passed, without filtration or defecation, to the vacuum pans, thus saving much labour and time. The water in the extracted cane chips was pressed out in the old cane mills and the chips thus dried were used as fuel for the boilers.

The following average figures show the working at Vonopringo:—

Analysis of the Cane.	29th July 1888.	12th August 1888.
Cellular matter	11.7	12.5
Juice	88.3	87.5
Cane Juice:—		
Percentage brix.....	18.6	17.1
Cane sugar	16.83	14.61
Purity	90.48	85.43
Glucose.....	7.0	1.11
Diffusion juice:—		
Percentage brix	14.7	13.5
Cane sugar.....	13.31	11.71
Purity	90.54	86.74
Glucose.....	0.42	0.64
Sugar in residue	0.30	0.56
„ in waste water.	0.08	0.12
Dilution.... per cent.	28.3	27.2
Purity of "thick juice"	90.34	87.49
„ maseuite ...	90.82	87.83
Cane sugar in maseuite	85.56	82.74
Glucose „ „	2.82	3.06

—W. M.

PATENT.

Manufacture of a Vegetable Black for Decolourising Purposes, and Apparatus therefor. E. A. de Lisle, Paris, France. Eng. Pat. 8738, June 14, 1888. 8d.

WOOD or bark is reduced to a fine powder by suitable means, and mixed with 15 to 20 per cent. of lime. The mixture is packed in perforated iron cylinders, closed at the

ends, and heated to redness in a closed retort. It is then allowed to cool spontaneously out of contact with the air, or falls into water when red-hot, and so cooled. In either case it is washed first with dilute hydrochloric acid, to remove the lime salts, then with water, and dried. Thus obtained it has a very high decolourising power. Exhausted Peruvian bark may be so utilised without the addition of lime. Any suitable furnace may be employed. An arrangement of apparatus is illustrated in the specification for carrying in effect the operations described above.—C. C. H.

XVII.—BREWING, WINES, SPIRITS, Etc.

Purification of Alcohol by Hydrogenation. L. Naudin. Chem. Centr. 1889, 331.

Titus is a method for purifying alcohol by nascent hydrogen generated by a zinc-copper couple, sodium amalgam, or other means. It is claimed that the process described by Godefroy (this Journal, 1888, 859), depends (so far as it is of any value) on the author's principle, and the latter considers the simultaneous addition of lime and calcium chloride to be worthless and harmful.—A. L. S.

Progress in the Manufacture of Spirit. Dingl. Polyt. J. 272, 29–41.

Crude Products and Malt.—The potato-rot is detected by a slight darkening in the colour of the skin, which gradually changes to a dirty shade. On cutting through the potato, brown spots are seen. The disease is due to parasitic worms, which are most dangerous to a variety of cereals, &c. Potatoes affected with it are best used for spirit manufacture, and not for making starch. The stalk-rot is generally restricted to certain of the stalks, but may sometimes attack the bulb. It is due to a parasite which lives in the upper layers of the earth. Free access of air is the best remedy against the disease.

R. Heinzelmann discusses the employment of wheat and wheat-malt in the manufacture of spirits. As wheat contains a larger amount of substance capable of fermenting than any other cereal, the author considers it most suitable for the production of malt. The latter is more readily prepared, the yield in alcohol and extract greater, than with barley. 100 grms. of wheat-malt gave 60.08 grms. of alcohol, while 100 grms. of barley-malt gave 52.03 grms. of alcohol. Different kinds of wheat, however, behave very differently. Those richest in substances containing nitrogen are best adapted for making malt. Moreover, the summer rather than the winter crop, the white rather than the red, and the soft rather than the hard variety, may be said to be most suitable. Wheat attacked by the corn-parasite will not germinate.

Steaming and Mashing.—Too great a dispersion of the steam is not advantageous in steaming potatoes, even when they are diseased. The opposite applies in the case of maize and other cereals.

Fermentation and Yeast.—To prevent a frothy fermentation, Christek advises addition of an extract prepared from 1 kilo. of rape-seed husks with 5 kilos. of water.

For preserving liquid yeast, it is advisable to add one-eighth its volume of glycerin; pressed yeast is simply covered, in closed vessels, with glycerin. Others recommend kneading with animal charcoal, and drying in the sun. Before use, the mass is dissolved in water, and the charcoal skimmed off.

Distillation and Rectification.—L. Godefroy's process (this Journal, 1888, 859) for purifying spirits is first described.

Hoper has taken a German patent for purifying alcohol by filtering through vegetable charcoal, and the crushed product obtained by fusing together manganese oxides, alkalis, and lime. The mass is revived by igniting in presence of superheated steam.

J. Traube's method for freeing spirit from fusel oil (this Journal, 1888, 762) has been improved upon, by allowing

for more thorough separation of the layers and by an extension of the plant; so much so, in fact, that the author believes the most inferior spirit may be turned into the best quality, with excellent yield, from the crude product, and at a very small cost.

In purifying spirits by filtering through charcoal, the filters are generally made of wood, 2 metres high by 1 metre wide. The charcoal is best prepared from ash or pine wood, and used as a fine and gritty powder. This cannot be regenerated; but such a filter will last 90–100 days, with 150 litres of spirit passing through it daily.

Plant.—In connexion with a discussion as to a good apparatus for peeling the potatoes, it was elicited by C. Bennewitz, that it is advisable to leave a certain quantity of the skin in the mash, as this favours fermentation.

An apparatus for freeing spirit from fusel oil by means of petroleum is described by Ruffin.

Analysis.—Sell thinks the only reliable means at present for estimating the quantity of fusel oil in crude spirit are Roes's (this Journal, 1888, 396 and 871), and Traube's capillarimetric and stalagmometric methods (this Journal, 1888, 42 and 396). Roes's improved method. A very pure alcohol of sp. gr. .96565 at 15.5° C. is required, corresponding to 30 per cent. by volume. The specific gravity is determined in a long-necked pycnometer. To obtain an alcohol of r per cent. by volume (r less than 30) for every 100 cc. of the same $\frac{r}{30}$ (30– r) cc. of absolute alcohol at 15.5° C. should be added. When the alcohol has the required density, the apparatus for shaking is filled to the lower mark with chloroform of 15° C., the 30 per cent. alcohol contained in a 100 cc. flask added, and 1 cc. of sulphuric acid, the strength of which though otherwise immaterial, must be the same in the various experiments. The mixture is now run into the extractor, shaken 150 times, and again returned to the cooling cylinder. After a short time the increase in height of the column of chloroform is noted. Several experiments are needed with the above pure normal alcohol as a basis for the numbers. In the same manner, the increase in the volume of chloroform is determined, which results from shaking it with alcohol of .96565 sp. gr. at 15.5° C., to which a known quantity of amyl alcohol has been added.

Every 0.15 cc. increase in the volume of the chloroform layer corresponds to 0.1 per cent. by volume of amyl alcohol. The numbers differ with different kinds of chloroform, whence fresh determinations must be made when different chloroform is employed.

In examining brandy, &c., or spirit, 200 cc. of the former, or 100 cc. of the latter, are distilled with a little caustic potash, and two pieces of pumice stone. The distillate is made up to the original volume at 15.5° C., and the determination carried out as above. If b be the basis of increase in volume, experimentally found with 30 per cent. alcohol, c the increase for a certain brandy, a the amount of water or alcohol which had to be added to 100 cc. of the original brandy, to make its strength 30 per cent. by volume, the percentage by volume of fusel oil contained in it is $f = \frac{(c-b)(100-a)}{150}$. The greatest importance attaches

to bringing the alcohol up to the accurate strength, the largest permissible margin being 29.96 and 30.04 (per cent. respectively), which is often only attained by determining the specific gravity three or four times. Both the chloroform and the alcohol must have a temperature of 15° previous to mixing.

A large number of substances may influence the height of the layer of chloroform either by decreasing or increasing it. Tables are given showing to what extent this applies with 24 different bodies, both before and after distilling with caustic potash, as compared with amyl alcohol. To spirits containing a high percentage of alcohol, water should be added previous to distilling with potash. Roes's method, when carried out with all the above precautions, gives very good results. In fact, 0.01 per cent. of fusel oil may be determined without difficulty.

Several precautionary measures to be taken in Traube's capillarimetric and stalagmometric methods are described

and formulæ given for calculating the fusel oil. The influence on the results through the presence of ethereal oils, &c., is greater in Traube's than in Roesse's method. Tables are given showing, as in the latter method, how far and in what direction this influence, extends. Traube's methods, though taking less time to carry out, are on the whole not as exact as Roesse's. On the other hand, the presence of such bodies as aldehyde cannot be determined by the latter process, only the numbers corresponding to fusel oil being obtained.—A. R.

Improvements in the Manufacture of Spirit. Dingl. Polyt. J. 272, 86—93.

Detection of Aldehydes and Ketones in Spirit. (U. Gayon and G. Dupetit. *Revue Industr.* March 3, 1888.)—The test consists in the addition of a sulphurous acid solution of rosaniline (for details see this Journal, 1888, 238). According to the *Zeits. f. Spiritusind.* 11, 387, the test is not reliable. As the reagent will only keep for a short time it should be prepared in small quantities only.

Estimation of Sugar in Molasses.—Oest. ung. Brennereizeit. 12 328, after calling attention to the unreliable results of the inversion process by the use of Clerget's formula, recommends that the raffinose should be ignored and the molasses examined by the inversion process, using Creydt's formulæ—

$$1. Z. = \frac{C - 0.493 A}{0.887}$$

$$II. R = \frac{A - Z}{1.57}$$

in which A = direct polarisation, B = polarisation at 20° C. after inversion, C = difference between these two results, Z = cane sugar, R = Raffinose. (This Journal 1888, 695 and 696.)

Examination of 263 samples of Brandy from various Districts in Germany. (Zeits. f. Spiritusind 11, 334.)—The price of the brandies varied between 20 Pf. and 1.30 M. per litre, and was on the whole independent of the amount of alcohol. *Colour:* 45.7 per cent. of the samples were colourless, 9 per cent. were brown; the cause of the colour is not stated. *Acidity:* 74.3 per cent. of the samples were neutral, 16.6 per cent. faintly acid, 8.3 per cent. more so, and 0.8 per cent. strongly acid. The acidity of the samples only faintly acid was probably due to acetic acid formed by oxidation. The more acid brandies probably contained mineral acids, which was the case in both the strongly acid samples. *Odour:* 16.6 per cent. of the samples had an odour of pure alcohol only, 44.5 per cent. of fusel oil, whilst the remaining samples were aromatic from the presence of ethereal oils or cinnamic ethers.

Percentage of Alcohol.

Per Cent.		Per Cent.
20—25 by volume in ..	6 samples	2.3
25—30 17 ..	....	6.4
30—35 25 ..	....	9.4
35—40 95 ..	....	35.8
40—45 81 ..	....	30.6
45—50 32 ..	....	12.1
50—60 6 ..	....	2.3
Over 60 3 ..	....	1.1

Fusel Oil: the samples, tested by Roesse's method, give the following results with the exception of seven samples (see below).

100 parts of brandy contained:—

Per Cent.		Per Cent.
No fusel oil	33 samples	12.8
Up to 0.05 fusel oil ..	..	19.8
0.05—0.10 55 ..	....	21.3
0.10—0.15 37 ..	....	14.3
0.15—0.20 45 ..	....	17.4
0.20—0.25 27 ..	....	10.6
0.25—0.30 6 ..	....	2.3
0.30—0.50 4 ..	....	1.5

Calculated upon 100 per cent. by volume of alcohol, the samples contained:—

Per Cent.		Per Cent.
No fusel oil	33 sample	12.8
Up to 0.10 fusel oil ..	38 ..	14.7
0.10—0.20 46 ..	....	17.8
0.20—0.30 30 ..	....	11.8
0.30—0.40 34 ..	....	13.2
0.40—0.50 39 ..	....	15.1
0.50—0.60 24 ..	....	9.5
0.60—0.80 11 ..	....	4.2
Over 0.80 3 ..	....	1.1

Windisch considers that the legal limits of the amount of fusel oil should be fixed for 100 parts of absolute alcohol, not for 100 parts of the original brandy.

The seven samples not included in the above tables yielded abnormal results when tested by Roesse's process. When distilled with caustic potash they became yellowish to brown, the distillate possessed the characteristic odour to a more marked degree than usual, and upon shaking it up with chloroform the greenish-yellow dye and all the other substances are dissolved by the chloroform, materially increasing its volume. Whether these substances possess the same injurious effects as the fusel oil from potatoes remains to be proved by physiological experiments. No sort of relation appeared to exist between the amount of fusel oil in the brandies and the price of them, or between the amount of fusel oil and of alcohol.

On the Injurious Effects of Amyl Alcohol in Brandy. (Strassmann. *Versamml. deutscher Naturforscher u. Aerzte zu Köln.*)—Dogs fed with alcohol containing 3 per cent. of amyl alcohol very soon exhibited nervous complaints and died in about half as long a time as dogs fed upon pure alcohol. With 1.5 per cent. of fusel oil the nerves were also more strongly affected, but duration of life not shortened compared with the use of pure alcohol. The author concludes that a liquid containing 0.3 per cent. of fusel oil, or only one-fifth of the smaller quantity with which he experimented, would show the same results as pure alcohol, and that the injurious effects of such a small proportion of fusel oil would be quite inappreciable compared with the much greater injurious effects of the alcohol itself.

On the Composition and Examination of Natural Brandies. (H. Roupes.)—By "natural" is meant the brandies obtained by the distillation of various fermented juices from plants. The author recommends the estimation of the alcohol, total extractive matter, acidity, and the furfural; also the qualitative examination of the different fractional distillates with rosaniline bisulphite, aniline acetate, sulphuric acid, potassium permanganate, and an ammoniacal solution of silver nitrate. The analyses given show that as a rule, compared with the natural brandies, the artificial samples are less acid and almost always contain much less furfural, often only traces.

Parasitic Bacteria in Grain. (Bernheim. *Naturforschersammlung zu Köln.*)—Pure cultivations of various cocci and bacilli were obtained from the inner part of maize and different kinds of grains, as also from leguminous seeds and tubers. In the dry ungerminated seeds only cocci are found; the rods which always appear in the cultivations must be present in the grains as spores. When germination begins the bacteria increase greatly in number, especially in the glutinous portion of the grains. The author considers that the appearance of these parasites in the gluten depends on the formation of diastase from it, and that the parasites are derived from the soil and pass up the stalks of the plant.

Diastase Ferment of Ungerminated Wheat. (C. J. Lüntner. *Wochenschr. f. Brauerei* 5, 1038.)—Wheat, contains a diastase ferment which, like malt diastase, converts starch into maltose. (Cousinier, on the contrary, maintains that the ferment in ungerminated grain forms glucose.) Although this ferment produces maltose it differs from diastase, as it cannot liquefy starch paste. It was also impossible to isolate this ferment, which can easily be done with malt diastase.

Saccharification of Starchy Substances with Hydrochloric Acid for making Spirit. (E. Bauer. Ber. Oest. Ges. z. Förderung. d. Chem. Ind. 1888, II. and III.)—A description is given of the various processes which have been proposed for replacing malt by an acid, but which have hitherto been unsuccessful. It is believed that this is due to the formation by the acid of substances which have an antiseptic acid. Details are given of the experiments, the results of which were afterwards patented by the author in conjunction with Krnis and Jahn.

Preservation of Diastase. (H. Leffmann and W. Baum. Zeits. f. Spiritus. u. Presshefe-ind. 9, 313.)—Salicylic acid and saccharin are unsuitable; boracic acid and bisulphite of soda appear to slightly diminish the activity of the diastase.

Manufacture of Dextrin. (Ljubawin. Zeits. f. Spiritus. u. Presshefe-ind. 9, 313.)—Four hundred grms. of potato starch are mixed with 200 grms. of water and 5 grms. of hydrochloric acid (sp. gr. 1.14), mixed well, and then allowed to dry, which requires about two days. The mixture is then heated over a water-bath for an hour and a half, and finally dried at 110°.—E. E. B.

The Alcoholic Fermentation of the Juice of the Sugar Cane. V. Marcano. Compt. Rend. 108, 955—957.

THE author has studied in the tropical regions the nature of the ferment and of the products which accompany the formation of alcohol from the sugar cane. The deposit from a vat of fermented cane liquor is seen under the microscope to consist of small cells much more minute than

those of beer yeast. They are round in shape and isolated from one another, not forming groups or bunches. When transferred to starch or dextrin solution, or even to another solution richer in sugar, a mycelium soon develops, the filaments of which penetrate in all directions. This yeast is most energetic at a temperature of 30°—35° C., and in a liquor containing 18 or 19 parts of sugar per 100 parts of water. When undergoing distillation the crude alcohol first gives off a gas of a disagreeable odour, and then a certain amount of methyl alcohol. The latter is followed by pure ethyl alcohol, but the last portions of this are mixed with an oily acid of an unpleasant smell, which may, however, if desired, be completely separated before rectification, as it forms with the alkalis salts insoluble in aqueous alcohol. No traces of alcohols higher than ethyl alcohol are to be found.—A. R. D.

Wines from Portugal. J. H. Vogel. Zeits. f. angew. Chem. 1889, 243—244.

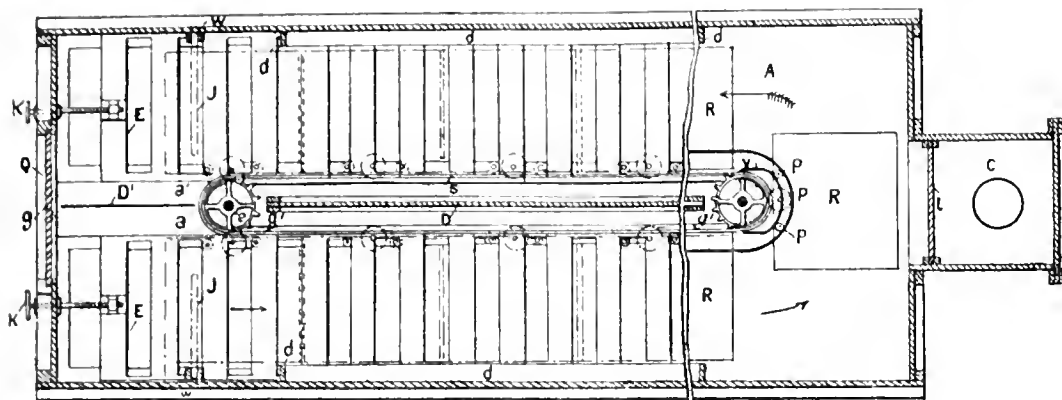
IN 1888 an exhibition of Portuguese wines was held at Berlin, and the author examined some specimens shown at this exhibition. As regards the method of analysing these wines, the percentage of alcohol, which on the whole was rather high, was estimated by means of Salleron's apparatus of distillation; tannin by titration with permanganate according to Loewenthal. The acid was calculated as sulphuric acid. The determination of colour and its intensity was performed by means of Salleron's "vinocolorimeter." The extract was estimated by means of Hondrat's oenobarometer. The figures obtained were as follows:—

No.	Origin of Wine.	Designation of Wine.	Specific Gravity.	Alcohol Volume Per Cent.	Colour.	Intensity of Colour.	The Wines contained in Grms. per Litre.				
							Extract.	Tannin.	Acid.	Sugar.	Ash.
1	Castello de Paiva...	Red table-wine	0.9940	11.00	1" violet-red	133.5	24.200	0.154	4.994	0.930	2.760
2	Sever de Vouga ....	..	0.9920	10.50	1" red	172.5	24.900	0.462	5.159	0.940	2.920
3	Anadia	Ordinary red wine	0.9900	13.95	Red	152.0	26.045	0.330	3.698	1.030	3.108
4	..	..	0.9940	13.90	5" violet-red	141.5	27.210	0.880	5.936	1.390	2.800
5	..	..	0.9940	12.90	Red	255.0	24.690	0.220	4.617	1.170	2.580
6	Cantanhede.....	..	0.9900	13.90	Red	221.0	25.480	0.504	4.994	0.712	3.348
7	..	..	0.9950	15.00	5" violet-red	148.0	34.740	0.330	6.031	0.620	2.800
8	..	..	0.9960	10.95	5" violet-red	168.0	23.480	0.220	5.300	0.861	2.720
9	..	Ordinary white wine	0.9900	14.00	White	..	22.000	0.154	5.819	2.670	2.960
10	..	..	0.9940	16.00	White	..	28.700	0.264	4.806	4.710	2.816
11	Celorio da Beira ..	Ordinary red wine	0.9890	14.30	1" red	449.0	19.300	0.154	4.712	0.659	2.320
12	Fornos do Algodres	..	0.9920	14.40	5" violet-red	240.0	25.500	0.440	4.358	0.917	2.480
13	Adriano Tavares Segurao.	..	0.9920	14.40	1" violet-red	167.0	23.000	0.396	4.452	1.767	2.360
14	Mangualde* .....	..	0.9920	13.30	4" violet-red	112.0	21.760	0.176	4.429	1.100	3.380
15	Oliveira do Hospital	Red table-wine	0.9910	13.00	5" violet-red	148.0	22.400	0.506	5.159	0.724	3.480
16	Nellas*	White sparkling	0.9850	16.30	Amber	..	20.34	0.000	4.735	2.250	1.680
17	..	Ordinary red wine	0.9890	14.40	4" violet-red	..	24.28	0.572	4.335	0.952	3.080
18	Penacova	Red table-wine	0.9900	13.00	3" violet-red	127.0	22.80	0.396	3.651	0.642	2.810
19	..	White table-wine	0.9860	14.30	Pinkish	..	16.40	0.154	4.617	1.020	2.340
20	..	Strong red wine	0.9900	14.00	5" violet-red	236.0	22.40	0.132	4.547	0.755	2.480
21	Penalva do Castello.	Ordinary red wine	0.9900	14.70	1" violet-red	122.0	23.00	0.572	3.699	1.000	2.840

* Sparkling wine.

—S. H.

Fig. 2.



B is an air heating chamber in which the air employed for dessication is heated by the steam pipes *m m*, and supplied to A through sliding openings in E. Q is the charging door. J J a moveable partition which slides down when Q is opened so as to prevent the escape of hot air from the back part of the dessicating chamber. The articles to be dried are placed on trays, R, suspended to the pitch chains running round the chain wheels mounted on the vertical spindles *e e*; the bevil wheels, *o o*, rotate these pitch wheels and the chains carry round with them the trays R. The hot air charged with the moisture extracted escapes by the outlet C, regulated by the damper *l*. The steam used in the heating pipes, *m m*, is supplied by the small boiler M placed below the whole apparatus.—C. C. H.

(B)—SANITARY CHEMISTRY.

Water Softening. G. E. Davis. Chem. Trade J. 4, 306—307.

THE author recommends that water used for boiler purposes should be so treated before entering the boiler that all formation of scale shall be prevented, and deprecates the use of substances which merely prevent the scale from adhering to the boiler. As an example of how various precipitating agents may be used in conjunction with one another, a water which contained 5.2 grs. of calcium carbonate, 24.3 grs. of calcium sulphate, 0.15 grs. of magnesium sulphate, 4.27 grs. of magnesium chloride, 17.27 grs. of magnesium nitrate per gall., was treated with a mixture of 17 grs. of caustic soda (77 per cent.), 17 grs. of sodium carbonate, 5 grs. of tribasic phosphate of sodium, with the result that of 12.9 grs. of lime only 0.78 grs., and of 6.6 grs. of magnesia only 3.78 grs. remained to enter the boiler, and this at a cost of 3½d. per 1,000 galls. The precipitate amounted to 25 tons semi-dry sludge (or 9 tons dry) from 5 million galls. of this water per week.—J. W. L.

PATENTS.

An Apparatus for Precipitating Inorganic and Organic Matter held in Solution or Suspension in Liquids, and for Purifying and Clarifying the Liquid afterwards, and for Treating the Precipitate. F. R. Lipscombe, London. Eng. Pat. 6405, April 30, 1888. 8d.

THIS specification describes several devices employed in the purification of water. (1.) The admission and regulation of the reagent used and its mixture with the water operated upon; this is accomplished by means of a reaction wheel or "Barker's Mill," worked by the incoming water, and admitting, by means of a tap in the case of liquid, or a plug in the case of solid, the measured quantity of reagent. (2.) A device for mixing the reagent with water when employed as a liquid, such apparatus being somewhat similar to that described under head (1). (3.) A form of

filtering, clarifying and settling arrangement for arresting the matter precipitated. (4.) An apparatus for treating and pressing the water from the precipitate, delivering it as a solid cake, enabling it to be recovered and used in a subsequent operation.—C. C. H.

Improvements in Means for Expelling Liquid from, and Compressing Sewage, Sludge, and other Semi-fluid or Plastic Substances. J. Price, London. Eng. Pat. 8491, June 9, 1888. 6d.

A MOUND made of wood, metal, or any suitable material strong enough to resist considerable pressure, provided with a perforated bottom, which may be packed on the under side with sponge, tow, or other soft substance, is placed upon a bed plate covered with suitable textile fabric. The interior of the mound is filled with the substance operated upon, and a plunger fitting the mound is then driven down with sufficient force to expel the water present, and pressure may be further continued to compact the residue into a solid mass.—C. C. H.

Improvements in or Connected with Apparatus for Purifying Water. A. Howatson, London. Eng. Pat. 10,098, July 11, 1888. 8d.

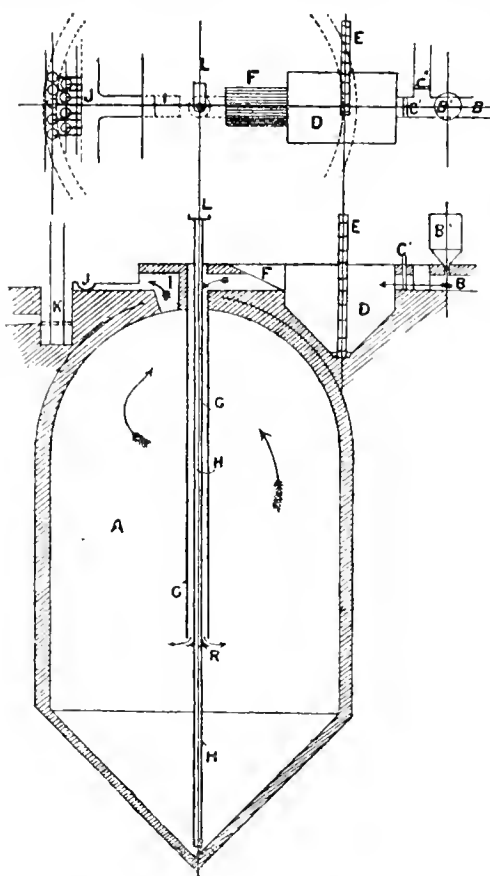
THE apparatus specified consists of a head tank for regulating the flow of the water; beneath this a reagent tank divided into two compartments, in which lime or other reagent may be dissolved; a receiving channel into which the water and reagent flow and mix simultaneously, and from which, by means of a pipe, it is conducted into a large settling tank below the whole, where settlement of the precipitated matter occurs. The upper part of the last-named tank is provided with a bed of filtering material through which the purified water ascends and which arrests any remaining suspended particles, and finally leaves the upper part of the settling tank by an overflow pipe.—C. C. H.

Improved Means for Clarifying, Purifying, Disinfecting, and Utilising Sewage and other Foul or Waste Waters. H. Wollheim, London. Eng. Pat. 15,321, October 24, 1888. 6d.

THE sewage is treated with milk of lime to which has been previously added, when freshly prepared, trimethylamine or an isomer; "a very soluble gas is evolved and is retained in the solution with very great tenacity." The gas so dissolved entirely destroys "every species of micro-organism occurring in sewage and other foul or waste waters." About 0.5 grm. of quicklime is used per litre of sewage, and to every volume of milk of lime equal to the treatment of 1,000 litres of sewage 0.25 grm. of trimethylamine is added.—C. C. H.

Improvements in Treating Sewage and in the Construction and Arrangement of Means therefor. H. Guthrie, Manchester. Eng. Pat. 4058, March 8, 1889. 8d.

This specification describes an improvement in the shape of the precipitating vessels used in the defecation of sewage.



B is the main sewage channel into which the hopper B¹ delivers the requisite quantity of any reagent. D is a settling tank or "débris tank" in which the larger and heavier impurities are deposited, and removed continually by the bucket wheel E. F is a strainer through which the sewage passes on its way to the conical tank or basin A, overflowing therefrom at I and conducted by channel J into suitable filters K. The sludge is deposited in the conical part of A and removed therefrom by the pipe H and pump L.—C. C. H.

(C)—DISINFECTANTS.

PATENTS.

Improved Means for Preserving Articles of Food. A. Poehl, St. Petersburg, Russia. Eng. Pat. 10,901, July 27, 1888. 6d.

The patentee finds that when salt is used for the preservation of articles of food it has more "anti-fermentive than anti-bacterial action;" certain bacteria even develop active properties in a concentrated solution of salt. On the other hand, certain ethereal oils, e.g., mustard, cinnamon, and clove, restrict considerably the activity of bacteria. He therefore proposes to use one or more parts of such an ethereal oil in conjunction with ten to twenty-five thousand parts of salt solution, and so secure "a perfect antiseptic action."—C. C. H.

A New Reagent for Disinfecting, Preservative, or Remedial Purposes. H. Wollheim, London. Eng. Pat. 16,242, November 9, 1888. 6d.

THE new reagent is "a very soluble gas," which is produced when milk of lime or other alkali acts upon trimethylamine or isomers thereof. The gas so evolved is capable of destroying in a very short space of time "the vitality of all germs and spores which can induce chemical change or disease."—C. C. H.

An Enamel or Paint having Disinfecting Properties. L. E. Andés, Chur, Switzerland. Eng. Pat. 5792, April 4, 1889. 6d.

See under XII., page 553.

XIX.—PAPER, PASTEBOARD, Etc.

New Microscopic Method of Testing Paper. F. von Hömel. Mittheil. des K. K. Tech. Gew.-Museums, 1889, 1—9.

THE microscope is generally used in the determination of the nature and amount of the different fibres composing a sample of paper, tests being made in the ordinary way for the weighting materials, size, and colouring matters.

For testing microscopically, the fibres may be conveniently grouped into—

1. Linen, hemp, and cotton.
2. Wood-cellulose, straw-cellulose, and esparto.
3. Ground wood-cellulose and jute.

According to the German official directions, the sample of paper to be tested is steeped in a solution of 1·15 grms. of iodine and 2 grms. of potassium iodide in 20 cc. of water, and then examined under the microscope. It is stated that, after this treatment, the fibres of group 1 are stained brown, those of group 2 are not coloured, whilst the strongly lignified fibres of group 3 are coloured yellow. But it is found that this method is very defective, the cellulose of group 2, for example, being invariably to some extent stained, whilst the members of group 1 are so deeply coloured that it is impossible to distinguish their structural characters. After many experiments, the following method was found most satisfactory. The paper is placed on the object glass of the microscope and treated with iodine solution, the unabsorbed iodine removed by means of filter-paper, and the paper covered with sulphuric acid of a strength found by experiment most suitable. The solution of iodine in potassium iodide should be of such a strength that a layer of 3 cc. thickness should be of a ruby-red colour and quite transparent. The various fibres, after being boiled with dilute potassium hydrate, and washed, gave, on testing by this method, the following results:—

1. Cotton, linen, hemp, bleached jute, China grass, and mulberry fibre take a red-violet or wine-red colour, the inner portions of the fibre being stained yellow. Patches or stripes of a dirty yellowish colour are seen on hemp.
2. Well bleached wood-cellulose and ordinarily bleached straw-cellulose are coloured grey-blue or pure blue without any tinge of red.
3. Unbleached or imperfectly bleached wood- and straw-cellulose absorb very little iodine, and remain colourless, at least in parts, or take a pale bluish colour.
4. Maize and esparto are coloured partly blue, partly red-violet, the real fibre being coloured red-violet.
5. Strongly lignified fibres, such as raw jute and ground wood-cellulose, are coloured yellow.

When sulphuric acid, of rather greater strength than that which is most suitable for general use, is employed in the testing, the fibres of group 1 are coloured red-violet, whilst those of groups 2, 3, and 4 are coloured entirely blue. After acting for two minutes with cold dilute nitric acid on the different fibres, the members of groups 3 and 4 absorb iodine freely, and are coloured blue with sulphuric

acid, the same treatment being without effect on the fibres of group 1; ground wood-cellulose and raw jute are stained yellow by the nitric acid, the colour being deepened by the subsequent treatment. The presence or absence of esparto in a sample of paper should be ascertained by a preliminary examination; in absence of this fibre, the foregoing method gives reliable results. Esparto is seldom or never present in German papers. The method given above only refers to white papers, the raw fibres and common papers not having undergone a bleaching process, give somewhat different results.—E. B.

Economy in Paper Making. G. E. Davis and P. Duxbury. Chem. Trade J., 1889, 274—275.

THE authors discuss the question of the economical recovery of the waste soda liquors from paper mills by the Porion system of evaporation. They also give the results of experiments made with a view of ascertaining what amount of soda could be recovered from liquors in which esparto had been boiled on the laboratory scale. For this purpose 77 grms. of esparto were boiled for five hours at 60 lb. pressure with 10 grms. of 77 per cent. caustic. The liquors which drained away yielded in evaporation and incineration 67 per cent. of the total alkali taken; the first wash yielded a further quantity of 11 per cent., and the second wash 2 per cent. The resulting pulp was dried and burned; the ash yielded 0.56 per cent. of the total alkali in the soluble form, and 5.00 per cent. insoluble. The total soda actually accounted for amounted to 85.56 per cent.—E. J. B.

PATENTS.

Improvements in Methods and Processes for Treating "Bauhinia Vahlia" and other like Fibrous Materials, and in the Application thereof to the Manufacture of Fibrous Sheets, Panels, Slabs, or Blocks suitable for various Useful and Ornamental Purposes. E. Brasier, London. Eng. Pat. 7350, May 17, 1888. 6d.

THE "Bauhinia Vahlia" or other suitable fibrous material after breaking and decorticating, is converted into pulp and is then made into webs of paper in the usual manner. Several of these webs can be joined together so as to produce slabs of any desired thickness, and they can also be treated with fire- and waterproofing solutions. In some cases wire gauze is laid between the sheets to give additional strength. The pulp may also be pressed in moulds of any desired shape.—E. J. B.

An Improvement in Discharging Excess of Bleaching Agent from Paper Pulp after Bleaching. A. Boake and G. A. Roberts, Stratford. Eng. Pat. 8840, June 16, 1888. 4d.

SODIUM metasilphite is added to the pulp, preferably immediately after the bleaching has been effected, until it is found, on testing, "that the required discharge of the excess of bleaching agent has been arrived at."—E. B.

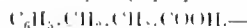
Improvements in the Treatment or Preparation of Paper, Cardboard, Paper-pulp, Papier Maché, and other Fabrics and Metals, to Render the same Imperious to the Action of Acids, Water, Air, Mineral Oils, and other Liquids or Gases. C. D. Aria, London. Eng. Pat. 8981, June 19, 1888. 6d.

THE material is coated or impregnated with a solution of gutta-percha in bisulphide of carbon mixed with shellac dissolved in spirits of wine.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Report on New Drugs and Fine Chemicals. Merck's Bull. 2 [1].

Hydro-cinnamic acid (β-phenyl propionic acid)



THIS substance is presented in the form of acicular, reddish-white crystals, but slightly soluble in water, soluble in six parts of alcohol, and possessing a slightly acid reaction. The alcoholic solution has a pleasant acid taste and an aromatic odour. This solution has been found very valuable in cases of phthisis.

Monobrom-camphor, $\text{C}_{10}\text{H}_{15}\text{BrO}$, forms colourless prisms, permanent in the air and light and possessing an odour both of camphor and of oil of turpentine. Melting point 77° C., and boiling point 274° C. It is insoluble in water, but little soluble in glycerol, easily in alcohol, fatty and ethereal oils, ether, carbon bisulphide, and chloroform.

Stevenson (*Med. Press and Circular*, 1888, October 24) reports that since 1871 he has used monobrom-camphor as a sedative in cases of epilepsy, hysteria, &c. It is found best to use the substance in combination with belladonna.

Cannabine Tannate.—This is an amorphous yellowish or brownish powder, of very faint cannabine odour and slightly bitter, but strongly astringent taste. It is but little soluble in water, alcohol, or ether, more so in acidulated water (very dilute hydrochloric acid), and readily in acidulated alcohol. As a hypnotic, the efficacy of which as well as general value, exceed those of morphine or chloral hydrate according to Prior, Vogelsang, and Mendel, it is generally administered in quantities varying from 0.25 to 0.5 gram.

Cresol salicylates (the ortho-, meta-, and para-compounds) $\text{C}_6\text{H}_3(\text{OH})(\text{CO}_2\text{OC}_6\text{H}_4\cdot\text{CH}_3)$. All the homologous monohydroxylic phenols and many of their derivatives are more or less related in their chemical action on animal life; they are all endowed with some antiseptic, antizymotic, bactericidal, or antipyretic powers. Prominent among those practically applied for such uses in medicine and surgery are especially the initial member of the phenol series, carbolic acid, and also thymol.

Among the dihydroxylic phenols and their derivatives are some very important remedial substances, similar in their capacities to the foregoing. These are resorcinol, guaiacol, quinol, eugenol, safrol, &c.

The peculiar physiological properties of certain organic acid esters of the compound class (esters) formed from various phenols, have attracted during late years much attention. Special success as remedial agents has attended two of these compounds, viz., the *salicylates of phenol* and of *β-naphthol* ("Salol" and "Betol"). Their eligibility for internal *antisepsis* is believed to be dependent on the fact that whilst inert in the stomach they become active in the intestines, no dissociation occurring in contact with the acid gastric fluid, but decomposition taking place into a phenol and salicylic acid, so soon as they reach and are reacted upon by the alkaline intestinal fluids. Nencki, the originator of both salol and betol, has now prepared compounds analogous to these from the three cresols, viz., *ortho-, meta-, and para-cresol salicylate*. These are all crystalline, insoluble in water, with difficulty soluble in alcohol, and possessed of an agreeable odour like that of salol. The *ortho-compound* melts at 35° C., the *meta-* at 71° C., and the *para-compound* at 39° C. The *ortho-compound* produces a slight burning sensation on the tongue, whilst the *para-compound* is without taste. The dissociation of these three substances in the animal economy is not only and entirely through the action of the pancreatic fluid, but is in part delayed and accomplished through other organs when these substances have already entered the circulation, as, for example, in the muscles. Their antiseptic action is the same as that of salol, and

Nencki considers them more eligible than salol in cases where the intestinal tract is to be treated by an agent at once antiseptic and innocuous.

Mercury-β-naphthol Acetate.—This most recent mercury compound has been recommended by Bombelon (Pharm. Zeit. 98) as an excellent substitute for corrosive sublimate and iodoform for the dressing of wounds and for internal administration in syphilitic affections. It is a heavy, amorphous, white powder, insoluble in ordinary solvents. It is presented as a preparation in a 1—2 per cent. mixture with natural quartz powder (Kieselguhr), or by means of gauze, or, triturated with fresh albumen, which mixture is then shaken up with water to form an emulsion.

Narcaine Meconate ("Mecon-narcaine"), narcaine being a non-acid base and meconic acid a dibasic acid, the inference would be that a neutral narcaine meconate must contain two molecules of narcaine and one of meconic acid. When the attempt is made to form the compound thus, the solution is found to crystallise at first in yellow needles, and then in white scales gathering into globular aggregations. The yellow needles are found to be richer in meconic acid than the white scales. The product is consequently not homogeneous. But a perfectly homogeneous product is obtained by uniting 1 mol. each of meconic acid and narcaine.

The narcaine meconate thus formed is of a lemon-yellow colour, tolerably soluble in boiling water, slightly in strong alcohol, and most readily in 50 per cent. alcohol. It melts with decomposition at 126° C., the temperature at which the previously described salt also melts, and with which it appears to be identical. The reaction of true narcaine mono-meconate is acid like that of all the narcaine salts, even the normal ones.

Santonin, Santoninic acid, Sodium santoninate.—It is singular that the internal use of sodium santoninate induces a partial colour-blindness along with other visual phenomena. This has been investigated and reviewed by Dr. H. König (Nature, 1889, 408). It is a well-known fact that persons under the influence of santonin toxication see all objects as if through a yellow medium. Dr. König finds that the visual power of recognising the ulterior portion of the blue and the entire extent of the violet of the solar spectrum is entirely abolished for the time being, whilst the point of neutrality is situated at the rare length of 573, this being the exact complementary point of the suppressed violet. König infers that the visual phenomena occasioned by the ingestion of sodium santoninate do not constitute actual violet-blindness, the retina or optic nerve being affected, but that the rays of violet light are, during the santoninic toxical condition, simply absorbed by certain of the media of the eye, which have been abnormally, and of course only temporarily, affected in that direction by the drug.

Anisic Acid (Methyl ether of *p*-hydroxybenzoic acid), $C_6H_4(OCH_3)COOH$.—This monobasic acid crystallises in colourless, monoclinic prisms, melts at 180° C., and sublimes without decomposition at or about 280° C. It is very little soluble in cold water, but quite readily so in alcohol.

Antonio Curei (Deutsche mediz. Zeit. 1889, No. 12) has made numerous physiological experiments on animals with this acid. He recommends its use as follows:—

1. As an antiseptic, and in the treatment of wounds and lacerations. Thus used, he finds it equally efficacious with salicylic acid.
2. As an antipyretic, if we except articular rheumatism, it is expected to act more intensely and harmlessly than salicylic acid. Anisic acid reduces temperature without depressing the action of the heart, sustains the augmented blood-pressure, does not impair nutrition, and induces no gastric disturbance. For this internal use, indications point to sodium anisate as an eligible form for communicating the acid.

Sodium Anisate, $C_6H_4(OCH_3)CO.ONa$, is crystallisable and readily soluble in cold water. It may safely be given in larger doses, and is more easily taken than sodium salicylate.

Imperialine, $C_{35}H_{50}NO_4$. An alkaloid recently discovered by K. Fragner in *Fritillaria imperialis* (this Journal, 1889, 132).—It is a heart-poison, and is probably closely related

to the older alkaloid *Tulipine* discovered by Gerard in *Tulipa Gesneriana*.

Thallium Salts, especially the soluble ones, are highly poisonous, and must not be confounded with thalline or tetrahydroparaquinanisol discovered by Skraup in 1885, and used as the sulphate and tartrate, as antipyretic, antiseptic, and antizymotic, especially in typhus and yellow fever. It is a question whether in the solitary attempt by Pozzi and Courtade (Gaz. Med. de Paris, 1884 (13), March 29) any therapeutic value at all was discovered in it, so easy is it to pass from therapeutic to toxic effects.

Thalline, sulphate and tartrate ($C_{10}H_{13}NO$) $_2$ H_2SO_4 and $C_{10}H_{13}NO.C_4H_5O_6$.—The name of thalline was given as being suggestive of the bright green colour obtained when thalline salts are acted on by oxidising agents. With ferric chloride, e.g., this colour is produced in a solution of 1 part in 100,000 of water.

The sulphate is a yellowish-white crystalline powder, with a cumarin-like odour and an acid-saline, and also bitterish aromatic taste. It melts when heated above 100° C., and is soluble in 7 parts of cold or 0.5 of boiling water and in about 100 of alcohol, slightly so in chloroform and ether. It contains about 76.9 per cent. of the base to 24.1 of the acid.

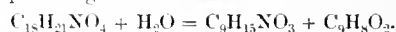
The tartrate resembles in appearance the sulphate. It is less soluble than the sulphate, requiring 10 parts of cold water and several hundred parts of alcohol. It is nearly insoluble in chloroform and ether, and contains 52.2 per cent. of the base to 47.8 of the acid.

It is principally owing to the work of von Jaksch that its salts have gained their position in the *Materia Medica*. —W.S.

The Coca Bases. O. Hesse. Ber. 22, 665—671.

Two kinds of coca leaves are found in commerce, the one obtained from *Erythroxylon coca*, which was the original trade product, and the other, which appeared later, derived from Jamaica and St. Lucia. The latter has been used in North Germany for the preparation of coca. The author obtained from this variety the substance which is named cocaine. This is a base which may be obtained in crystals by treating with acetic acid and precipitating with ammonia. It has the formula $C_{19}H_{23}NO_3$, and combines with one molecule of hydrochloric acid. Both the base and hydrochloride decompose on heating, the former yielding methyl alcohol and the latter methyl chloride. The residue left by the decomposition of the hydrochloride is cocainelegonine, $C_{18}H_{21}NO_3$, and by a secondary reaction a small quantity of cocaine acid.

If the hydrochloride be boiled with hydrochloric acid it is split up into eugonine and cocaine acid—



This acid is identical with γ -isotropic acid of Liebermann. A second acid is also present, but the quantity is too small for analysis. It is separated from the cocaine acid by the insolubility of the lime salt. Cocaine acts physiologically like cocaine, but rather weaker. The anaesthetic action is particularly weak. The action of γ -isatropylcocaine is, according to Liebreich, of an entirely different character, being a strong poison. If the crude coca bases are fractionally precipitated and dissolved in ether and the ether evaporated a syrupy residue remains, which, after maintaining for some time at 60°, no longer dissolves completely in acids. The insoluble portion dissolves in ammonia, and is precipitated by barium chloride. This new substance may be purified by fractional precipitation. Boiled with dilute acids it yields a new acid, which has not been further investigated, and eugonine. The substance itself has the formula $C_{18}H_{19}NO_4$. The author calls the acid cocaineic acid, and the substance cocainelegonine, and methylated cocainelegonine, cocaineamine corresponding to cocaine. The brownish-yellow oil obtained by the action of hydrochloric acid upon the so-called isatropylcocaine (this Journal, 1889, 305) is probably cocainelegonine, which is formed from the cocaineamine present. This is probably

the reason that Liebermann's base has poisonous properties. The solution from which the cocaine is separated contains a mixture of bases, which, when treated with hydrochloric acid, yield ecgonine, an oily non-volatile base and hygrin, and the following acids, coccic acid, cinamic and benzoic acid. The author concludes that the amorphous bases in the genuine coca are the benzoyl compounds of an oily non-volatile base and cocaine; but that other coca varieties consist of cocaine and the cinamyl compound of the oily base, and that cocerylamine accompanies both. Both bases yield hygrin.—J. B. C.

The Coca Base. C. Liebermann. Ber. 22, 672—675.

THE paper is a criticism on the foregoing investigation of Hesse, in which the author maintains the correctness of his former researches on the alkaloids accompanying cocaine.

—J. B. C.

Hygrin. C. Liebermann. Ber. 22, 675—679.

To prepare the pure material, the crude product was dissolved in ether, separated from water and allowed to stand over solid potash. The ethereal solution was then poured off and distilled in vacuo. The oil was fractionated. One portion boiled at 128—131° under a pressure of 50 mm., and another at 215° under the same pressure. Both bases differ in so far from Hesse's analytical results, that they contain oxygen, whereas Hesse's hygrin has the formula $C_{15}H_{15}N$.

The lower boiling base boils at 193°—195° under ordinary pressure, and the analysis and vapour density corresponds with the formula $C_{15}H_{15}NO$. It forms salts and a picric acid addition product. The higher boiling substance cannot be distilled at the ordinary temperature without undergoing decomposition. From a series of analyses of the free base and various salts it appears to have the composition $C_{14}H_{12}N_2O$. Neither base is decomposed by heating with conc. hydrochloric acid to 120°.—J. B. C.

Chemically Pure Narceine. E. Merck. Chem. Zeit. 13, 525—526.

As the author has found that the melting point of various preparations of narceine melt as much as 20° above the melting point given by Hesse, he considered it doubtful whether the pure substance had yet been obtained. He obtained a sample melting at 153°, which contained 1.06 per cent. of hydrochloric acid. This amount it obstinately retains and crystallises from water containing free ammonia without losing chlorine. To prepare the pure base the author starts from chemically pure narceine hydrochloride prepared by himself. It melts at 163° with decomposition, crystallises with one molecule of hydrochloric acid, but without water. Treated with water it decomposes yielding the pure base, melting at 170°—171° with decomposition. It possesses a feebly alkaline reaction. It combines readily with acids, absorbing hydrochloric acid if present in the atmosphere, by which the melting point is at once lowered considerably. For therapeutic purposes a good quality of commercial narceine should be free from meconine, and when free from acid should not melt under 165°. Chemically pure narceine is free from acid, and melts not below 170°.

—J. B. C.

Hydrargyrum Oleicium. A. P. Brown. Amer. Pharm. Journ. 1889, 168.

MERCURY oleate is best prepared by triturating 240 grms. of fine white soap powder and 98 grms. of finely-powdered mercury bichloride with a little water. The pasty mass is boiled with water until an oily yellow liquid is formed, which is cooled and thoroughly washed with distilled water. The excess of moisture is driven off on a water-bath. The product mixes well with fats and lanolin.—G. H. B.

On "Exalgine." G. Bardet. Nouv. reméd. 1889, 5, 197.

THE author corrects a former statement made by himself and Dujardin-Beaumetz (this Journal, 1889, 412) that "exalgine" is orthomethylacetanilide. "Exalgine" is methylacetanilide, of which an ortho-compound does not exist. He states that antiseptic properties are exhibited chiefly by the hydrated aromatic compounds, like the phenols, naphthols, and "oxyphenols"; whilst the amido-compounds, like kairin, thallin, and their acetyl derivatives mostly exhibit a cooling action, which is shown most powerfully in those amido-compounds in which a hydrogen atom is substituted by a hydrocarbon radicle of the fatty series, and especially by the methyl group. The author confirms his opinion that "exalgine" is a harmless anodyne, which acts extremely well in small doses in neuralgia and diabetes.—G. H. B.

Work of the Pharmacopœia Commission of the German Society of Apothecaries. Arch. Pharm. 1889, 27, 337.

Bitter Almond Water.—To test the proportion of prussic acid, 10 grms. of the liquid are treated with 1 cc. of decinormal silver solution and a few drops of nitric acid, and filtered. The filtrate must give no immediate precipitate with silver nitrate. This test permits the presence of the small quantity of free prussic acid which may result from the decomposition of benzaldehyde during the distillation.

Chlorine Water.—A volumetric determination must show at least 0.4 per cent. of chlorine.

Distilled Water.—100 cc. treated with 1 cc. of zinc iodide starch solution and dilute acid must give no colouration in 10 minutes (nitrites). 100 cc. treated with 1 cc. of dilute sulphuric acid and 0.5 cc. potassium permanganate solution must keep the red colour a long time, and must not be quite decolourised even on boiling (organic matter).

Ereosote.—The specific gravity must not be under 1.07, whilst the present pharmacopœia allows 1.03. The alcoholic solution must give a deep blue colour with a little ferric chloride solution. Mixed with 10 volumes of alcoholic caustic potash (1:5), the ereosote must congeal after a short time to a firm crystalline mass. An admixture with phenols would retard the solidification. 1 cc. of ereosote shaken with 2 cc. of petroleum spirit and 2 cc. of baryta water must give no dirty or blue colour to the petroleum, or red colour to the aqueous layer (pyrogallie ethers from beech tar).

Oil of Carraway.—The higher boiling portion of carraway oil—the carvol—of sp. gr. 0.96 must be employed. 8 drops of the oil must dissolve to a clear liquid in a mixture of 2 cc. of alcohol and 1 cc. of water.

Oil of Clove.—The specific gravity of 1.041 is increased to 1.05 or 1.06. 5 drops of the oil shaken well with 10 cc. of lime water must separate in flocks, which tend to stick to the sides of the vessel.

Oil of Cinnamon.—1 drop well shaken with hot water and mixed with lead acetate may give a white turbidity, but no yellow precipitate, as would be produced if oil of clove were present.

Croton Oil.—Sp. gr. 0.94—0.96. Soluble in two volumes of hot absolute alcohol. An elaidin test is used to detect admixture with non-drying oils, and Hübl's test for the presence of drying oils.—G. H. B.

The relation of the Caustic Action of Carbolic Acid to the Solvent. P. Carles. Journ. Pharm. Chim. 1889, 19, 425.

A MIXTURE of 30 grms. of pure neutral glycerol with 5, 10, 20, and even 30 grms. of chemically-pure carbolic acid may be placed on the skin without causing irritation. But if the glycerol contain water, the mixture is unbearable on the skin. Further examination of this phenomenon showed that the caustic action of pure carbolic acid is greatly reduced by solution in pure glycerol or strong alcohol so long as no water is added. In cases of burns caused by

strong carbolic acid, it would therefore be better if strong alcohol were used instead of water to remove the acid from the skin.—G. H. B.

PATENTS.

An Improved Process for Extracting Moisture and Volatile Bodies from Animal, Vegetable, and Mineral Substances. O. C. Hagemann, London. Eng. Pat. 6851, May 8, 1888. 6d.

THE object of this invention is the elimination or extraction of moisture or volatile bodies from the substances specified, so as to secure their preservation in some cases, and in others in order to obtain the volatile bodies themselves. This is effected in a closed chamber by means of a suitable gas or vapour, having no action upon the substances themselves, but acting as a carrier for the said moisture and volatile bodies. The moisture or volatile bodies carried away may be removed from the gaseous medium by absorption in any suitable liquid or absorbent material.—C. C. H.

Improvements in Medicine for Human Use. H. G. Noakes, London, E. J. Tucker, Catford, and D. Clark, London. Eng. Pat. 8869, June 16, 1888. 6d.

THE patentees propose to mix any drug or drop, in suitable quantities, with chocolate, which may, if requisite, be flavoured with essential oils or essences, so as to conceal any obnoxious flavour or taste. The mixture may be divided into tablets of such a size that each shall contain a proper dose of the drug.—C. C. H.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

PATENT.

Improved Bath with Circular Flow of Water, for Washing Photographic Pictures. W. Rooke, London. Eng. Pat. 838, January 16, 1889. 8d.

IN this invention, "the main feature is to cause a swilling action of the water upon, or against, or between the photographic prints or negatives under operation, and said photographic pictures or negatives can be placed in and removed without interfering with the inflow and outflow of water." For details of the apparatus, the specification must be consulted.—O. H.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENT.

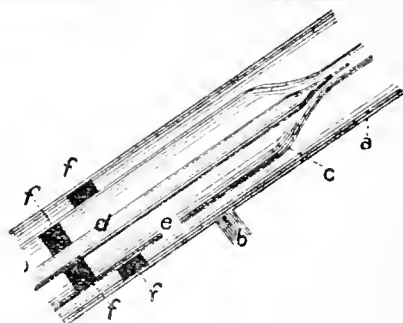
Improvements in Explosives for Use in Fire-Arms. T. G. Hart, London. Eng. Pat. 9164, June 23, 1888. 6d.

THIS invention relates to a form of gunpowder consisting of compressed chlorate of potassium, granulated, and permeated "with a saccharine solution, or other suitable hydrocarbon liquid."—C. N. H.

XXIII.—ANALYTICAL CHEMISTRY.

An Improved Gas Blowpipe. M. Lange. Chem. Zeit. 13, 660.

THE plan advocated consists in mixing the gas and air previous to their reaching the mouth of the blowpipe. This can be effected by means of the apparatus shown in the accompanying figure, in which *a* is the outer tube conveying



the gas which enters it at the side tube *b*, *c* an inner tube concentric with *a*, and communicating with the annular space between them by means of the opening *e*, and *d* a narrow inmost tube for the blast of air, placed in such a position with regard to *c*, and having a jet so shaped as to act as an injector, and draw the gas from *a* to *c*, and thence on to the mouth. The parts marked *f* merely represent rings to support the tubes in the proper positions relative to each other.

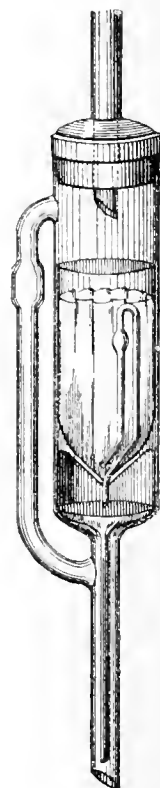
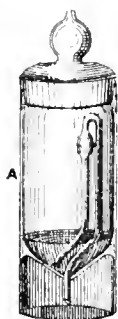
Another method of achieving the same result is that of dispensing with the use of gas, except as a small "pilot jet" to avoid the necessity of relighting the blowpipe every time it is used, and passing the air through a vessel filled with some porous material which is repeatedly soaked with petroleum spirit from a tap-funnel. The proportions of air and inflammable vapour can be regulated by providing an alternative path for the air to the blowpipe without passing through the carburetting vessel.—B. B.

Apparatus for the Extraction of Fat. R. Fruehling. Zeits. f. angew. Chem. 1889, 242—243.

THE apparatus consists in a modification of the well-known Soxhlet apparatus, and it is claimed for the new form that that part which holds the sample to be extracted allows of a very convenient handling on weighing before and after the extraction. Fig. 1 represents the portion for the

Fig. 1.

Fig. 2.



reception of the sample. It is provided with a syphon, the longer leg of which passes through the bottom, where it is cut off aslant. The sides of the vessel A, which has the well-known form of a filter-drying tube, are continued beyond the bottom, to allow of its being placed upright on the pan of the balance. The other part of the apparatus, shown in Fig. 2, serves for the reception of the tube A, and has the customary form of a Soxhlet apparatus without the syphon-tube. Its application will be readily understood from the diagrams.—S. H.

A convenient Method of making Chromic Chloride. A. Vosmaer. *Zeits. Anal. Chem.* **28**, 324.

THE writer has made Cr_2Cl_6 by passing chlorine over ferro-chrome (containing 21 per cent. of Cr) heated in a glass combustion tube. Chromic chloride, ferric chloride, and manganous chloride (MnCl_2) are formed, and can be easily separated in the combustion tube as ferric chloride is much more, and manganous chloride much less, volatile than Cr_2Cl_6 .

If the tube be allowed to become plugged, ferrous chloride, which is difficult to volatilise, is formed.

The chromic chloride made in this way is obtained in long violet needles which are quite insoluble in water.

Ferro-tungsten, treated in the same way, did not yield tungsten hexachloride (WCl_6), but a mixture of scarlet needles of tungsten monoxytetrachloride (WOCl_4), and yellow tungsten dioxychloride (WO_2Cl_2).—H. S. P.

Boric Acid as a Plant Constituent. C. A. Crampton. *Amer. Chem. J.* **11**, 227—232.

THE author has found boric acid in a large number of samples of wine, also in the ash of a number of samples of water-melon vine fruit. In the ash of apples, Oregon sugar-beet, Louisiana sugar-cane, and cider, boric acid could not be detected. Other chemists, Baumer (this Journal, 1889, 130), Rising (Bull. Chem. Div. U.S. Dept. Agric. **19**, 38), Soltsien (Pharm. Zeit. **33**, 312), Knorr (Pharm. Zeit. **33**, 90), have all observed it as a plant constituent, the first three named chemists having detected it in wines from various parts of Europe and America, whilst the last-named found it in peach trees and fruit. As it has its origin in the soil, this detection of it in fruit grown over such a wide area would show it to be a much more widely distributed element than is generally supposed, and F. W. Clarke of the Geological Survey, United States of America, suggests that possibly soils having granitic origin would be found to contain it, whilst those of limestone formations would probably prove to be destitute of this element.—J. W. L.

A Rapid Colorimetric Method of determining Nitrates in Potable Waters. S. C. Hooker. *Amer. Chem. J.* **11**, 249—258.

THE reaction of Gräbe and Glaser between carbazol and nitric acid in sulphuric acid is the basis of this method.

Iron and chlorine must be absent; if present, the former may be removed by evaporating the water to dryness with excess of alkali and dissolving out the nitrates from the residue; the latter may be precipitated by means of sulphate of silver. The method is applied as follows:—2 cc. of the water are measured into a clean, dry test tube, 4 cc. pure sulphuric acid, sp. gr. 1.84, added, the mixture cooled, and 1 cc. of the carbazol solution added, when a green colouration is immediately formed. This is compared with the colouration produced by solutions of known quantities of nitrate treated exactly in the same way as the water under examination, and indeed at the same time, the colouration altering in intensity the longer it is kept. The solution of carbazol is made by dissolving 0.6 gm. in 100 cc. of acetic acid (99—100 per cent.), and of this solution 1 cc. is mixed rapidly with 15 cc. sulphuric acid, this latter dilute solution of carbazol being made up fresh on the day it is required, while the acetic acid solution remains good almost indefinitely.

The amount of nitrogen as nitric acid which may be operated upon in any determination may vary between 0.03 and 0.40 parts in 100,000, so that quantities either greater or less than these may be successfully determined by either diluting or concentrating the water. The author recommends that the potassium nitrate solution shall contain 0.0004 gm. of nitrogen in 1 cc., and that from this a second solution of $\frac{1}{10}$ the strength be prepared as required.

—J. W. L.

The Detection of Nitrous Acid in Drinking Water. B. Proskauer. *Pharm. Ch. N. F.* 1889, 260.

WITH reference to a recent communication by F. Musset (this Journal, 1889, 420) on the blue colouration produced by bacteria during the testing of a drinking water by zinc iodide, starch, and acetic acid, the author remarks that J. Rahemann has made the same observation. The author considers that a distillation of the nitrous acid may give rise to errors, and recommends testing with *m*-phenylenediamine, or to remove the bacteria by filtration through dense filter-paper before treating with the iodised starch. He also refers to the importance of testing the water samples for nitrates, nitrites, and ammonia as soon as they are received in the laboratory, as these nitrogen compounds are subject to change on keeping.—G. H. B.

On the Detection of Phosphoric Acid of Mineral Origin. J. Stoklasa. *Chem. Zeit. Rep.* **13**, 141.

LORENZ proposed (this Journal, 1889, 307) to take advantage of the fact that phosphates of mineral origin are richer in fluorine than those of animal origin, in testing for mineral phosphates in artificial manures. His test depends on the formation of silicon tetra-fluoride and the decomposition of this with water, whereby silica is deposited.

The author has determined the fluorine, by Fresenius's method, in a sample of spent animal charcoal, and found it to be 0.26 per cent., while that in bone meal was 0.11—0.16 per cent. that in steamed bones was 0.31 per cent., and that in bone ash was 0.57 per cent. Fresh bones, finely ground, did not give Lorenz's reaction, and bone ash only gave it feebly. One per cent. of calcium fluoride added to the ground bones gave a very distinct reaction. Bones which had been buried for 20 years gave much the same reaction as fresh bones, but all fossil bones contain relatively as much fluorine and ferric oxide as mineral phosphates do; in time bones acquire fluorine and iron compounds from clay and humus soils.

Superphosphate made from fresh bones, from steamed bone meal, and from spent animal charcoal did not give Lorenz's reaction, while that made from bone ash gave it feebly, but that made from alluvial bones gave a distinct reaction.

The author concludes that Lorenz's reaction is uncertain, and points out that the origin of the phosphate does not much affect the value of the superphosphate.—A. G. B.

On Capillary Analysis and its various Applications.

F. Goppelsröder. *Mittheil. d. k. k. technolog. Gewerbe-Museums in Wien*, 1888, 86; 1889, **3**, 14.

A VERY extensive treatise on experiments made since 1861 with the object of rendering capillary phenomena useful in analytical practice. In inorganic analysis very small quantities of substances in solution may be detected by the method. For example, natural waters were tested by hanging long strips of Swedish paper, cotton, linen, woollen and silk cloth over and dipping into 40 cc. of the water for 24 hours. When the water contained only a trace of iron, this was shown by a yellowish zone high up on the strip of paper or cloth, on which iron could be identified by touching with dilute acid and potassium ferrocyanide. Waters containing organic impurity give similar zones, which can be distinguished from iron by their passivity to reagents. In organic chemistry and in the examination of colouring matters, the capillary method is especially applicable. Solutions of the alkaloids give rather high-lying zones,

which may be tested by touching with the suitable reagents. A solution of a pure colouring matter will give one or more zones of the same colour, but the presence of even traces of other colours becomes evident by the formation of separate zones. The composite nature of a given dye may thus be detected where other methods of analysis would fail. The coloured zones can be examined with the spectroscope as they stand or in solution made by extracting the colour from any particular part of the strip of paper, cloth, or parchment. Such solution can also be subjected to further capillary analysis. The delicacy of the method is very great. Strips of material dipping a few millimetres into 40 cc. of a solution containing only 0.0000019 gm. of magenta acquired zones more or less coloured in each case. The height of the zones above the surface of the solution varied between 3.5 cm. in the woollen strip and 5.7 cm. in the silk strip, the height on paper being 4.5 cm. The author shows the applicability of the method for the examination of coloured waste waters, food-stuffs, and the various matters concerned in sanitary and judicial chemistry. It is also adapted to the examination of the colouring matters of plants. In concluding his work on capillary analysis, which embraces thousands of experiments, the author treats of the diffusion of colouring matters in plants. The plants were kept with their roots in aqueous solutions of the colouring matters for several days or weeks, and their several parts were then examined. Certain colours were able to penetrate as far as the blossom, but others, such as methylene blue, did not extend far from the root.—G. H. B.

On the Analysis of Gases. C. Winkler. Zeits. Anal. Chem. **28**, 269—289.

This paper deals with the estimation—(1) of carbonic oxide, (2) of heavy hydrocarbons, and (3) of methane.

(1.) W. Hempel has described (Ber. **20**, 2344; this Journal, 1887, 747) the phenomenon observed by K. Markel, viz., that when a volume of gas is brought in contact with a solution of cuprous chloride, for the purpose of absorbing carbonic oxide, the volume of the gas is sometimes increased instead of decreased. Hempel, at first, suggested as an explanation, that cuprous chloride absorbed ethylene and afterwards liberated it when brought in contact with a fresh volume of gas. H. Drehschmidt (Ber. **20**, 2752; this Journal, 1888, 133), however, showed by experiment and by reference to the published work of A. Tamm (von Jüptner, Prakt. Handb. f. Eisenhütten-Chemiker, 243), that this increase of volume might take place in the entire absence of ethylene and other heavy hydrocarbons, and maintained that the explanation was to be found merely in the loose state of combination in which the CO is held by Cu_2Cl_2 . He also pointed out that the phenomenon was more noticeable when a hydrochloric acid solution of Cu_2Cl_2 was used than with an ammoniacal solution, and further, than an ammoniacal solution, after having developed the property of giving up a part of the CO previously absorbed, gradually lost this power, owing to the oxidation of the CO to CO_2 , and the consequent deposition of metallic copper. W. Hempel (Ber. **21**, 898; this Journal, 1888, 403) did not uphold his former statement, but ascribed the phenomenon to the mere physical absorption of the other gases brought in contact with the Cu_2Cl_2 , and their subsequent rendition in presence of a fresh volume of gas. But H. Drehschmidt (Ber. **21**, 2158) clearly showed by further experiment the accuracy of his position; and proved—(1) that an ammoniacal solution of Cu_2Cl_2 is better than a hydrochloric acid one for absorbing CO; (2) that two absorption vessels should be used, the first to absorb the chief part of the CO, and the second to absorb the remainder; after a time the second vessel to be used as a first absorber, and a fresh one used as second; (3) that both acid and ammoniacal solutions of Cu_2Cl_2 , when charged to a certain point with CO, will give up a portion of the CO to fresh gas brought in contact with them. The more CO a solution has absorbed, the more readily it will give it up. By keeping an ammoniacal solution for some time, it loses this property, owing to the formation of carbon dioxide with deposition of metallic copper. (4) That the error due to the physical absorption of

other gases besides CO is very small in comparison with that due to rendition of CO, but that, as stated by Hempel, such absorption does take place is no doubt true.

The author, without quoting figures, states that his experiments fully bear out Drehschmidt's conclusions. He finds that when a solution of Cu_2Cl_2 , either in HCl or in NH_4OH , has been often used to absorb CO, it will give up, if shaken with hydrogen, a volume of CO amounting to as much as 2.3 per cent. of the volume of H used. When a strongly ammoniacal solution is used, it is necessary to wash the gases with dilute H_2SO_4 before measuring the contraction, and the author suggests that perhaps this operation might be avoided by using a weakly ammoniacal solution of Cu_2Cl_2 dissolved in ammonium or sodium chloride. The fact that CO is oxidised to CO_2 in an ammoniacal solution of Cu_2Cl_2 indicates that if a substance could be found to prevent the precipitation of cuprous hydrate from an acid solution of Cu_2Cl_2 by KOH (as sugar, glycerol, and other organic substances, prevent precipitation in solutions of cupric salts), then we should have an absorption medium for CO, which would effect the complete oxidation of the CO with formation of a carbonate, and, in the presence of enough Cu_2Cl_2 , last until the KOH was saturated. Unfortunately such a substance is not yet known.

The author is unable to confirm Leybold's statement (Chem. Zeit. **12**, 1277) that Cu_2Cl_2 which has become somewhat oxidised by the air, gives up this oxygen when it absorbs CO. He thinks Leybold may have been led into error from using phosphorus as an absorbent for the O in coal gas, as the author found no oxygen when he used alkaline pyrogallol.

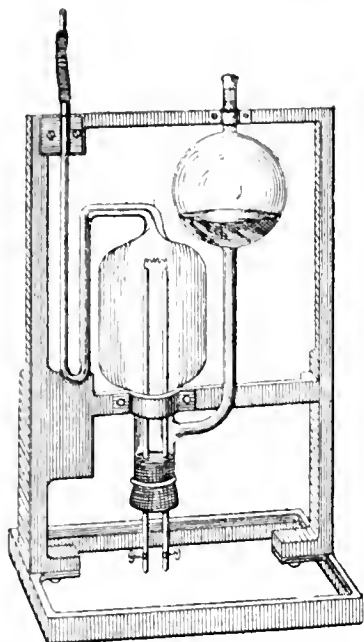
The writer then details experiments upon the behaviour of carbon monoxy-cuprous chloride with solutions of palladium chloride. This salt has no reaction with Cu_2Cl_2 , but if the Cu_2Cl_2 solution contain CO, then under certain conditions a black precipitate of metallic palladium is formed, according to the equation $\text{PdCl}_2 + \text{CO} + \text{H}_2\text{O} = \text{CO}_2 + 2\text{HCl} + \text{Pd}$.

The formation of this precipitate affords a very delicate test for CO. As a result of the author's experiments, he proceeds as follows:—The Cu_2Cl_2 is dissolved in a saturated solution of NaCl, and the gas to be tested is passed through some of this liquid. After the absorption the solution is diluted with four or five times its volume of water, and a drop or two of sodium palladious chloride is then added; if CO be present, a black spot is observed to form where the drop of yellow-coloured palladium salt mixes with the solution. In this way 0.01 cc. = 0.0000125 gm. of CO may be detected. The author has also devised a volumetric method of estimating carbon monoxide, founded upon the fact that when carbon monoxide is passed through a mixture of cuprous chloride, and sodium palladious chloride, both dissolved in saturated NaCl solution, the palladium salt is reduced and the CO oxidised and given off as CO_2 . By absorbing the CO_2 by KOH a contraction is observed equal to the CO present. The method was accurate in the author's hands, but occupies much time, and he does not recommend it.

(2.) The author's experiments on the estimation of the heavy hydrocarbons and of benzene, lead to the following conclusions:—(a.) Fuming sulphuric acid rapidly and completely absorbs ethylene and benzene. It cannot be used to determine their respective amounts when they occur together. (b.) Fuming nitric acid absorbs ethylene nearly, but not quite, as completely as $\text{H}_2\text{S}_2\text{O}_7$. Its action on benzene is somewhat less complete. Moreover, it has an oxidising action on CO, which is so often present in gas mixtures. (c.) Bromine-water acts rapidly, but incompletely, as an absorbent for ethylene; its action on benzene is less rapid and less perfect. (d.) It follows that fuming sulphuric acid is the best absorbent for ethylene and benzene; it cannot, however, be used, in mixtures of these gases, to estimate their respective amounts. As yet, no means of doing this is known. These results are in accordance with those of H. Drehschmidt (Jul. Post, Chem. techn. Analyse, 2 Ed. vol. 1, p. 108), and of F. P. Treadwell and H. N. Stokes (Ber. **21**, 3131; this Journal, 1889, 64).

(3.) The estimation of methane by combustion with air over heated cupric oxide, absorption of the CO_2 thereby

formed, by a standard solution of baryta-water, and determination of the excess of barium by oxalic acid, is a method well suited to the analysis of large volumes of a gas containing but a small quantity of methane, as, for instance, in testing the air of coal mines, but when the gas is rich in methane, as is the case with illuminating and heating gases, the method is tiresome and too long. The writer recommends the following process for gases rich in methane:—Into the neck of the inverted tubulated Hempel pipette (shown in the figure) an india-rubber cork is fitted. Through

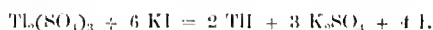


two holes in the cork are passed two varnished brass rods which reach to within 2—2.5 cm. of the upper end of the pipette. These rods are fitted with screws for connecting them with the poles of a battery of two Grove's cells; the ends inside the pipette are united by a spiral of platinum wire about 0.35 mm. thick, the spiral having about six turns formed by wrapping the wire round a needle 1.3 mm. in diameter. The pipette is completely filled with water before the gas to be burned is introduced. Supposing the gas to be tested is a sample of illuminating gas, the CO_2 is first absorbed by KOH , the heavy hydrocarbons by fuming sulphuric acid, the oxygen by alkaline pyrogallol, the CO by an ammoniacal solution of Cu_2Cl_2 . The gas that remains (or a portion of it), consisting of H , CH_4 , and N_2 is then mixed with enough air to burn the H , and the mixture is led over gently-heated platinised asbestos; one-third of the ensuing contraction represents the amount of oxygen that has been consumed. The oxygen still present, due to air, can then be reckoned, and the amount of N due to air is known. The difference, consisting of CH_4 and the N of the gas, is mixed with air so as to contain one vol. of O to two vols. of the residual gas. The battery is then connected with the above-described apparatus, and the mixed air and gas are allowed to slowly enter the pipette until the water with which it was filled leaves the platinum spiral exposed. The spiral then begins to glow, and the combustion of the CH_4 takes place quietly and without explosion. The whole of the gas is allowed to flow slowly into the pipette, and a minute suffices to complete the combustion. But if the gas be introduced too quickly, or if the pipette is first filled with gas, and then the battery connected, an explosion may occur which might blow the cork out. The CO_2 that is formed by the combustion is absorbed by KOH and one-third of the contraction gives the volume of CH_4 . The method is a modification of that used by Coquillon (Compt. Rend. 1877, 84, 458), who employed a palladium spiral and led the gas backwards and forwards over it, combined with a method

by A. Schornidorff, who used an inverted pear-shaped or cylindrical glass vessel filled with water as the combustion chamber. He also allowed the gas to remain quietly in contact with the glowing spiral instead of leading it backwards and forwards over it. The advantage of this is that the wire is not subjected to frequent coolings and the combustion takes place more quickly.—H. S. P.

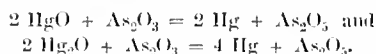
Volumetric Estimation of Thallium and of Mercury.
W. Feit. Zeits. Anal. Chem. 28, 314—322.

The usual way of estimating thallium is by precipitation as thallous iodide. The precipitate takes some time to settle, and, after settling, is collected and dried at 110° — 120° on a weighed filter. The results, although concordant, are too low, owing to the partial solubility of the precipitate of TlI . The author has devised a volumetric method depending upon the liberation of iodine when potassium iodide is added to an acid solution of a thallous salt:—



After the greenish-grey precipitate of TlI and I has formed, the liquid is rendered alkaline with sodium bicarbonate, and sufficient decinormal arsenious acid added. The iodine is thus converted into hydriodic acid, and the precipitate (now consisting of pure TlI), turns to a bright yellow colour. This is separated by filtration, and the excess of As_2O_3 is estimated in an aliquot part of the filtrate by titration with $\frac{1}{20}$ normal solution of iodine, using starch as indicator. It is best to operate on the thallous sulphate. Thallous salts may be converted into the sulphate by heating with sulphuric acid, and the halogen compounds and thallous salts may be converted into the sulphate by adding the requisite quantity of sulphuric acid, and boiling with bromine water. A sample of thallous sulphate containing, theoretically, 81.12 per cent. of Tl (but of which the actual composition cannot be positively determined), gave, by the gravimetric method, 79.52 per cent. of Tl , and by the volumetric 80.18 per cent.

The author's volumetric method of determining mercury depends upon the reactions represented by the equations—



In carrying out the method, the mercury compounds are all brought into solution as mercuric compounds. To the solution more than enough caustic soda needed to precipitate all the HgO is added, then an excess of decinormal As_2O_3 solution is poured in, and the liquid boiled and allowed to stand for 5—10 minutes. It is then cooled, and the precipitate of mercury separated by filtration. An aliquot part of the filtrate is taken, the alkali neutralised with hydrochloric acid, and then, after addition of excess of sodium bicarbonate, the excess of As_2O_3 is determined by titration with $\frac{1}{20}$ normal iodine solution. A sample of pure mercuric chloride, containing 73.80 per cent. of Hg , gave, in five determinations, results varying from 73.73 per cent. to 74.49 per cent. of Hg .

When operating upon the sulphides (which must be dissolved in nitrohydrochloric acid) or upon substances which must be brought into solution with nitric acid, and which contain chlorine compounds, the free chlorine that is formed would combine with the caustic soda afterwards added, producing oxychlorine acid salts, which have an oxidising action on As_2O_3 . The chlorine cannot be expelled by evaporation, as mercury would be thereby lost. To obviate this, after bringing the compound into solution, an excess of sodium bicarbonate is added, and then potassium iodide until the precipitate of HgI_2 redissolves. The separated iodine, which colours the solution yellow, is then converted into hydriodic acid by a few drops of sodium sulphite or arsenious acid. Any slight excess of either of these is next removed by a dilute solution of iodine, using starch solution as indicator, and then the volumetric process as above described may be proceeded with.—H. S. P.

Estimation of Silicon and Iron in Cryolite. R. Fresenius and E. Hintz. *Zeits. Anal. Chem.* **28**, 324—327.

THE authors find that when cryolite is decomposed by heating with sulphuric acid, that nearly all the silica remains as sand, and that only a very small proportion is evolved as tetrafluoride. To obtain the total amount of silica, they effect the decomposition in a U-shaped leaden tube, connected, on the one hand, with a wash-bottle containing sulphuric acid, and on the other, with two smaller U-shaped leaden tubes, which are moistened inside with ammonia. All the connexions are made with india-rubber corks and small lead tubing. The last of the smaller U-tubes is connected with a glass U-tube, trapped with water, which in turn is connected with an aspirator. The decomposition tube is first moistened with sulphuric acid and heated to 260°, which forms a protective coating of lead sulphate inside it. About 5 grms. of cryolite are treated in this tube with 15 cc. of conc. sulphuric acid and heated on a sand-bath to 200° for two hours, while a slow current of air is continuously drawn through the apparatus. The contents of the decomposition tube are then washed into a platinum dish and boiled with water and a drop or two of hydrochloric acid to remove alumina, &c. The residue contains the whole of the silica except a minute quantity that has passed over as silicon fluoride and which is retained in the tubes containing ammonia. This residue is fused with sodium carbonate. For fear a small quantity of fluoride has been left, the fused mass is first triturated with water and filtered from the insoluble residue; the aqueous solution is then only partially neutralised with hydrochloric acid so that after evaporation the greater part, but not all, of the silica is precipitated (1). This is filtered off and to the filtrate is added an ammoniacal solution of zinc carbonate, and it is then evaporated until the ammonia is expelled. By dissolving the precipitate thus obtained in nitric acid, and evaporating to dryness, &c. in the usual way, the silica from this portion is obtained (2). The portion of the melt that was insoluble in water is treated with hydrochloric acid and the silica obtained in the usual way (3). The silica contained in the smaller leaden U-tubes is next determined. It is necessary to filter the ammoniacal liquor from the lead sulphate that has formed in the tubes. The silica is obtained from the clear liquid by first adding so much sodium carbonate as to render it alkaline, after boiling off the ammonia, and then precipitating with zinc carbonate, &c. (4). To guard against any possible loss of silica, the precipitate of lead sulphate, from the ammonia tubes, is burnt off, a few drops of nitric acid added, and the lead sulphate dissolved out with ammonium acetate. Any residue is weighed as silica (5). The sum of the weights of these five portions of silica gives the total weight of the silica in the sample. Three samples of cryolite were found to contain, respectively, 0.80 per cent., 1.23 per cent., and 1.39 per cent. of Si.

The iron in cryolite is determined by decomposing the mineral with sulphuric acid and filtering. The residue is fused with sodium carbonate and the silica precipitated by hydrochloric acid. The solution obtained after filtering from the silica is added to the previously obtained solution in sulphuric acid, and boiled with chlorine water to oxidise the iron. On pouring the solution into hot concentrated caustic potash, a small precipitate of ferric hydrate is obtained which may be estimated by conversion into sulphide and finally oxide, or (after reduction), by titrating with potassium permanganate.

The three samples above mentioned were found to contain, respectively, 0.11 per cent., 0.85 per cent., and 0.88 per cent. of Fe.—H. S. P.

Notes on the Estimation of Sulphur in Burnt Ore, &c.
G. Lunge. *Zeits. f. angew. Chem.* 1889, 239—240.

THE author once more investigated all the methods published for the quantitative determination of sulphur in burnt ore, and found that Watson's modification of Pelouze's process (this Journal, 1888, 305) was not only the simplest and cheapest, but also the quickest and most accurate test ever devised.—S. H.

Sodium Hypophosphite as a Reducing Agent. C. Reinhardt. *Stahl und Eisen*, 1889, **9**, 404.

THE author considers this substance to be a better reducing agent in ironworks laboratories than sulphurous acid or sulphites. It reduces ferric chloride even in concentrated solution and in presence of large excess of acid on heating, and does not decompose with sulphuretted hydrogen, so that it is not necessary to get rid of excess of reducing agent. On account of its hygroscopic nature, sodium hypophosphite must be kept in glass stoppered bottles. The author used a solution containing 200 grms. of salt in 400 cc. of water.—G. H. B.

Estimation of Chromium in Iron and Steel. C. Reinhardt. *Stahl und Eisen*, 1889, **9**, 404.

THE process depends on the fact that chromic oxide is completely precipitated on heating with zinc oxide, whilst ferrous and manganous chlorides remain in solution. The reduction of the ferric chloride is effected by heating with sodium hypophosphite. Excess of zinc oxide is then added and heated for some time before filtering. The precipitate is redissolved in dilute hydrochloric acid, heated with a little sodium hypophosphite and again precipitated with a slight excess of zinc oxide. The precipitate is then twice redissolved in acid and reprecipitated with ammonia to remove zinc.—G. H. B.

The Estimation of Copper in Iron and Steel. C. Reinhardt. *Stahl und Eisen*, 1889, **9**, 405.

THE solution of the metal in hydrochloric acid is heated with sodium hypophosphite to effect the complete reduction of the iron, and the copper is then precipitated by a current of sulphuretted hydrogen. The sulphide is filtered, ignited, and weighed as cupric oxide. If the latter is required to be free from small traces of iron, the sulphide is redissolved and the above process repeated.—G. H. B.

An Error accompanying the Estimation of Nitrates in Soils, &c. M. Gimti. *Le Stazioni Speriment. Agrar. Italiane*, **15**, 1888, 5—15.

THE author observed, during the extraction of certain soils with water for the estimation of nitrates, that the percentage of nitrates became smaller the longer the soil remained in contact with the water. This is found to be due to the activity of denitrifying organisms, and can be prevented by sterilising the soil or other material undergoing extraction. To effect this the author adds 5 cc. of chloroform to 500 grms. of soil, requiring about 1 litre of water for extraction.

—D. A. L.

Delicate Reaction for the Detection of Rosin. Mittheil. des K. K. Tech. Gew.-Museums, 1888, 77—78.

IN a previous paper (Mittheil. 1888, 14; see also following abstract), on Storch's test for rosin, reference was made to Holde's test for the same, in which sulphuric acid of sp. gr. 1.53 is employed. Holde now makes a communication to the effect that his method is essentially different from that of Storch, inasmuch as, besides using weaker acid, he dispenses with the use of acetic anhydride.—E. B.

Detection of Rosin-oil and Rosin. T. Morawski. Mittheil. des K. K. Tech. Gew.-Museums, 1888, 77—81.

IN testing by Storch's method (this Journal, 1888, 136, 526, and 871) for the presence of rosin in the cake of fatty acids separated from soap, the author finds it preferable to use sulphuric acid of sp. gr. 1.53 instead of stronger acid. Again, when heat is applied to dissolve an oil in acetic anhydride, and sulphuric acid of sp. gr. 1.53 added to the cooled solution, the colouration is frequently, even in

absence of rosin oil, so intense that the latter can only be detected with difficulty; but, by adding sulphuric acid of the same strength to a solution made in the cold, the colouration, as a rule, is paler and the rosin reaction therefore not hidden. The majority of oils give paler and more greenish colourations when they have been dissolved in the cold, those obtained after heating with acetic anhydride being generally dark brown or reddish-brown.

The quantity of rosin in hard soap may often be roughly ascertained by this test, but it is preferable to estimate gravimetrically the amount of rosin contained in soft soaps, as these frequently contain fatty acids which give dark colourations.—E. B.

The Colour-Reaction of Oil of Cloves with Aniline Sulphate. E. Nickel. Chem. Zeit. **13**, 592.

THE author has previously shown that eugenol gives a yellow colour with aniline sulphate (this Journal, 1889, 421); this reaction is also given by oil of cloves, which contains eugenol.

If filter-paper (free from lignin) be impregnated with oil of cloves and then with aniline sulphate a reaction similar to the so-called "lignin-reaction" of wood is obtained.

Sodium nitroprusside is a reagent for aldehydes, for the group CO, as has already been pointed out by Weyl and Legal.—A. G. B.

On the Composition and Nature of Spent Animal Charcoal. G. Stoklasa. Chem. Zeit. Rep. **13**, 147.

THE author found in a sample of spent animal charcoal an excess of 1.75 per cent. of CaO over the quantity required to form the normal salts present, and infers from this that the compound CaHPO_4 must be present, as well as ordinary tricalcium phosphate. He objects to reporting the phosphoric acid found by the molybdic method as tricalcium phosphate as the waste material contains considerable quantities of iron and alumina, whilst the method involving titration with uranium solution is inexact in presence of these impurities. He recommends the precipitation by molybdic solution with the modification of P. Wagner, and the precipitate should be washed with water which dissolves the ammonium silicon molybdate, the phosphoric acid compound remaining insoluble. This method of operating removes any necessity for evaporating to dryness to separate silica, a fact recently established by Isbert. Meissl considers that the presence of 0.6 to 2 per cent. of ferric or aluminium phosphate in superphosphate made from animal charcoal is an evidence of admixture with mineral phosphate, but the author thinks this conclusion untenable, as spent animal charcoal may normally contain these impurities.

—G. H. B.

Analysis of Turkey-Red Oil. F. Breinl. Mittheil. des K. K. Tech. Gew.-Museums, 1888, 81—85.

THE author has previously used the term "total fat" to designate the mixture of neutral fat, fatty acid, hydroxyoleic acid, and fatty-sulphuric acid contained in Turkey-red oil, this being the generally accepted definition of the term. On this understanding of the meaning of the term the author compared the analytical results obtained by the various methods in use for the testing of Turkey-red oil, and criticised the methods (see this Journal, 1888, 872). Benedikt has, however, recently proposed another definition for the term, which he suggests should denote the mixture of all the insoluble fatty matters and the oxyleic acids, formed by the decomposition of the fatty sulphuric acids. Under this definition, the percentages of "total fat," found by the methods of Stein and Brühl, become higher and still more incorrect, whilst that obtained by Benedikt's method is reduced to within half per cent. of accuracy, a closer degree of accuracy being difficult to obtain on account of the danger of injuring the fatty matters, on completely removing the sulphuric acid.

Another method of analysing Turkey-red oil, stated to be due to Finsler, is largely employed in practice. A flask of about 200 cc. capacity provided with a long neck, which is graduated to $\frac{1}{2}$ or $\frac{1}{10}$ cc., is used for the test. The lowest graduation represents a capacity of 150 cc., the uppermost 200 cc. Exactly 30 grms. of the oil to be tested are weighed out, washed into the flask, and the volume made up to 100 cc. with water, then 25 cc. of sulphuric acid of 62 B. are added, and the mixture heated to the boil. Hot water is next added until the separated layer of fat rises into the neck of the flask, its volume being read after the lapse of half an hour. The oil, as a rule, rises better if a little of a hot concentrated solution of common salt is added. After the sulphuric acid has been added it is necessary to maintain the mixture at the boil and to shake frequently until the separated oily layer is quite clear and transparent. Concordant results are obtained by closely adhering to the above method. The calculation is made from the formula $G = 3V$, where G denotes the percentage of total fat, V the volume of separated oily matters. The old formula $G = \frac{1}{3}V$, obtained with Stein's method, is incorrect. The method is suitable for rapid analyses, where a high degree of accuracy is not required.—E. B.

The Analysis of Commercial Dextrin. C. Hanofsky. Mittheil. des K. K. Tech. Gew.-Museums, 1889, 56—59.

IN the analysis of the dextrin of commerce there have to be determined: 1. Dextrin; 2. Starch; 3. Sugar; 4. Ash; and 5. Moisture.

The estimation of the portion soluble in cold water is made by mixing 25 grms. of the sample with water in a 500 cc. flask, filling to the mark and allowing to stand. The slightly turbid solution is then filtered and used for the determination of (a) maltose, (b) dextrin, and (c) acidity.

(a.) The maltose is determined by means of Fehling's solution diluted with four times its volume of water to avoid the necessity of making corrections for the density of the maltose solution. A preliminary test is made to find what amount of the solution will reduce 10 cc. of the Fehling's solution, then 1 or 2 cc. less are taken and diluted with water to make 57—58 cc. Soxhlet found that four minutes' boiling was required for maltose to fully reduce Fehling's solution. One part of copper is reduced by 0.808 part of maltose; suppose, therefore, that 100 grms. of substance contain m grms. of maltose.

(b.) 50 cc. of the filtered solution (or 100 cc. if the amount of insoluble matter be large) are diluted to 200 cc., and boiled for two hours with 15 cc. of hydrochloric acid of 1.125 sp. gr., dextrin and maltose are thus changed into dextrose. The solution is then brought into a 300 or 500 cc. flask, neutralised, diluted to the mark, and the dextrose determined with Fehling's solution. Supposing that the amount of dextrose obtained from 100 grms. of substance = D grms., the percentage of dextrin will be $0.9(D - 1.05m)$, as 20 parts of dextrose correspond to 19 parts of maltose.

(c.) As, according to Schwachhöfen, all dextrins have an acid reaction, it is useful to determine the acidity, which is done with 50 cc. of the solution, using phenolphthalein and decinormal potash.

In cases where the amount of insoluble starch is large, a correction should be made for the volume of the same. Assuming that the specific gravity of starch is 1.6, the number of cc. to be deducted is found by dividing the amount in grms. of insoluble matter in 25 grms. of the sample by 1.6, thus the volume for 40 per cent. of starch will be 6.2 cc.

The portion insoluble in cold water, which consists almost entirely of starch, is most conveniently estimated by mixing 2.5—3 grms. of the sample with 200 cc. of water and 15 cc. of hydrochloric acid of sp. gr. 1.125, and maintaining at a gentle boil for two hours, with an arrangement for preventing evaporation, then neutralising, making up to 300 or 500 cc., and testing with Fehling's solution. If D_1 grms. of dextrose are obtained from 100 grms. of substance the percentage of starch will be $0.9(D_1 - D)$. The water is determined by drying at 110°C. The difference between 100 and the sum of the maltose, dextrin, starch, moisture, and ash, gives the percentage of other organic matters.

The following results were obtained with this method:—

Sample.	Maltose.	Dextrin.	Starch.	Moisture.	Ash.	Other Organic Matters.	Acidity of 100 Grms. in cc. of Decinormal Potash Solution.
No.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	
1	4.25	47.78	35.55	10.11	0.27	2.04	40.0
2	10.90	36.75	43.20	7.02	0.39	1.74	26.6
3	3.75	29.46	58.00	6.85	0.60	1.34	25.3

—E. B.

On the Methods for Estimating Starch. A. v. Asbóth. Chem. Zeit. **13**, 591 and 611.

THE albuminoids in grain meal do not interfere with the baryta method of estimating starch (this Journal, 1887, 608), but the oil uses up some of the barium hydroxide. On this account the author recommends that 10 grms. of the meal (the amount of water in which is known) be first extracted with ether in a Soxhlet's apparatus, and then, after exposure to air to allow the ether to evaporate, crushed in a mortar. 1—1.8 grms. of the meal so prepared may be taken for the estimation of starch, and several grms. for that of moisture, which must be determined in order to calculate the percentage of starch in the original meal.

The above method gives higher results than Lintner's method, and this is due, according to the author's experiments, to incomplete solution of the starch in the latter method, for a residue is obtained which is converted into sugar by diastase.

Schrich (this Journal, 1889, 127) has asserted that the baryta method is not adapted for the analysis of rice, but according to the author is mistaken, for excellent results are obtained if the rice be first extracted with ether.—A. G. B.

The Determination of Glycerol in Crude Glycerin.

J. Lewkowitsch. Chem. Zeit. **13**, 659.

THE author has already shown that the tri-acetin process of Benedikt and Cantor (this Journal, 1888, 696), gives closely concordant results in the case of moderately pure "crude glycerins"; he now quotes figures showing a similar agreement with each other, for crude glycerins obtained by various methods of saponification, including that effected by the use of acid, and by the autoclave process. In the 24 numbers given, the maximum difference between duplicates is 0.58 per cent., and it is generally much less.

He also recommends its adoption in all cases where the glycerol is first isolated in a fairly pure state, as for instance, in its determination in fats and oils. In his recent examination of the fat of the Sawari nut, it was used with success, the fat being first saponified, the fatty acids liberated by means of sulphuric acid, the filtrate from them treated with barium carbonate, evaporated nearly to dryness, extracted with ether-alcohol, and the solution thus obtained evaporated first by gentle warmth and finally in a desiccator, leaving the crude glycerin; by then using the tri-acetin process it became unnecessary both to dry to constant weight and to determine the ash.

The author has tried the lead oxide method for the determination of glycerol, it having a certain vogue among English analysts, but considers it unreliable. (Compare O. Hehner, this Journal, 1889, 4—9.)—B. B.

Estimation of the Alkaloid in Coca-leaves. v. d. Marek.

Chem. Zeit. Rep. **13**, 144.

FIFTY grms. of the powdered coca-leaves are mixed with 20 grms. of calcined magnesia, triturated with water, dried at 60°, and extracted with ether. The ether is distilled off, the residue taken up with 2 per cent. hydrochloric acid, filtered, and the filtrate shaken with ether till no more colouring matter is extracted. The solution is then made alkaline with ammonia and shaken three times with 25 cc. of

ether. This ethereal extract is dried by calcium chloride, drawn off by a pipette, evaporated and the residue of alkaloid dried in a desiccator and weighed.—A. G. B.

On the Estimation of Organic Nitrogen by Volume, by Soda-Lime, and by Kjeldahl's Method. L. L'Hôte. Compt. Rend. **108**, 817—820.

THE author has made a series of determinations of organic nitrogen both by Kjeldahl's method and with soda-lime. Below are his results:—

	Theory.	Soda-Lime.	Kjeldahl.
	Per Cent.	Per Cent.	Per Cent.
Brucine	7.10	7.15	5.89
Cinchonine sulphate ..	7.46	7.42	{ 3.40 3.92
Asparagine	18.66	18.42	18.33
Caffeine	28.86	28.78	28.74
Oxamide	31.82	31.68	31.67
Uric acid	33.33	33.27	33.19
Urea.....	46.66	46.54	46.5

He draws the conclusion that Kjeldahl's method is by no means capable of universal application. He has also established the satisfactory nature of the soda-lime process, when used to determine organic nitrogen in urine and albumen, using as a check method that of Dumas. Cazeneuve and Hugonnet had impeached its accuracy as regards these substances.—A. R. D.

The Estimation of Organic Nitrogen by Kjeldahl's Method.

E. Aubin and L. Alla. Compt. Rend. **108**, 960—961.

IT is maintained that the physical conditions of many of the samples with which an agricultural chemist has to deal are such as to make the soda-lime process inconvenient or inapplicable. Kjeldahl's method, on the other hand, is employed in the greater number of the agronomic laboratories of France, which, alone, would seem to indicate its general usefulness. With regard to the brucine, sulphate of cinchonine, and urea referred to in a previous note, the authors explain that they had taken no pains to ensure the purity of the samples used in their analysis, which were only comparative, hence they must decline to accept the criticisms of L'Hôte, which are based upon the discrepancies between their figures and those yielded by theory.—A. R. D.

The Quantitative Estimation of Wood-Cellulose in Paper.

R. Godeffroy. Mittheil. des K. K. Tech. Gew.-Museums, 1888, 67—77, and 1889, 9—14. (See also under XIX., page 564.)

THIS is a continuation of the work commenced by Max Coulon and the author (see this Journal, 1888, 863—864) in connexion with a process of estimating the amount of ground wood-cellulose contained in paper, the process being founded on the property this substance possesses of reducing salts of gold.

As an average result of a number of tests it was found that 100 parts of purified ground pinewood cellulose, when boiled with gold chloride solution, reduced 14 parts of gold. The investigation of the reducing powers of the wood-cellulose of the ash, beech, poplar, willow, and fir, is in progress.

Wood-cellulose and the celluloses of straw, cotton, and linen in the chemically pure condition are incapable of reducing gold salts, but pure linen-cellulose reduces silver when boiled with a perfectly neutral solution of silver nitrate, no other of the celluloses mentioned above, if pure, being capable of effecting this change. A number of determinations were made to

ascertain whether linen-cellulose reduced a definite amount of silver. The linen-cellulose used in the experiments, after being repeatedly washed and finally dried at 100°, contained 1·71 per cent. of ash. Weighed quantities of the washed and dried cellulose were boiled for a few minutes in glass beakers with a neutral solution of silver nitrate, the linen-cellulose, coloured black by the reduced silver, was then brought on to a filter, washed, dried, and ignited. It is noteworthy that reduction does not take place with slightly acid solutions of silver nitrate, whilst alkaline solutions are reduced by the other kinds of cellulose as well as by linen-cellulose.

The following analytical results were obtained:—

Determination.	Amount of Linen-Cellulose taken.	Amount of Ash Calculated.	Weight of Silver and Ash Found.	Weight of Silver.	100 Parts of Linen-Cellulose Reduce of Silver.
	Grms.	Grms.	Grms.	Grms.	Parts.
1.	0·9686	0·06563	0·0302	0·01937	2·027
2.	0·9088	0·015540	0·0343	0·018760	2·064
3.	0·7886	0·013485	0·0304	0·016915	2·145
4.	0·8798	0·014944	0·0354	0·020456	2·325
5.	1·3076	0·022359	0·0490	0·026641	2·037
6.	0·7638	0·013090	0·0367	0·017610	2·305

It thus appears that 100 parts of linen-cellulose reduce as a mean 2·1 parts of silver.

Eight samples of paper made from mixtures of linen-cellulose and wood-cellulose were taken and analysed, after extracting with alcohol and ether, the results being calcu-

lated on the assumption that 100 parts of wood-cellulose reduce 14 parts of gold, and 100 parts of linen-cellulose reduce 2·1 parts of silver. The compositions of the papers were:—

No.	1.	2.	3.	4.	5.	6.	7.	8.
	Per Cent. 80	Per Cent. 70	Per Cent. 60	Per Cent. 50	Per Cent. 40	Per Cent. 30	Per Cent. 20	Per Cent. 10
Wood-cellulose								
Linen	20	30	40	50	60	70	80	90

The results of the determinations are given below, the calculations being made upon the weights of air-dried paper taken.

QUANTITATIVE ESTIMATION OF WOOD-CELLULOSE.

Paper.	Moisture.	Ash.	Extractive Matter.	Percentage found of		Total.
				Wood-Cellulose.	Linen.	
No.	Per Cent.	Per Cent.	Per Cent.			
1.	8·991	0·657	1·886	72·125	..	..
2.	8·751	0·645	1·702	61·102	27·410	90·610
3.	8·471	0·739	1·513	53·485	35·311	100·519
4.	8·278	0·817	1·433	43·996	45·612	100·166
5.	7·507	0·893	1·287	..	..	..
6.	7·121	1·026	0·994	24·414	64·769	93·627
7.	6·817	1·014	0·814	17·376	73·495	99·516
8.	6·444	1·099	0·733	..	80·794	..

A number of other determinations of linen and wood-cellulose in samples of paper made with linen and cotton rags, wood-cellulose, and china clay, gave satisfactory results.

It is pointed out that the previous results published are slightly incorrect, as no allowance was made for the presence of extractive matter, so that the percentages of wood-cellulose are slightly too high.

A sample of paper was prepared by hand from a mixture of equal parts of linen cellulose, and sulphite-cellulose.

The linen-cellulose, after being washed and extracted, contained 1·02 per cent. of ash; the extracted sulphite-cellulose 0·349 per cent. of ash. 100 parts of the linen-cellulose reduced 1·99 parts of silver from a solution of silver nitrate; the extracted sulphite wood-cellulose exhibited no reducing power either for silver or gold. The

paper was tested and gave the following percentage results: linen-cellulose 50·9, ash 2·08, matter extracted by alcohol, 2·399, matter extracted by ether, 0·834.

Different kinds of ground wood-cellulose, obtained as far as possible from various trees of the same age, and grown on the same ground, were tested with the results given below:

Kind of Tree.	Ash in Dry Unextracted Ground Wood-Cellulose.	Matter Extracted by Alcohol.	Matter Extracted by Ether.	Ash in Dry Extracted Ground Wood-Cellulose.	100 Grms. of Dry Extracted Ground Wood-Cellulose Reduce Gold in
Willow	Per Cent. 3·2115	Per Cent. 1·5845	Per Cent. 0·039	Per Cent. 3·1385	Grms. 13·94
Poplar.....	2·307	3·158	0·055	2·133	13·35
Elm	1·4855	1·690	0·020	1·458	13·65
Acacia	2·635	1·2575	0·0335	2·5535	11·347
Fir (pinus silvestris).....	3·7635	3·696	0·054	3·248	14·068
Pine (pinus abies)	1·1955	1·731	0·037	1·4305	14·226

Alkaline solutions of copper sulphate and of bismuth are reduced by extracted ground wood-cellulose, but a quantitative determination cannot be based on this fact. No other purified and extracted celluloses induce these reductions.

—E. B.

PATENT.

Improvement in Thermometer. C. U. Fisher, London.
From C. J. Tagliabue, New York, U.S.A. Eng. Pat. 5819.
April 5, 1889. 6d.

The object of this invention is to prevent the breakage of the thermometer should the case containing it be dropped. The case is open at both ends, each being provided with an elastic pad having a flange in the centre of its length considerably wider than the case. Each pad is so placed that one portion of it is inserted into the case, and abuts against the instrument, whilst another portion projects outside beyond the flange, which thus rests on the end. Should the case fall lengthwise it is protected by the flange, whilst should it drop endwise a like protection is afforded to the instrument by the pad.—E. S.

New Books.

DIE FABRIKATION DER THEERFARBSTOFFE UND IHRER ROHMATERIALIEN. Von Dr. W. HARMSEN. Berlin: S. Fischer Verlag, 1889. London: H. Grevel & Co., King Street, Covent Garden.

SMALL 8vo. volume, bound in cloth, price 10s., contains preface, table of contents, introduction covering the first seven pages, and subject matter extending to page 310. An appendix of a couple of pages and an alphabetical index conclude the work.

To give a precise idea of the nature of the contents of this little work it may shortly be said that whilst apparently designed as a text book for the student of chemical technology, the matter in it brings him still more closely in contact with the practical operations of the factory than is usual in works already written on this subject. If, for example, the text book of Noelting and Julius be regarded on the one hand as suited *par excellence* for the preparation of students in getting a theoretical grasp of the subject, then the work under present consideration may be regarded as complementary to it, supplying in concise outline the details of operation, apparatus, and plant. The text is illustrated with 34 wood engravings.

DIE CHEMIE DES STEINKOEHLENTHEERS. Mit besonderer Berücksichtigung der künstlichen Organischen Farbstoffe. Von Dr. GUSTAV SCHULTZ. Zweite vollständig umgearbeitete Auflage. Zweiter Band. Die Farbstoffe. Vierte Lieferung. Braunschweig: Druck und Verlag von Friedrich Vieweg und Sohn. London: H. Grevel & Co., 33, King Street, Covent Garden. 1889.

THIS, the fourth part of the second volume of what will be the most complete work ever written on the coal-tar colours, includes chapters thirty-seven to thirty-nine. CHAP. XXXVII. treats of the Alizarin colouring matters, Alizarin, Alizarin orange, Alizarin blue and Alizarin blue S., Alizarin W.S., Purpurin, Anthracene brown (Anthragallo), Flavopurpurin, Isopurpurin, Alizarin black and Galloflavin. CHAP. XXXVIII. treats of the Diphenylamine colours; there we find the Indophenols, Oxazines and Thiazines; whilst Chap. XXXIX. comprises the Eorholines, Safranines, Mauveïn, Magdala red, Neutral blue and Basile blue.

The text is illustrated by seven wood engravings and extended by numerous references to original sources of information. Very full references are also given to the more important sources of patent literature. The part, for volume it cannot be termed, commences abruptly with page 577, and ends with an unfinished sentence on page 768.

THE CHEMISTRY OF THE COAL-TAR COLOURS. Translated from the German of Dr. R. BENEDIKT, and edited, with additions, by E. KNECHT, Ph.D., F.I.C. Second edition, revised and enlarged. London: George Bell and Sons, York Street, Covent Garden. 1889.

ACCORDING to the preface of this work, designed principally for the student who desires to master the branch, as one of applied organic chemistry, two circumstances have combined to urge the translator and editor to the production of a second edition. Firstly, the appearance in the market, since the appearance of the first edition, of a large number of new coal-tar colours; and secondly, the increased scientific development of the subjects,—“the constitutional formulæ of many products of which we then (the period of the appearance of the first edition) knew little more than the empirical formulæ, having been definitely proved.” There is in this work, however, though as above stated, “principally designed for the student of applied organic chemistry,” a distinct practical direction, and this is perhaps rather towards the wants of the dyer than towards those of the colour manufacturer, though the latter must of necessity be acquainted with both classes of requirement. Part I. (pp. 5 to 68), for example, is devoted to “The Optical Properties of Colouring Matters,” “General Chemical Properties of the Colouring Matters,” “Methods of Dissolving the Colouring Matters,” “Dyeing with Coal-Tar Colours,” and “The Testing of Colouring Matters.” In Part II. the main subject is then commenced, “Coal Tar and the Raw Products used in the Manufacture of the Coal-Tar Colours;” and in Part III. attention is concentrated upon “The Coal-Tar Colours” themselves, arranged in the following

groups: (1.) Colouring matters from benzene and toluene. (2.) Phenol colouring matters. (3.) Naphthalene colouring matters. (4.) Anthracene colouring matters. The work, exclusive of index, now covers 325 pages.

COMMERCIAL ORGANIC ANALYSIS. A Treatise on the Properties, Proximate Analytical Examination, and Modes of Assaying the various Organic Chemicals and Products employed in the Arts, Manufactures, Medicine, &c. With concise methods for the detection and determination of their Impurities, Adulterations, and Products of Decomposition. By ALFRED H. ALLEN, F.I.C., F.C.S. Second edition, revised and enlarged. Volume III. Part I. Acid derivatives of Phenols, Aromatic Acids, Tannins, Dyes and Colouring Matters. London: J. and A. Churchill, 14, New Burlington Street. 1889.

As the author states in his preface, when the manuscript advanced towards completion, it became evident that the subject-matter would be too extensive to allow of publication of Vol. III. in one part. Consequently, the present issue forms Part I. of that volume, itself forming a large 8vo. volume containing 120 pages, and an independent alphabetical index.

The contents are as follows:—

ACID DERIVATIVES OF PHENOLS AND AROMATIC ACIDS.—Phenol-sulphonic acids; Benzoic acid; Cinnamic acid; Phthalic acids; Salicylic acid; Protocatechuic acid; Gallic acid; Tannins and Tannic acids. **DYES AND COLOURING MATTERS.**—Constitution of Colouring matters; Nitro-colouring matters; Nitroso-colouring matters; Aurin and its Allies; Phthalicins; Azo-compounds and Colouring matters; Rosaniline and its Allies; Safranines and their Allies; Anthracene Colouring matters; Sulphuretted and Unclassified Coal-Tar Dyes; Colouring matters of Natural Origin; Recognition of Colouring matters; Examination of Commercial Colouring matters; Examination of Dyed fibres. The work concludes with a table of Errata for Volumes I., II., and III.

Trade Report.

(From Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

RUSSIA.

Modifications in Customs Tariff.

Note.—Poud = 36 lb. avoirdupois. Funt = 902 lb. Gold rouble = 3s. 2d.

A despatch, dated the 19th June last, has been received at the Foreign Office from Mr. Audley C. Gosling, Her Majesty's Chargé d'Affaires at St. Petersburg, transmitting a statement notifying several alterations in the Russian Customs Tariff.

Notice is also given in the *Official Gazette* that various explosives, the importation of which has been hitherto prohibited, may now be imported by public institutions, companies, and private individuals, for agricultural, mining, signalling, and other purposes, with the sanction of the Minister of Finance and primarily of other authorities.

Section 243 of the Customs Tariff relating to such explosives is read as follows: (a.) Gunpowder.—Duty, 1 10 r. gold per pound gross. (b.) Dynamite and every kind of explosive substance and fulminating compounds, also all accessories for explosions, such as quick and slow matches, electric primings, &c., not specially mentioned in the tariff.—Duty, 3 r. gold per pound gross.

Section 45 of the Customs Tariff will henceforth be as follows:—

Starch in lumps and powder.—Duty, 1 10 r. gold per pound.

The new rates of duties are to come into operation from the date of their notification.

Notice is furthermore given that point 7 of section 26 and note 2 to section 153 of the tariff are modified, and are henceforth to be as follows, and that these modifications are to come into operation from the date of their notification in the *Official Gazette*.

Section 26, point 7. *Wax.* (a.) Bees wax, vegetable wax, wax for dressing trees, as also purified mineral wax (seresine).—Duty, 1 50 r. gold per pound. (b.) Mineral wax unrefined (ozokerite).—Duty, 40 copecks gold per pound.

A later report of Mr. Gosling, dated the 26th June, says that the *Messenger Officiel* contains the following notification modifying the Customs duty on paper pulp:—

Sections 25 of Customs Tariff, point 2, to be as follows:—

Section 25, paper pulp, point 2. (a.) Wood pulp, except pulp prepared chemically, 20 copecks gold per pound. (b.) Wood pulp prepared chemically (cellulose), though pressed, 25 copecks gold per pound.

At the same time the following rates have been fixed for paper pulp and its products when imported into Russia from the Grand Duchy of Finland:—

Paper pulp of every kind, except pulp chemically prepared, dry, 14 copecks gold per pound; paper pulp of every kind, except pulp chemically prepared, wet, 9 copecks gold per pound; cardboard of paper pulp, 20 copecks gold per pound; paper pulp prepared by chemical process (cellulose), though pressed, 25 copecks gold per pound.

Nematolite, agalite, asbestine, and similar products in fine powder and resembling asbestos in their composition, to be cleared (with the exception of ground tale, section 7) under section 145 of Customs Tariff.—Duty, 30 copecks gold per pound.

Notice is further given that the importation into Russia is allowed of ichtiola and salt of silpho (? sulpho), ichtiolic acid, but ready preparations of the same, such as solutions, ointments, pills, capsules, plaister, soap, &c. are prohibited, these being galenic preparations.

SWITZERLAND.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220 4 lb. avoirdupois. Franc = 9 $\frac{6}{10}$ d.

The following decisions, affecting the classification of articles in the Swiss Customs Tariff, were given by the Swiss Customs authorities during the month of May last:—

Acetate of soda, naphthionate; salt known as "Conservierungssalz" in open package.—Category 17. Duty, 1 franc per quintal.

"Phosgene" (solution of chloroxycarbonic gas in toluol and benzol).—Category 18. Duty, 2 francs per quintal.

SPAIN.

Classification of Articles in Customs Tariff.

Note.—Kilogramme = 2 20 1 lb. avoirdupois. Peseta = 9 $\frac{6}{10}$ d.

According to the *Deutsches Handels-Archiv*, the following decisions affecting the classification of articles in the Spanish Customs Tariff have recently been given by the Spanish Customs authorities:—

Unrefined mineral oils mixed with tallow are classified under Category 7. Duty, 41 cs. per 100 kilos., with a surcharge of 8 pes. 34 cs. and a transitory duty of 3 pes. 75 cs. per 100 kilos.

Resinous oils are classified under Category 58. Duty, 2 pes. per 100 kilos.

UNITED STATES.

Recent Customs Decision.

In the case of Castille soap and other commodities where the difference between the invoice weight and the weigher's return may be due to evaporation or other like causes, and

it appears to the satisfaction of the appraiser and collector that the foreign market value per pound of the goods landed has proportionally enhanced, so that there has been no diminution of the total entered value of the invoice in the foreign market, notwithstanding the shrinkage in weight, it would seem to follow that the foreign market value per pound would be represented by the result which would be obtained by dividing the total foreign market value of the invoice by the number of pounds landed. Article 604, Regulations, is modified accordingly.

CANADA.

Classification of Articles in Customs Tariff.

The following decisions affecting the classification of articles in the Canadian Customs Tariff have recently been given by the Canadian Customs authorities :—

Second-process molasses, testing by polariscope less than 35 degrees, when imported by manufacturers of blacking for use in their own factories in the manufacture of blacking, may hereafter come duty free under certain conditions.

Alizarine, blood albumen, arseniate, bi-arseniate, chlorate and stannate of soda, tannic acid, tartar emetic, chlorate of potash crystals, gum gedda, gum barberry, grey tartar, fustic extract, and quercitron or extract of oak bark, when imported by the manufacturers of cotton and woollen goods for use in their own factories only; and grey tartar, fustic extract, and quercitron or extract of oak bark, for the manufacture of colours, are admitted free of Customs duty until the end of the next session of Parliament.

Sulphate of alumina and alum cake, used as a substitute for alum by paper-makers, are placed on the list of articles that may be imported into Canada free of Customs duty.

Sumac, when imported to be used for dyeing or tanning purposes, *i.e.*, manufacturing purposes, not further manufactured than crushed or ground, is placed on the list of articles that may be imported into Canada free of Customs duties.

Camwood, when imported to be used for dyeing or tanning purposes, *i.e.*, manufacturing purposes, not further manufactured than crushed or ground, is placed on the list of articles that may be imported into Canada free of Customs duties.

Ferro-manganese, ferro-silicon, &c., entered for mixing with iron when smelted for castings, is allowed entry at the rate of 4 dols. per ton as iron in pigs.

SOUTH AUSTRALIA.

Drawback on Paint and Varnish.

A communication, dated the 13th May last, has been received from the Collector of Customs at Port Adelaide, South Australia, enclosing copy of an order of the Governor in Council, providing for the payment of drawbacks on paint and varnish exported from the colony, as follows :—

Paints mixed ready for use, manufactured in South Australia from materials upon which the full duty has been paid upon importation, provided that the proportion of oil used in the manufacture of such paint be not less than 33 per cent., will be entitled on exportation, and proof to the satisfaction of the collector of Customs of the correctness of the claim, to a drawback of 2s. per cwt.

Varnish manufactured from materials upon which the full duty has been paid in South Australia on importation, provided that the proportion of oil used in the manufacture of such varnish be not less than 33 per cent., will be entitled on exportation, and proof to the satisfaction of the collector of Customs of the correctness of the claim, to a drawback of 2d. per gallon.

Additional articles upon which no drawback will be allowed, unless in original packages or packed therefrom, in all cases upon the production of the original stamped invoices, *viz.* :—Blacking, blue, pickles, starch.

CHANGES IN THE FRENCH INDO-CHINESE CUSTOMS TARIFF.

The *Journal Officiel* publishes a decree of the President of the French Republic, effecting the following modifications in the Customs tariff of French Indo-China :—

Note.—Kilog. = 2·204 lb. avoird. Hectolitre = 92 imp. gallons. Franc = 9 ⁶/₁₀ d.

Articles.	Rate of Duty.	
IX.—OILS AND VEGETABLE ESSENCES.		
Oils :		Frs. Cts.
Of gum benjamia.....	100 kilos.	720'00
Of mint, spiced	"	350'00
Olive	"	15'00
Gums :		
Gamboge.....	"	12'00
Dragons' blood.....	"	720'00
Essence of myrrh.....	"	540'00
Do. of olibanum	"	540'00
Gum benjamin.....	"	35'00
Camphor and camphor waste in lumps, known as "barrow ".....		Free.
Opium :		
Benares, raw.....	100 kilos.	1,300'00
Do., boiled or prepared.....	"	2,600'00
Yunnan, raw.....	"	916'66
Do., boiled or prepared without mixture..	"	1,833'33
Do., boiled or prepared.....	"	2,600'00
Balsams		Free.
XIII.—DYES AND TANNING MATERIALS.		
Mangrove bark	100 kilos.	0'35
Gambier, raw.....	"	2'00
Do., prepared.....	"	25'00
XV.—STONES, EARTHS, AND COMBUSTIBLE MATERIALS.		
Plaster	"	0'08
Lime.....	"	1'00
Cement.....	1,000 kilos.	10'00
Sulphurs, sublimate and others	100 kilos.	10'00
Mineral oils.....	"	5'00
XVI.—METALS.		
Lead in ingots	"	3'60
Copper ores.....	"	6'00
Zinc in pigs.....	"	3'60
XVII.—CHEMICAL PRODUCTS.		
Yellow oxide of lead (massicot).....	"	4'20
Cinnabar, natural.....	"	9'00
Sea salt.....	"	1'66
Saltpetre	"	10'00
XVIII.—PREPARED DYES.		
Cochineal.....	"	60'00
Lac.....	"	3'60
Indigo, liquid.....	"	2'50

Articles.	Rate of Duty.	
XIX.—COLOURS.		
		Frs. Cts.
Green paints (Chinese)	100 kilos.	5'50
Chinese ink	Free.	
XX.—MISCELLANEOUS COMPOSITIONS.		
Bezoar stone.....	100 kilos.	1,700'00
Rhubarb	"	15'00
Medicaments, not specified in an official pharmacopœia, and not otherwise mentioned in the tariff.....	10 "	<i>ad val.</i>
Chinese sauces and other food preparations not otherwise distinguished	Free.	
Glue	100 kilos.	5'00
Isinglass.....	Free.	
XXI.—BEVERAGES.		
Alcohols :		
Brandy, in bottles, per hectolitre of liquid	Hectolitre	50'00
Do., other than in bottles, per hectolitre of pure alcohol.....	"	50'00
Other, per hectolitre of pure alcohol	"	50'00
Liqueurs, per hectolitre, liquid	"	50'00
XXIX.—ARMS, POWDER, AND AMMUNITION.		
Gunpowder and filled cartridges	10 %	<i>ad val.</i>
Pirworks and petards, Asiatic.....	10 %	<i>ad val.</i>

abolish or reduce the duties on the above-mentioned four fertilisers, and also on the following :—Phosphate of lime, nitrate of potash, nitrate of soda, sulphate of potash, silicate of potash, sulphate of copper, sulphur.—*Ibid.*

BRITISH BURMAH.

The Cutch Industry.

Next to rice, cutch is the most important article exported to Europe from Burmah. The cutch trade has become more and more important during the last 20 years, and although its prosperity received a temporary check in 1885-86, as a result of the annexation of the upper country, it has now fully recovered its former activity, and the production is as large as, if not larger than, that of previous years. And there is no doubt that in the same measure in which order and tranquillity increases throughout the country, and with the opening of new commercial routes, the manufacture of this product, which is so abundant in the forests of this country, will grow more and more. The cutch trees are found throughout the vast forests which cover the surface of Burmah. The wood has a dark red exterior, and much resembles mahogany. Cut into small pieces and boiled in water it is reduced to a paste called "Sha" in Burmese, which forms the cutch. This cutch is largely manufactured by the inhabitants of the villages fringing the borders of the forests. Cutchmaking is a very simple process, and only requires a pair of strong arms, an axe, and a vessel for boiling. In October, at the end of the rainy season, the Burmese go into the woods with their families in bands of three to six. By preference spots are chosen where clusters of strong and tall trees are found. Small holes are then cut in the earth, in which to place the vessels. Thereupon the trees are felled, hewn into logs, and peeled until the core is reached, which is immersed in water and boiled. As soon as the resulting paste has attained the requisite thickness it is emptied out on a mat and dried in the shade. The best qualities are next shaped into the tablets met with in commerce, and measuring 12 in. x 7 in. x 5 in. The colour of the cutch varies, according to the age or quality of the tree and the duration of the boiling process, from red or dark red to black. The bright red and red grades are considered the best, and are fashioned with much more care and in smaller tablets than the others. They are, along with betel and areca nuts, a favourite masticant of the natives. The dark red and black grades are especially made for the European and American markets, and it is these varieties that are bought up by the Rangoon merchants. Pure cutch, properly dried, should be of a regular and even shape, bitter and arid taste, and of a flavour resembling that of opium. The colour is more appreciated the nearer it approaches bright red. Enormous quantities of soft or elastic cutch are thrown on the market, because the boilers are in too great a haste to take advantage of a favourable market to properly dry the cutch. Some years ago the brand known as "*Mindoon pure cutch*," which excelled in uniformity of manufacture, was placed upon the market. A product locally named *Than-sha* is sold as an imitation of true cutch. It was first brought out about eight years ago, when it sold at 10 rupees per 100 "viss," but during the last season it has been worth 25 rupees per 100 "viss." Other varieties of cutch are mixed with fibrous matter, sand, or clay, or are prepared without regard to the quality of the wood or the boiling period. These grades are known as *Sal-sha*, *Naylan-sha*, *Revenoon-sha*, and *Pet-tok-sha*. Cutch mixed with sand or earth is easily known by weighing or tasting it. The Chinese never buy cutch from the Burmese without previously sorting it. The prices they pay run from 37 rupees per 100 "viss" for good hard cutch, to 20 or 30 rupees for soft grades, and from 25 down to 8 rupees for adulterated stuff.—*Ibid.*

CHINA.

China Root.

Nearly a quarter of the China root exported in 1887 from China came from Kiukiang, and the export in that year was below the average. It is grown principally in the

EXTRACTS FROM BRITISH AND FOREIGN CONSULAR REPORTS.

BRAZIL.

British Chemicals.

British trade with Santos has greatly progressed lately at the expense of that of Germany. Chemicals, hitherto exclusively derived from German sources, are now obtained from Great Britain in greater quantities, and preferentially. —*Chemist and Druggist.*

Chemical Manures.

For growing coffee it has hitherto been the custom to cut down the virgin forest, and when the woods and leaves become dry to burn them as they lie, thus adding natural potash to the already fertile humus. As the coffee tree only lasts about 15 years, estates without virgin forest are hardly saleable. The planters either move on to certain unvisited parts of São Paulo and Espírito Santo, which are being opened up by the Sorocabana and Leopoldina railways, or commence to use chemical manures. The latter course, however, is greatly impeded by the inconceivable height of duties on such fertilisers. The following four instances may be given :—On bisulphurate of carbon, price in France, 15*l.* a ton, the Customs duty here is 32*l.* a ton, without counting warehousing, Customs portorage fee, or 5 per cent. additional Customs dues. Sulphate of iron costs in France 2*l.* 16*s.* per ton, and pays taxes here 16*l.* per ton, without the additionals above mentioned. Sulphate of ammonia costs in Portugal 18*l.* per ton, and the Custom house here takes 40*l.* a ton. Superphosphate of lime, used for vines, coffee trees, cotton, and cane, costs 3*l.* a ton in France, and here pays 80*l.* duty, besides the extras above mentioned. In the Budget Law for 1889 the Government is authorised to

Chien-shan and Ho-shan districts in Anhui, and reaches the Yangtse at An-ching. To avoid lekin exactions it is brought to Kiukiang instead of Wuhu, and is shipped chiefly to Ningpo and Canton, from which latter port it is said 45,000l. worth is annually sent in the form of medicines to the Chinese in Australia and California. The exports from Kiukiang were 781,560 lb. (worth 13,547l.) in 1888, and 504,257 lb. (worth 8,048l.) in 1887.—*Ibid.*

Vegetable Tallow.

The export of vegetable tallow from Jui-ch'ang, the next district west of this, amounted this year to 517 tons, valued at 12,997l., or double the export of 1883 and 1884. It is reported that the natives are learning to adulterate it by mixing in kerosene or other cheap oil with the tallow while it is cooling. Chinkiang, Tientsin, and Peking take most of the tallow exported.—*Ibid.*

Cuttlefish.

There was a decrease in the exports in foreign vessels of cuttlefish from the Chinese port of Ningpo from 47,881 piculs in 1887, to 43,468 piculs in 1888; but it is believed that only about two-fifths of the take are exported in foreign vessels, the remainder going in junks to Wenchow, Fuhkien, and elsewhere. The fishing commences about April, and with the drying goes on till about June, when the market opens. The success of the trade is very dependent on the weather; a cloudy season interferes with the curing, north-east winds disperse the fish, and a mild winter naturally means scarcity of ice.—*Ibid.*

ECUADOR.

Drugs from Guayaquil.

The shipments of cinchona bark from the port of Guayaquil were larger in 1888 than in the previous year, the figures being:—1888, 880 quintals, value 2,640l.; 1887, 549 quintals, value 1,647l. Nearly the whole of this went to England. Of Condurango 8,250 lb. were shipped, of which two-thirds to England and most of the remainder to Germany; and of sarsaparilla 20,365 lb. to England and Chili.—*Ibid.*

FRANCE.

The Marseilles Oil Trade.

The total imports of seed oils in Marseilles in 1888 attained 278,527 tons, against 286,770 in the previous 12 months; the falling off has been chiefly in gingelly seed from Bombay, owing to the small crops there. The general state of trade improved considerably during the year, as, by reason of the shorter supplies and substantial rise in tallow and all greases, prices of seed-oil rose considerably, and there was a steady sale during the last six months. For 1889 the general opinion inclines to lower values, as the crops of ground-nuts on the Madras and Coromandel coast promise large yields, and the Bombay crops are also full average ones. Under oleaginous seeds are also comprised palm kernels and coprah, which produce concrete oil, and form one of the principal ingredients in the manufacture of soap, which is made of about 30 per cent. concrete oil and 60 per cent. to 70 per cent. seed-oils. Coprah gives about 65 per cent. oil, and palm kernels about 44 per cent. Nearly the whole of the said imports of oil-seeds, viz., 278,527 tons, have been crushed by Marseilles crushers, giving a production of 100,000 to 110,000 tons of oil. These products are connected with one of the largest and most prosperous industries in Marseilles, viz., the candle and stearine factories of Messrs. Les Fils de Frederic Fournier, who are among the very largest manufacturers in Europe, their production of stearine amounting to nearly 1,200 tons yearly, and about 16,000 tons of candles, stearine, and tallow. The chief articles used for this production are palm oil and tallow, and their imports for these for 1888 have amounted to 11,551 tons palm oil and 4,195 tons tallow, in addition to common greases and French home-melted stuffs.—*Ibid.*

MOROCCO.

Cumin Seed.

A good deal of cumin seed is produced in the districts near the city of Morocco (Marakesh in the vernacular), and in addition to being much used by the natives, both Mohammedan and Israelitish, in cooking and confectionery, is an article of export, the value for the year 1888 being quoted at 708l. for 21½ tons of this small grain, shipped to England, France, and Spain.—*Ibid.*

Olive Oil.

The 1888 yield of this oil from the Mogadore district was considerably below that of 1887, and as the prices obtainable on the European markets were by no means encouraging, a considerable proportion of this yield appears not to have been shipped, but to have been stored in the interior, in hopes of better times.—*Ibid.*

Argan Oil.

The oil produced from the kernels of the bitter berries of the argan tree (*Argania sideroxylon*), forests of which form an interesting and peculiarly characteristic feature of the landscape in Southern Morocco, is of universal use in these parts for lighting and cooking purposes. The rank smell and taste which characterise the raw oil disappear entirely at a certain degree of heat, imparting no disagreeable flavour whatever to food properly cooked in it.—*Ibid.*

RUSSIA.

Russian Quicksilver.

Our Consul at Taganrog (Black Sea) mentions that the quicksilver mine in his district, of which mention was first made in the year 1886, has been successfully worked in 1888, 32,300 tons of ore having been extracted; 32,800 tons were sorted, of which nearly 30,000 tons contained quicksilver, averaging from 0.44 to 6.90 per cent. The latter quality is rare; only 1½ per cent. of the ore gave such high results. About 28,500 tons were calcined, and yielded 3,234 cwt. of clean quicksilver. In 1887, the first year, only 1,266 cwt. were produced. This Russian quicksilver is remarkably pure, and has supplanted all foreign importations.—*Ibid.*

MISCELLANEOUS TRADE NOTICES.

IMPORTANT SALT DISCOVERY AT BARROW.

The find of salt on Walney Island over a large area is viewed with some apprehension by the Salt Syndicate. The quality of the deposit is excellent, and it is in the hands of a small syndicate, which will first consider the interests of this town before entertaining any proposals from the Union for keeping up prices. The price of salt has gone up quite 75 to 80 per cent. to consumers; but it is hoped that the Walney discovery will bring it down considerably, and at the same time furnish cargoes for ships bound for the East.—*Chemist and Druggist.*

PRONUNCIATION OF CHEMICAL TERMS.

A committee, consisting of Professor Thos. H. Norton, Professor Edward Hart, and Professor H. C. Botton, appointed by the Chemical Section of the American Association for the advancement of Science, to report on the question of uniformity in the pronunciation and orthography of chemical terms, are desirous of obtaining from the chemists of America a full expression of opinion on the more important questions where usage is uncertain or variable.

With this object in view, the committee have sent a list of the more important and typical words used in chemistry, based largely on one compiled by Professor J. H. Appleton,

of Brown University, modified, however, by numerous additions and by the omission of all names of minerals. The pronunciations given are those of standard dictionaries, but are in no sense to be regarded as recommended by the committee; they serve rather as a guide to uniformity in the manner of indicating pronunciation.

It is hoped thus, through the co-operation of chemists, to obtain, by this means, a valuable fund of material, showing the prevalent feeling and usage with regard to orthography and pronunciation, which will serve as the basis for definite recommendations to the Association, and later for propositions leading to unity of action with the chemists of Great Britain.

Among the names which the committee have included in the circular that they issue are the following:

Aluminium, which they pronounce al-ū-mīn'i-um, which we believe to be far less desirable than "aluminum"; anadgam, a-nad'gam; anode, an'ōd; apparatus, ap-pa-rā'tus; argillaceous, ār-jil-lā'shus; arsenic, ār-sen-ik; asbestos, az-bes'tos; asphalt, asfalt; assay, as-sā; auriferous, āu-rif-er-us; barium, bā'ri-um; basic, bā-sik; bismuth, biz'muth; boron, bō'ron; centigrade, sen-ti-grād; centimeter, sen-ti-mē'ter; chromium, krō'mi-um; cobalt, kō-bālt; concentrated, kon-sen-trāt-ed; crystalline, adj., kris'tal-in; crystallography, kris-tal-log'ra-fi; delugating, def-la-grāt-ing; didymium, di-dim'i-um; dilute, di-lat'; distillation, dis-til-lā'shun; ebullition, eb'ul-li-shun; electrolytic, e-lek'trol-it'ik; endiometer, ū-di-om'et-er; Fahrenheit, fā'ren-bit; fluorine, flū'or-in; gangue, gang'; gaseous, gaz'e-us; gelatin, jel'at-in; gelatinous, jel-at'in-us; halogen, hal'ō-jen; hydrochloric, hī-drō-klō'rik; hydroxide, hī-droks'id; hydroxyl, hī-droks'il; indium, in'di-um; iridium, i-ri'di-um; isomerie, i-sō-mer'ik; isomerism, i-som'er-izm; kupfernickel, kup'fer-nik-el; lanthanum, lan'than-um; liter, lē-tēr; litharge, lith'ar-j; lixiviation, liks-iv'i-ā'shun; magnesium, mag-nē'shi-um; manganese, man'gan-ez; mercuric, mer-kū'rik; mercurous, mer-kū-rus; metallurgy, met'al-er-j; meter, mē'tēr; millimeter, mil'li-mē-tēr; molecular, mol-ek'u-lēr; molecule, mol'e-kūl; molybde, mol-ib'dik; molybdenum, mol-ib-dē-num; monad, mon'ad; nickel, nik'el; osmium, os'mi-um; oxide, oks'id; palladium, pal-lā'di-um; paraffin, par'af-in; platinum, plat'in-um; polymerism, pol-in'er-izm; potassium, pō-tas'si-um; quinine, kwīn'in; réaumur, rā'ō'mūr; rhodium, rō'di-um; rubidium, rō-bid'i-um; ruthenium, rō-the'ni-um; selenium, sē-lē'ni-um; stoichiometry, stōi-ki-om'et-ri; strontium, stron'shi-um; sulphurous, sul'fer-us; tantalum, tan'ta-lum; tellurium, tel-lū'ri-um; terbium, tēr'bi-um; tetrad, tet'rad; tetratomic, tet-ra-tom'ik; thallium, thal'li-um; titanium, ti-tā'ni-um; titer, tīt'r; titrate, tīt'rāt; titration, tī-trā'shun; tungsten, tungs'ten; uranium, ū-rā'ni-um; valence, val'ens; vanadium, van-ā'di-um; ytterbium, it-ēr'bi-um; yttrium, it'ri-um; zirconium, zēr-kō'ni-um. — *Engineering and Mining Journal*.

PROTECTION AGAINST ACCIDENTS BY EXPLOSIVES IN NEW YORK.

A new series of regulations to govern the manufacture, transportation, sale, storage, and use of explosives within the limits of the city of New York has been issued by the Fire Department. These regulations have been drawn up by a committee consisting of General Fitz John Porter and S. Howland Robbins, Commissioners, with Carl Jussen as secretary and J. H. Striedinger, C.E., as expert.

In the explanatory notes, giving a classification of what are termed high explosives, viz., those that are more sudden and violent in their action and effect than gunpowder, and in the notes on the properties of certain high explosives, is to be found much information useful to all whose business brings them into contact with such materials.

The most important and well-known of these "high explosives" are the following:—

Nitro-glycerin, pure and simple. Dynamite, with explosive base, like dynamite or giant powder No. 1. Dynamites, with explosive base, like "Rendrock," "Vulcan powder," "Atlas powder," "Hercules powder," "Dualin," and "Judson powder." Explosive or blasting gelatin. Gelatin dynamites, like some varieties of "Foreite." The foregoing

are all nitro-glycerin mixtures. Gun-cotton, pure and simple, or prepared as tonite. Pierates, such as "Designolle" powder and pierie powder. Chlorates, like "Raekaroek." Sprengel's group of modern explosives, also called pan-elastites. Fulminates of mercury and of other metals.

The manufacture of all such explosives, gunpowder included, is forbidden within the city limits, and the regulations as to packing for transportation, transportation itself, sale and storage for sale, are such that, if properly observed, no explosion of a really dangerous character can take place. The permits for use, location and nature of magazines, are also well guarded, the applicant having to state in writing the proposed location, depositing a plan of the building, and furnishing a bond for 5,000 dols. for the payment of any loss, damage, &c. The permits are only for 12 months, non-transferable, and subject to revision and amendment at any time.

The restrictions limiting the amounts kept in main magazines, which must be well and substantially built of brick, stone, or concrete, or excavated in solid rock, earth, or mine refuse not liable to take fire, are reasonable, and, while protecting the public, offer no real impediment to business. The amount that may be kept in a main magazine, if not less than 50 yards from the nearest protected structure of the first class and 100 yards from the nearest protected structure of the second class, is 500 lbs. of blasting powder, or half that amount of high explosive. When the above distances are increased to 75 yards and 150 yards respectively, the amount may be increased to 1,120 pounds of blasting powder, or half that amount of high explosive. One very necessary and important regulation is that no detonators shall be kept in a high-explosive magazine. The definitions of protected structures of the first class comprise all buildings used for dwelling or manufacturing purposes, workshops, furnaces or fire-places for boilers, engines or other machinery, provided the same are occupied by the licensee, or that the persons occupying them consent in writing to the proposed location of the magazine, which consent shall be filed with the application for the permit. All highways, roads, streets, or avenues, open places of public resort, canals, and other navigable waters, docks, piers, sea-walls, or reservoirs, are also comprised in this class.

Protected structures, &c. of the second class comprise all structures, &c. not in the first class, and also all buildings used for religious, educational, charitable, or public purposes, or for purposes of amusement or instruction.

The directions for the use of explosives in blasting operations are so clear and sensible that we print them in full in another column, along with the notes on the properties of some of the high explosives.—*Engineering and Mining Journal*.

EXPLOSIVES REGULATIONS FOR THE CITY OF NEW YORK.

Directions for use in Blasting.

The cartridges delivered to the men shall be protected by them against frost, moisture, fire, and contact with iron, steel, or grit.

It is forbidden to use cartridges frozen or only partly thawed out.

It is forbidden to warm frozen cartridges by direct exposure to fire, by keeping them before fire-places, by putting them on stoves or in ovens, or by laying them on hot ashes.

1. It is required that frozen cartridges shall be returned to the foreman in charge and shall not be reissued for use until thoroughly thawed out.

2. It is required, in thawing out frozen high explosives, that one of the two following methods shall be observed, the first being the safest and most practicable for large quantities and therefore preferable:—

Put the boxes containing the explosives in fresh horse manure, or entirely surround the magazine therewith.

Put the cartridges in a double vessel consisting of two watertight tin kettles or pots, so made that one shall fit inside of the other and leave a space for water (which must be lukewarm) between the buttons and sides.

It is forbidden to attempt to break or cut cartridges entirely or partly frozen.

It is forbidden to prime more cartridges with fuses and detonators than are actually needed at the moment, or to keep on hand such primed cartridges.

It is forbidden to use metallic rammers in tamping drill-hole charges.

It is forbidden to "bring home" the tamping by powerful strokes.

It is forbidden to introduce into a drill-hole more than one primer, or to roughly handle the primer, especially while placing it on the top of the charge, or while tamping it.

It is forbidden to approach a drill-hole charge which failed to explode without waiting at least 10 minutes, counting from the time of setting fire to its fuse.

It is forbidden to remove the tamping of a charged drill-hole.

It is required, in case an attempt to fire a "missed blast" by means of exploding a strong primer on top of it is unsuccessful, that a new hole be drilled not nearer than 12 inches from the first one, and a fresh charge put in (that being the safest method), the explosion of which will probably be communicated to the first charge, or if it is not, will at least dislodge it. But the distance between these holes must be increased if there is any reason to believe that the nitro-glycerin mixture of the first charge has spread laterally.

It is forbidden, in case the explosion of a charge does not carry away the whole drill-hole, leaving the lower part intact, to use the remaining part of the old drill-hole as a starting point for a new drill-hole; because portions of the former charge may remain and explode when exposed to the blows of percussion drills.

It is forbidden to allow boys under twenty-one (21) years of age, or men who cannot read English, or are untrained in the care of high explosives, to be in the vicinity of hand magazines or handle such explosives.

It is required that, to ensure the safety of surrounding property and of persons in the vicinity, no larger charge shall ever be used than is necessary to properly start the rock.

It is required that rock excavations contiguous to any structure shall be so carried on as not to cause any damage to such structures. To secure this, weak walls, &c. of such structures must be shored up, and all rotten or decomposed rock must be removed by the use of gads, picks, and crowbars only. When blasting next to such structure is unavoidable, light face blasts only, with short lines of resistance and small charges, shall be used.

It is required that only careful, reliable, and thoroughly experienced foremen shall be employed in blasting operations.

It is required that in the neighbourhood of roads, houses, and objects which may be damaged by blasts, the shots shall be carefully covered (preferably with brush mattresses, facines, and the like), and the charges shall be so reduced in size that no flying about of debris shall be possible. Red flags shall be placed at reasonable distances from the blast on all sides; a whistle shall also be blown, or a bell rung, five minutes before the explosion takes place, to give all persons proper warning. Men shall also be stationed at the doors of houses in the immediate vicinity and on the different highways and sidewalks, to caution all persons against approaching the blast.

Notes on the Properties of certain High Explosives.

Pure nitro-glycerin, at 60° F., has a specific gravity of 1.6. It is odourless, nearly colourless, and has a sweetish, burning taste. It is poisonous. Handling it is apt to cause headache. It is slightly soluble in water. It will explode when heated to a temperature of about 356° F.

These properties undergo no change when nitro-glycerin is absorbed by other substances, in forming nitro-glycerin mixtures or dynamites such as those enumerated in the paragraph defining the term "high explosives."

The temperature at which nitro-glycerin mixtures freeze varies from 39° to 50° F., according to the difference in the methods of manufacture and the quality of the nitro-glycerin used. The use of such substances as silicious marl ("Kieselguhr") as an absorbent in the manufacture

of dynamite and giant powder No. 1, undoubtedly hastens their freezing.

Reliable experiments made in Austria show that frozen nitro-glycerin mixtures are less liable to explode from mechanical shocks than when they are not frozen.

When, however, the nitro-glycerin mixture is in a partly frozen condition, or when it is either in process of freezing or of thawing, its sensitiveness to explosion is greater than when in its normal condition, and it is then especially liable to be exploded by repeated light shocks, such as are produced in the operation of packing, transportation, &c. The experience both of the laboratory and of the factory confirms these views.

As before stated, nitro-glycerin mixtures explode at a temperature of about 356° F. They also explode by percussion, concussion, friction, pressure, &c., viz., by any act converting mechanical energy into heat.

By the use of fulminate of mercury caps as an initiatory explosive, the entire mass of nitro-glycerin mixture is converted into gas with such suddenness that it may practically be considered instantaneous; this sudden effect is termed "detonation."

In dynamites containing a large percentage of nitro-glycerin, the latter is liable to exude, or ooze out. This is especially so in warm weather or in thawing out at high temperatures.

Exposure to water is injurious to dynamites. In the high grades the water, by its great affinity for the inexplorable absorbent (Kieselguhr), drives out the nitro-glycerin; in the lower grades it is apt to dissolve the salts (nitrates of potash or soda, &c.) contained in the explosive absorbent, thus setting free the nitro-glycerin.—*Engineering and Mining Journal*.

OIL OF LEMON AND LEMON-JUICE IN SICILY.

In a recent report on the manufacture of lemon-juice and essential oil of lemons in Sicily it is stated that with all classes of lemons the yield of juice and its acidity varies considerably from month to month. The amount of juice increases from October to April, but its acidity and density decrease, and the same is the case with the density of the essence, owing to the winter rains. Raw and concentrated lemon-juice is exported in casks of 130 gallons capacity. It requires 1,500 lemons to yield 26 gallons (1 hectolitre) of raw juice, and 2,500 to yield the same quantity of concentrated juice, and about 200,000, according to their acidity, to give a cask. The lemons of the province of Messina, especially from the Eastern shore, contain more acidity than the lemons grown elsewhere in Sicily. The value of lemon-juice is governed by its acidity. The rule is that concentrated lemon-juice shall show 60 degrees of acidity, while the juice extracted from the bergamot or the sour orange must show 48 degrees, or one-fifth less than that derived from the lemon, and it also sells for one-fifth less than lemon-juice. Formerly a citrometer, known as Ronchetti's gauge, was used to ascertain the percentage of acidity; now, however, resort is had to chemical analysis, which is more satisfactory both to seller and buyer. Lemon-juice is used in the printing of calicoes, and for many other purposes. Of late years a new article, known as vacuum-pan concentrated juice of lemon, has been manufactured in Messina. The juice concentrated by this method contains 600 grains of crystallisable citric acid for every quart. It is exported in casks containing 112 gallons, in half and quarter casks. It is also shipped in bottles of 500, 300, and 150 grains each. This concentrated juice is as limpid as first quality oil. There is an establishment in Messina, probably the only one of its kind in Italy, that prepares crystallised citric acid. It takes from 340 to 380 lemons to make a pound of citric acid. The following is the process of preparing essential oil of lemon. The lemons are peeled lengthwise with a sharp knife, and the peel dropped into a tub under the chopping-block. The peeler then cuts the lemon in two and throws it from his knife into a bucket. He fills from 10 to 12 tubs with peel a day, and is paid 2½d. for a tub weighing 77 lb. The fresh peel is soaked in water 15 minutes before the essence is extracted. The operative holds a small sponge in his left hand, against which [and the *cevrille*?] he presses the epicarp of each piece of peel

two or two times, simple pressure followed by rotary pressure. The women employed in this work run a piece of cane through their sponges to enable them to hold them more firmly. The sponge when saturated with the essence is squeezed into an earthenware vessel which the operative holds in his lap. He is expected to press the peel so thoroughly as not to overlook a single cell. This is ascertained by holding the pressed peel to the flame of a candle, when it should not crack. The essence is skimmed off, bottled, and left to settle for a few days. It is then drawn off with a glass syphon into coppers, which are hermetically sealed. The expressed peel is used as a cattle food, or left to decompose and employed as a fertiliser. The industry is carried on five months in the year. Immature fruit contains most oil. From November to April, in the province of Messina, 1,000 lemons yield about 14 oz. of essence and 17 gallons of juice. An operative expresses about 190 lb. of lemon-peel a day, for which he is paid about 2s. 6d. Six men can work about 8,000 lemons a day; two cut off the peel while four extract the essence, and obtain 136 gallons of lemon-juice and 7 lb. of essential oil. In a bergamot-distilling establishment in Reggio, on the mainland, a hand machine for extracting essential oil is used. The skin of the unpeeled bergamot is punctured by a system of revolving knives and then gently pressed. It should be borne in mind that the bergamot is spherical in shape, and this machine could not therefore be used for lemons. A thermopneumatic essence extractor, worked by steam-power, has also been invented, but the old system is still in general use in Sicily on account of abundant and cheap labour. The method employed for the extraction of essential oil from the lemon applies also to the sweet and sour orange, the bergamot, and the mandarin.—*Chemist and Druggist*.

THE FOREIGN TRADE OF MADAGASCAR.

The following statistics of the trade of Madagascar for the year 1888 are extracted from the *Journal Officiel* for the 17th June last:—

The total value of the exports was 4,119,234 francs. The principal article of export is hides, valued at 1,760,801 frs. Then come caoutchouc, with a value of 1,366,211 frs.; rafia, valued at 441,079 frs.; wax, worth 280,243 frs.; and oxen assessed at 244,044 frs.

Articles were imported to the value of 4,050,779 frs. Textiles, with a value of 1,788,540 frs., constitute nearly one-half of the value of the total imports.

PRODUCTION OF PETROLEUM IN GALICIA.

The *Revue de l'Orient* gives the following account of the production of petroleum in Galicia:—

The most important springs of petroleum are found in the region of the Carpathian Mountains, and along the chain of those mountains, from Gryhow in the west to the frontier of Moldavia on the east. The annual product amounts to about 600,000 casks, that is to say, more than 90,000 tons. The system of working most generally in use is the Canadian system of tapping. The setting up of a complete system of tapping does not cost 1,000*l*. The most important centres are Bobz, where there are 42 production wells with a total yield of 2,000 casks a day—that is to say, 318 tons of petroleum; Vietzno, with one well yielding 200 casks; Vastova, which gives the best quality and the richest oil, containing 70 per cent. of oil for lighting purposes; Kryg, Lipinki, and Sloboda. The specific gravity of these qualities of petroleum varies from 0.92 to 0.79. Refining takes place by means of distillation, principally in order to obtain lamp oil. In several distilleries nothing is preserved except the first produce of the distillation, that is to say, only what is obtained at a low temperature. The remainder, especially the liquid tar, is taken elsewhere to undergo a second process of distillation. In other refineries the process is pushed as far as it will go at first until there is nothing left in the retorts but coke or cinder. At 40° the distillation gives a brownish-yellow benzene, which becomes whiter and whiter until 150° is reached. Between 150° and 300° various light oils are obtained which, subjected to a second distillation, produce lamp oils; beyond 300° those heavy oils are met with, from which fatty substances and paraffin are extracted.

The lamp oils, on leaving the retorts, cannot immediately be distributed to the trade, being as yet neither homogeneous nor pure. They are subjected to a treatment with sulphuric acid and a solution of soda. The acid serves to remove the resinous parts, while the solution of soda removes any excess in the acid. As to the paraffin, this is commonly extracted from gross oils of a green colour, having a density of 0.91. It is deposited in the form of a thick, mucous mass, which is collected in canvas sacks to be then compressed by hand, or with hydraulic or steam presses.

Among the principal refineries, that of Libuzza takes the first place. It produces several qualities of petroleum: "standard white," at 22 frs. 50 the quintal on delivery at Jagorzany; "prime white," at 33 frs. 75; "superfine white," at 25 frs.; "water white," at 26 frs. 25. The price of the cask is 3 frs. 75 and above per quintal of petroleum. Examined against a black background, the "standard white" is yellower than the "prime white"; looked at against the light it has the colour of an opal. The "water white" is perfectly translucent, and looked at against the light appears slightly bluish. The "standard" marks 47° R., and the firing point is 23°. This is the petroleum most generally used for lighting purposes and in commerce. In this Libuzza refinery the raw petroleum of the Kryg, Libuzza, and Lipinki regions are treated. At the Kolomea refinery the petroleum of those of Hoboda and Rofa.

It is found that Galician petroleum burns best in lamps with a diametrical wick, while the American petroleum gives more satisfaction when used with a wick of circular form. A comparison of the yield in refined petroleum of various quantities of petroleum from different countries gives the following result:—

- 100 kilos. of Russian raw petroleum gives 45 per cent. of refined petroleum.
- 100 kilos. of Galician raw petroleum gives from 50 to 52 per cent.
- 100 kilos. of American raw petroleum gives from 60 to 63 per cent.

THE TRADE IN MASTIC.

The *Journal de la Chambre de Commerce de Constantinople* for the 22nd June last has the following note with reference to the trade in mastic:—

The Administrative Council of the island of Chio recently made a study of the best means of raising the price of mastic, which had remained at a low price for several years. Among other measures it was decided to prohibit:—

1. The repeated incisions in the trees.
2. The offering for sale of impure, yellow, or black mastic.
3. The mixing of this native product with dust or with residues of the tree bark, more or less impregnated with mastic.

Since these salutary measures have been adopted and carried out, the price of the mastic has advanced to an appreciable extent, and the Government of the island informs the commercial world that, for the future in respect of this article:—

1. The bark of these resinous trees must not be tapped more than twice a year, and that at fixed and determined periods.
2. There must only be gathered the white mastic, free from powder or from any other foreign substance.

THE ADULTERATION OF CITRONELLA OIL IN CEYLON.

The *Ceylon Observer*, with reference to the adulteration of citronella oil in Ceylon, says:—

"A correspondent (evidently a native) reported as follows to a contemporary some little time ago:—

"A few weeks ago about 650 cases of kerosine oil were taken to the Weligama Custom house by boat, either from Galle or Colombo. Of these about 500 cases were taken to Matara, Akurassa, Weligama, and Kumburupitiya. It is highly improbable that such a large quantity of kerosine oil would be used for lighting purposes by the people of those districts. The reason for such a large consignment of kerosine oil is easily explained. Kerosine oil is now being largely used for adulterating citronella oil, and so

there is now a large demand for it. Villagers in the places mentioned may be seen conveying kerosine oil to places where citronella oil is stored, the two oils are then mixed in certain proportions and sold to several European firms in Galle and Colombo as good citronella oil. If European merchants think that the citronella oil as supplied them by their contractors, and that supplied direct by the proprietors of citronella estates, are the same, they make a great mistake; for the oil supplied by proprietors and manufacturers is pure and free from any adulteration. It will now strike European merchants as strange that, in the contract which they entered into between themselves and the contractors, there is generally a conditional clause to the effect that the oil supplied by contractors will be *market oil*. If any dissatisfaction is ever expressed by a merchant as regards the oil thus supplied, the contractors' plea is that it is market oil, and they are not responsible for its quality; but such an excuse could not be made by a proprietor."

"We asked the opinion, on this subject, of perhaps one of the best authorities in the island, at least of those resident in citronella-planting districts, and he reports as follows:—

"Some five years ago I took a trip to the principal citronella-producing district to investigate this very matter, and was much surprised on being told by one of the largest buyers of this oil that the great bulk of citronella was largely adulterated with kerosine. Indeed, he said that up to 25 per cent., detection, so far as he knew, was impossible. The increase of cultivation since then has been out of all proportion to the increase of citronella exportations, while a large acreage of the old grass must by this time be decreasing in yield; therefore, I do not doubt that the adulteration is increasing in proportion.

"Lately, at Nuwara Eliya, I met a gentleman from England, who is a large buyer of Ceylon citronella oil, who informed me that he could not get it pure in the market."

THE PRODUCE OF LAGOS.

In a letter to the African Trade Section of the Liverpool Incorporated Chamber of Commerce, his Excellency C. A. Moloney, C.M.G., Governor of Lagos, referring to various specimens of the products of Yoruba which he had brought from Lagos, and which he had left with the Chamber at Liverpool, says:—

"*Gum*.—Specimens about $\frac{1}{2}$ cwt. each. These are really resins. Much inferior samples have been valued in England at 96*l.* to 120*l.* per ton.

"Trade has made a start at Lagos in this commodity, small consignments having realised from 40*s.* to 50*s.* per cwt.

"There is room for a considerable development of this industry. Yoruba abounds in the article.

"The native name '*ogea*' is generally applied to gum, as is '*ibo*' to rubber.

"The tree yielding this resin has been given by Professor Oliver, of the Royal Gardens, Kew, as a *Daniellia*, and will probably prove a new species.

"You have also with you two or three small samples of gum I got at Benin; it is deeper in colour and somewhat different in smell from the Yoruba '*ogea*.'

"*Rubber*.—Rubber is in its infancy in the colony of Lagos. We have there several *Landolphas*, which yield the best white rubber of commerce. In view of the success of this industry in the Gold Coast Colony within six years, Lagos bids fair to rival the sister colony before long.

"Interesting experiments on the *Abba* juice have been made by Mr. Alvan Millson, Commissioner of Badagry, which were fully published in the Government *Gazette*. He deserves considerable credit for his efforts in the direction of promoting the economic botany of his district. This industry requires greater attention and persistent efforts put forth.

"*Cocoa-nut Industry*.—Lagos offers a fair field for the establishment of an oil-crushing business conducted on a small scale at first. Cocoa-nuts can be there purchased, as they fall from the tree, at 2*s.* to 2*s.* 6*d.* per 100,

"In connexion with any cocoanut-crushing business, an addition with profit might be made by associating with it the preparation of fibre, in which Yoruba is rich. As examples—

"*Coir*.—You have some samples roughly prepared in the Lagos gaol. It has been divided in England into three samples, as is required by the trade, which have been valued respectively at 10*l.* to 11*l.* per ton, 18*l.* to 19*l.* per ton, and 29*l.* to 31*l.* per ton.

"*Sausieria Guineensis*.—The Yoruba name for this commodity is '*ojathoka*,' which is generally indeed applied by Yorubas to *Sausieria* fibre. West Africa is rich in species. I had some fibre roughly prepared in the gaol from the *Sausieria Guineensis*. It unfortunately arrived damaged, and, notwithstanding, has been valued at 15*l.* per ton. I am informed that, if properly prepared and carefully shipped, it should realise from 20*l.* to 30*l.* per ton. Samples are at Liverpool.

"*Honkenya Ficifolia (Tiliaceae)*.—This is a jute-like fibre, and might be cultivated to any extent in Yoruba. Samples sent to England have been valued at 16*l.* to 17*l.* It compares favourably with Indian jute. The native name of this plant is '*bolobolo*' in Popo, and in Yoruba, '*Aghorin Ilasa*.'

"You have also another tiliaceous fibre, native name Toja, closely allied to the *bolobolo*, which has been valued at 17*l.* to 18*l.* per ton. This plant is capable of extensive growth, and deserves attention.

"Next you will notice a large bunch of grass-like fibre, composed of epidermal strips of the leaves of the *Raphia vinifera*, or what is commonly called *bamboo*. In 1886, Messrs. Cross and Bevan, consulting chemists, London, called special attention to this yield, and said it should command a high price amongst gardeners and nurserymen, as did Madagascar *rafia*. I left with you a bunch of West African *rafia* dyed black.

"The *white clay* (used for personal adornment—I should say disfigurement—in Yoruba) comes from Okeodan, behind Badagry, and may deserve attention. Could it be put profitably to any use at home? The leguminous pods are seeds used medicinally by the natives.

"There are also samples of camwood and barwood (*Baphia nitida*) from Benin river, and a native mangle of country wood sent to me as ebony.

"*Indigo*.—Yoruba land is famous among West Africans for its blue dyeing. Over it are found many botanical species that yield the indigo of commerce. Some time back, through the courtesy of Kew, I had some specimens, prepared on the Niger, analysed. The report was that it was worth 4*s.* to 4*s.* 6*d.* per lb. If prepared with care it might compete with Bengal. A large field here offers for development."

THE PITCH LAKE OF TRINIDAD.

A legislative order was passed some time ago in the West Indian island of Trinidad which may effect the commercial position of asphalt. The order raises the export duty on asphalt from 2*s.* to 5*s.* a ton, and the receipts from this source have been more than trebled in 1888. Most of the asphalt shipped is obtained from the Pitch Lake, which is the property of the Crown. The whole of the lake, with the exception of five acres, was from time to time between 1867 and February 1888 leased at almost nominal rates to private individuals or companies, but so long as the five-acre reserve was maintained no monopoly could be established. In November 1886 the Government gave notice that licences would be issued for the winning of pitch from this five-acre lot. The lessees, who, it appears, had formed some sort of coalition, ventured to dispute the right of the Government to grant such licences, but their appeal to the Privy Council was rejected. They thereupon adopted other means, and after much negotiation it was arranged that they should be granted a concession entitling them to the exclusive right of winning asphalt from the lake on payment of a royalty of 1*s.* 8*d.* and an export duty

of 5s. for every ton shipped, they on their part engaging to ship not less than 30,000 tons per annum. The minimum payment to be made by the concessionnaires is thus fixed at 10,000*l.* a year, which, as already stated, is very largely in excess of the annual income formerly derived from the Pitch Lake. The new arrangement is working very satisfactorily, and thus the colony has turned to profitable account a mine of wealth which has hitherto been regarded as little more than a natural curiosity and a show place for persons visiting the island.—*Chemist and Druggist*.

GATHERING SULPHUR FROM VOLCANO PITS.

The barque "Belle of Oregon" landed at Philadelphia a few days ago 300 tons of sulphur gathered from the extinct volcanoes in Japan. It is reported that the Japanese have recently found that the craters of some of the extinct volcanoes with which their islands abound are rich in sulphur. The ship "Cheesbrough" has been chartered to load a similar cargo at Hakodadi, Japan, for Sandy Hook, at seven dollars per ton.—*Engineering and Mining Journal*.

PRODUCTION OF SULPHUR IN ITALY IN 1888.

We are indebted to Mr. A. de Forester, Chargé d'Affaires of Italy, in Washington, for the following information concerning the sulphur production of Italy in 1888. It was furnished to this Legation by the Royal Ministry of Agriculture, Industry, and Commerce:—

—	Tons.	Lires.	Dollars.
District of Bologna....	19,254	1,554,825	= 310,385
" Sicily.....	322,042	21,512,405	= 4,302,481
" Naples	35,252	1,945,784	= 389,156
Total	376,538	25,013,014	= 5,002,602

—*Ibid.*

CHROMATES FROM NEW CALEDONIA.

Potash chromates begin to come in from New Caledonia. The extraction processes, as described by M. Kienlen before the Paris Chemical Society, are either of the following:—(1.) The chrome-iron ore, previously powdered by quenching, is heated for 10 hours in a reverberatory furnace with quicklime and an alkaline carbonate. The product, on being mixed with a solution of soda sulphate, and treated with sulphuric acid, yields soda chromate and sulphate, easily separated by crystallisation. (2.) M. Schwartz's method, in which alkaline sulphates are substituted for the carbonates. The ore is heated with a mixture of soda sulphate and carbonate; in the neutral chromate solution a stream of hydrochloric acid is run, which precipitates most of the sodium chloride, after which the chromate is purified by crystallisation. According to M. Friedel, sulphate of lime alone will decompose the chromite ore, but very high temperatures are necessary.—*Chemist and Druggist*.

USE OF ROBURITE IN MINES.

A conference of the Lancashire Miners' Federation was held at Wigan on July 4th, when a special report, which had been prepared by a committee appointed by the Federation to make investigations into alleged injurious effects upon the health of the miners caused by the use of roburite for shot-firing purposes in mines was brought up for consideration. This report, which is the joint production of the whole of the committee, consisting of Mr. S. Woods, the president; Mr. T. Ashton, secretary of the Federation; Mr. T. Aspinwall, and four colliers, takes the form of a criticism upon the conclusions arrived at by Messrs. H. B. Dickson, C. J.

Mounsey, and N. Hannah, who were appointed jointly by the employers and workmen engaged at the Garswood Coal and Iron Company to investigate and report upon the effect of roburite fumes on the health of the workmen. The committee appointed by the Lancashire Miners' Federation complain that the operations expressed in the report of the specialists, who are two medical practitioners and an analyst, are so shrouded in a multitude of technical scientific statements that it is difficult to discover what their conclusions really are; but the report, it is pointed out, evidently establishes the following points, namely:—

1. That the fumes of roburite, when inhaled into the system, are an exceedingly deadly poison, even in the smallest quantity.

2. That when these fumes are inhaled into the system in a coal mine they carry with them two poisonous gases, differing from each other only by a little in their harmful effect on the human system, viz., nitric oxide and carbonic oxide.

3. That roburite may be safe while kept in the sealed cartridges, but the moment they are broken and exposed to the air, the substance is so volatile and poisonous that it at once becomes a great source of danger.

4. That incomplete or partial combustion of roburite allows the deadly elements of the composition—nitrobenzine—to escape and freely mix with the air in the mine, and therefore to be breathed by the men or absorbed by contact with the skin.

5. That roburite fired in coal dust gives off a recognised quantity of carbonic oxide.

6. That in handling roburite the greatest possible care is necessary, the greatest danger is risked, and the slightest departure from this may be followed by serious results.

7. That in the cases examined of men who had worked in places through which the roburite fumes had passed, they suffered from carbonic oxide poisoning when small quantities of the gases mixed with air had been inhaled.

8. That specially-trained men only should manipulate or be entrusted with roburite.

9. That no miner would be safe in his place until all the fumes had disappeared.

10. That where roburite is used the ventilation must be perfect, with a large quantity of air, and the brattice must be kept close to the coal face.

These 10 facts, it is urged, surely fully establish the whole of the miners' contention that overhead fumes are injurious to the health of the workmen.

After some discussion, the report was unanimously adopted by the Conference, and as a result, the future use of roburite in mines for shot-firing purposes will be opposed by the workmen.—*Iron and Coal Trades Review*.

THE ALCOHOL QUESTION IN SPAIN.

A new Act dealing with the duties on alcohol came into force on the 1st July. The matter is one of general interest, because in the natural course of events it should lead to the establishment in Spain of distilleries on a large scale. At the same time it may be anticipated, owing to the want of knowledge and enterprise on the part of Spanish capitalists, that it is only foreign capitalists who would be likely to produce alcohol in Spain under conditions likely to lead to success. The following are the chief features of the new law: Foreign alcohol of any strength continues to pay an import duty of 21 pesetas per hectolitre. All alcohol produced from anything but grapes pays 25 pesetas per hectolitre, whether of foreign or home production; the foreign spirits, however, have to pay the duty on passing the Custom house, while that made in Spain does not pay duty until it leaves the distillery where it is made. Two results may be expected, one of which might be immediate, while the other might take years to show itself. The first is that alcohol will cease to be imported. There is no reason whatever, leaving want of enterprise out of account, why alcohol, either

from grain or potatoes, should be more cheaply produced out of Spain than in Spain; and as the import duty, freight, insurance, and other import expenses come to about 50 per cent. on the prime cost, it should not be expected that the import should continue. Spirits can possibly be produced here at a lower cost than in Germany or Sweden, using the same processes and under equally intelligent management. Where land and labour are cheap it is only bad cultivation and want of manure which make agricultural produce dear. Combining the growing of potatoes and Indian corn with the production of spirits on a large scale would cause all difficulties to disappear. If English capital does not take the lead in this direction, German or Belgian capital will. The requirements of Spain may be taken at an annual wholesale value of 20,000,000*l.* so that it can be seen that the business is a large one. There is also another question in connexion with this subject. Grapes grown specially for the production of alcohol, without regard to the quality required in the grapes to make wine, and dealt with properly when gathered, will give alcohol at a lower cost than that obtained from any other material, and of a much better quality; but of course ten or twelve years would be required to prepare a vineyard specially for the production of alcohol.—*Industries.*

UNIFORM NOMENCLATURE FOR MATERIALS MADE OF IRON OR STEEL AND USED ON RAILWAYS.

Dingl. Polyt. J. 272, 46—48.

The Prussian Ministry has decreed that henceforth different kinds of iron and steel are to be known and described by specified terms. A very large number of these are given divided under two headings, viz., names having reference to method of manufacture, and names which depend on the application of the material. The former are divided into six chief groups—(1) crude iron; (2) cast iron; (3) weld iron; (4) weld steel; (5) ingot-iron; and (6) ingot-steel.—A. R.

GERMAN MANUFACTURE OF TIN.

The manufacture of tins and the putting up of goods has grown to such dimensions in Germany that the French are finding great competition, and one large Nantes (France) sardine house has a branch in Strasburg. Most of the canning houses manufacture their own tins.—*Ironmonger.*

PROPOSED STEELWORKS FOR ITALY.

Italy appears about to advance another stage as a manufacturing country, for some English capitalists intend investing 100,000*l.* in erecting works for reducing the ores to be obtained from some mineral deposits, which are stated to have been discovered in a mountain only $2\frac{1}{2}$ miles from the sea in the province of Pisa. This will do away with the transport of the minerals to Swansea for reduction, and return to Italy in a metallic state, which adds two freights and a duty to the cost of reduction. These deposits are reported to consist of tin, copper, lead, and manganese. It is stated that there is also a very rich deposit of iron ore suitable for steel-making. From this latter ore the company proposes to manufacture large steel gun-forgings. This class of ordnance is now largely coming into use, and it is stated that Armstrong and Co. have not provided for the production of such forgings at their new works near Naples. The requirements will, therefore, be met by the proposed works.—*Ibid.*

FRENCH REGULATIONS FOR PREVENTING FRAUDS IN THE MANURE TRADE.

(See this Journal 1888, 143.)

The recent law respecting artificial manures provided, among other things, that suitable regulations should be published by the administration to ensure uniformity in

chemical analyses and to avoid contentions, when fertilisers are sold according to the percentage of useful constituents. Artificial manures are often purchased at the rate of so much for combined nitrogen, so much for soluble phosphoric acid, &c., and chemists know that to have comparable analyses it is almost indispensable that similar processes be followed. Consequently, with the advice of experts, the following rules have been set down:—(1) Nitrogen shall be estimated as follows: (a) In the shape of nitric acid; turn into nitrogen binoxide by ebullition with ferrous chloride, and measure the gas evolved. (b) Ammoniacal nitrogen; distil with caustic alkali in an ascension condenser, and titrate the ammonia. (c) Organic nitrogen; all nitrates having been removed, treat with either soda lime, and titrate the ammonia formed; or with sulphuric acid containing a little mercury, and estimate the ammonia sulphate by the ammonia process as above. (2) Phosphoric acid: (a) The total acid; dissolve the substance in hydrochloric acid in the presence of ammonia citrate to keep iron, alumina, and lime in solution, and estimate, after precipitation, as ammonio-magnesia phosphate, in the shape of magnesia pyrophosphate. When too much lime is present, separate it out with oxalate of ammonia. (b) Soluble phosphoric acid; macerate the specimen for a reasonable time with distilled water, and treat the filtered liquid as above. (c) Phosphate soluble in ammonia citrate; macerate for twelve hours in alkaline ammonia citrate, and treat the filtrate as has been said before. Note: In the three foregoing processes the phosphoric acid may be first precipitated with ammonia nitro-molybdate and then estimated as magnesia pyrophosphate, as has been explained. (3) Potash: (a) Estimate as perchlorate which is to be washed with alcohol, dried, and weighed. (b) With platinum; precipitate the potash with platinum chloride, wash the precipitate with alcohol, and reduce it with soda formiate; weigh the platinum black, and calculate the corresponding weight of potash. (c) As double chloride of platinum; wash the precipitate with alcohol, dry, and weigh it. Of course proper directions are also given for taking the samples to be analysed. And, finally, a scale of prices is established as follows:—For each element estimated 10 frs., and for the report 25 frs. For one fertiliser, however, whatever may be the number of elements evaluated, the cost of the whole analysis shall not exceed 50 frs. To further ensure the operation of the law, a number of experts have been appointed in all parts of France, who shall be entitled to 6 frs. for each three hours' sitting when taking samples, travelling expenses to be borne by the State.—*Chemist and Druggist.*

PRODUCTION OF SUGAR IN THE WORLD.

Stamner. Dingl. Polyt. J. 271, 266—278.

The following tables show the quantities of sugar produced and consumed in the world:—

1. SUGAR PRODUCED.

(a.) Beet Sugar in Tons.

	1887-88.	1886-87.
	Tons.	Tons.
Austro-Hungary	400,000	550,000
Germany	915,000	1,024,000
France	400,000	483,000
Russia	430,000	472,000
Belgium	93,000	91,000
Holland and other countries	60,000	50,000
Total	2,427,000	2,670,000

(b.) *Cane Sugar in Tons.*

	1887-88.	1886-87.
	Tons.	Tons.
Barbadoes	55,000	50,000
Brazil	270,000	250,000
Cuba	625,000	625,000
Demerara	100,000	130,000
Egypt	50,000	45,000
Guadeloupe	50,000	52,000
Hawaii	90,000	90,000
Jamaica	50,000	25,000
Java	390,000	360,000
Louisiana	140,000	90,000
Martinique	40,000	40,000
Mauritius	115,000	100,000
Natal and Mayotte	12,000	12,000
East Indies	50,000	50,000
Peru	40,000	40,000
Philippines	160,000	150,000
Porto Rico	70,000	80,000
Reunion	10,000	35,000
St. Croix and Antilles	45,000	45,000
Trinidad	55,000	60,000
Total	2,427,000	2,335,000
Cane and beet sugar together	4,725,000	5,005,000

II.—CONSUMPTION PER HEAD IN POUNDS (500 GRMS.)

Germany	Lb. 18'64	Spain	Lb. 7'49
Austro-Hungary	11'08	Portugal	9'00
France	22'83	England	66'57
Russia	8'64	Bulgaria	3'30
Holland	19'94	Greece	10'0
Belgium	18'32	Servia	2'94
Denmark	19'05	Turkey	4'33
Norway and Sweden ..	17'42	Switzerland	21'37
Italy	7'19	United States of North America	47'19
Roumania	3'86		

III.—SUGAR CONSUMPTION IN TONS.

	1887.	1886.
	Tons.	Tons.
England	1,179,000	1,108,000
France	423,000	425,000
Germany	445,000	430,000
Austro-Hungary	250,000	245,000
Russia	360,000	344,000
Italy	100,000	97,500

	1887.	1886.
	Tons.	Tons.
Spain	50,000	49,000
Turkey	45,000	42,500
Belgium	46,000	45,000
Holland	45,000	44,000
Norway and Sweden	44,000	42,000
Switzerland	40,000	40,000
Denmark	36,000	35,000
Portugal	16,000	15,500
Roumania	13,000	12,500
Greece	9,000	10,000
Servia	4,000	3,500
Montenegro	1,000	1,000
United States of North America	1,397,000	1,389,000
Total	4,503,000	4,376,500

—W. M.

BEET SUGAR INDUSTRY IN JAPAN.

Dingl. Polyt. J. 271, 278.

The beet sugar factory at Mombetsu, in the island of Yesso, Japan, continues to work, and has made a small profit. The beet crop has been small, and this is chiefly due to the land being split up into very small farms, the owners of which have not much intelligence or appliances for working economically. The Government, however, is helping the farmers.

Experiments have also been made at Sapporo on the growing of beet, and the roots have been found to contain 12½ per cent. of sugar. A company has been formed to start a factory there and in this the Government is a large shareholder.—W. M.

NEW AUSTRIAN PHARMACOPŒIA.

The committee appointed to prepare a new addition of the Austrian Pharmacopœia has completed its labours; the seventh edition will be published forthwith, and will come into force on January 1, 1890. The last edition was published on October 1, 1869, so that it is not surprising to find in the list of drugs and preparations introduced for the first time many which now take rank among well-established remedies. Amongst the newer remedies which find a place are antifebrin, antipyrin, cascara sagrada, lanoline, betanaphthol, oil pini pumilionis, strophanthus, thymol, and vaseline. There are altogether 578 articles in the seventh edition, which is 43 more than there were in the last. A very considerable advance is shown in that part of the work devoted to the testing of drugs and chemicals; the apparatus to be used is described, and the tests are those best designed to detect common impurities. Volumetric analysis is applied to the estimation of the strength of certain compounds, such as the mineral and dilute acids. The opium to be used in making medicinal preparations is to contain 10 per cent. of morphine, while the cinchona is to be succimbra, of 3·5 per cent. alkaloidal value. Lanoline is defined as purified wool fat containing 30 per cent. of water. Chloroform is to have a specific gravity of 1·485—1·500, so that it may contain a little alcohol or none at all, and in the latter case the article will be liable to spontaneous decomposition, while the alcoholised one will be permanent. Sulphate of quinine is to be tested by Kerner's method, the temperature of solution being fixed at 60° C. as determined by the French Commission. In galenical preparations a little attempt has been made to fix the proportion of the active ingredient of those which are toxic. A few fluid

extracts are introduced, and for the preparation of several ordinary extracts, such as aconite, belladonna, Indian hemp, male fern, and nux vomica, percolation is for the first time employed. Most of the tinctures are to be made 1 in 10, and more precise directions are given regarding pressing and filtration. It is noticeable in regard to ointments that vaseline is not employed for any one of them, but lanoline is used in making ung. hydrargyri. Lead plaster is to be made with lard and litharge. Synonyms, which hitherto have accompanied the scientific and common names of the articles, are now placed in a table at the end of the book. To take their place we have the names of the preparations used in foreign Pharmacopœias, this being perhaps the most useful and sensible addition to the Pharmacopœia, considering the frequency with which continental pharmacists are now called upon to dispense foreign prescriptions. We propose on another occasion to more fully criticise this new Pharmacopœia, especially in regard to the influence which the international scheme has had upon it.—*Chemist and Druggist*.

GERMAN SOCIETY FOR THE PROTECTION OF CHEMICAL INDUSTRY.

The annual meeting of the Society for the Protection of Chemical Industry in Germany was held in Hamburg on July 2, under the presidency of Dr. Holtz, of Berlin. The Society's report for 1888 speaks favourably of the condition of the German chemical industry in general, and points out that the extension of the combination movement has been advantageous, less through the advance in price caused by it than because it has steadied business in general and succeeded in limiting surplus production. The number of chemical works in the whole of Germany at the close of 1887 was 4,325. At the end of last year it had risen to 4,464. The aggregate of working days in the whole of these works had been 24,375,434 in 1887, and 25,100,024 in 1888, while the money paid in wages had increased from 62,710,380 m. to 65,644,013 m., or, from 765 m. to 773 m. per head. The import of raw materials from foreign countries had increased by 124,552 tons; the export of manufactured chemicals by 33,890 tons. A careful analysis of the financial results of the year's working, as shown by the balance sheets of companies, showed an average dividend of 6.20 per cent. for alkali works, 8.05 per cent. for artificial manure works, 10.89 per cent. for manufactories of pharmaceutical and technical preparations, 13.25 per cent. for explosives works, and 15.44 per cent. for coal-tar dye works. The average percentage of dividends for the entire chemical industry was 8.50 per cent.—*Ibid*.

THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCES.

The French Association for the Advancement of Sciences will hold their annual meeting from August 8th to 14th, at the School of the Ponts-et-Chaussées, 28, Rue des Saints-Pères, Paris. A number of interesting papers have been announced, and among the following bearing on chemical subjects: On Quibar, by M. d'Abbadie, of the Académie de Sciences; nitro and nitroxy combinations, Professor P. Alexeyeff, of Kief, Russia; carbon and spectroscopy, by pharmacist P. van Assche, of Rouen; starchy adulterations of pepper, M. G. Bertèche, of Valenciennes; ozone, Professors Bichat and Guntz, of the Nancy Faculty of Sciences; the photometry of incandescent lamps, and a standard for actinometers, Professor A. Crova, of the Montpellier Faculty of Sciences; on ammonia protoxide, on hydrogen protonitride, and on the acid S_2O_2 , by Professor Mauméné, of the Lyons Free Faculty of Sciences; the Eiffel Tower meteorological observatory, anemometers and anemoscopes, self-registering galvanometers, by M. Richard; electrodynamics and the motion of planets, spectroscopy of the ultra-red and ultra-violet parts of the spectrum, by Professor Zenger, of the Prague Polytechnic School. Some 18,000 frs. have been this year granted by the association to aid various researches, none of which, however, have reference to chemistry.—*Ibid*.

SENEGAL CASTOR OIL.

According to a suggestion made by pharmacist Castaing, of the French Navy, Senegal planters have commenced cultivating castor beans for export to Marseilles. So far, they have found the crop more remunerative than pea-nuts, which are produced at very low prices in the Levant and the East Indies. By the way, the quantity of castor beans received at Marseilles has considerably increased of late. In 1877 the imports amounted to 3,190 cwt. and to 67,980 in 1879, while in 1881 they rose to 181,000 cwt. Nevertheless, the demand has kept up with the supply, because new uses have been found for the oil. Perfumers consider it an excellent pomade basis; soapmakers highly appreciate it; and considerable quantities are used by machinists for lubricating, and dyers for Turkey-red. The consequence is that only an insignificant percentage, but, of course, the finest quality, of the oil is kept for pharmaceutical purposes.—*Ibid*.

IMPORTANT LEGAL DECISION.

A very important decision in commercial law has just been given by Lord Trayner in the Glasgow Court of Session. The pursuers were the Seville Sulphur and Copper Company, and the defenders Thomson, Dickie, and Co., marine insurance brokers, both of Glasgow. A cargo of pyrites, which had been insured by the defenders for the pursuers, had been lost, and a claim was made for over 6,000l. The policy had been underwritten by 13 underwriters. Three of these paid the loss claimed, but 10 had become insolvent, and only a moiety of the sum for which they were liable had been recovered from their estates. In these circumstances, the pursuers charged their brokers with carelessness in their selection of underwriters, and claimed upon them to make good the loss. They pleaded the exercise of due caution, and non-liability in consequence. The judge decided in favour of the defenders.—*Ironmonger*.

MERCHANDISE MARKS ACT (1887) AMENDMENT.

The following Bill to amend the Merchandise Marks Act, 1887, has been introduced into the House of Commons by Mr. Broadhurst, the Hon. Bernard Coleridge, and Mr. Fenwick:—

1. This Act may be cited as the Merchandise Marks Amendment Act, 1889, and shall be read and construed with the Merchandise Marks Act, 1887, as one Act.
2. All goods of foreign manufacture imported into this country shall be plainly and distinctly marked with the names of the country and place in which such goods have been manufactured. Where it is impossible to place such names on the goods themselves, all parcels or packages, of whatever size or quantity, shall bear on the cover or thing in, on, or with which any such goods are sold or intended to be sold or offered for sale, the names of the country and place in which such goods have been manufactured.
3. All goods manufactured in Great Britain and Ireland shall be plainly and distinctly marked with the name of the manufacturer and the name of the town in which such goods have been manufactured. Where it is impossible to place such names on the goods themselves, all parcels or packages, of whatever size or quantity, shall bear on the cover or thing in, on, or with which any such goods are sold or intended to be sold or offered for sale, the name of the manufacturer and the name of the town in which such goods have been manufactured.
4. In cases where machinery has entered into competition with skilled labour in the manufacture of goods, all such machine-made goods shall be marked as such.
5. Every mark or name placed on any goods or on any cover or thing in, on, or with which any goods are sold, or intended to be sold or offered for sale, shall be deemed to

be classed as manganese ores; the remainder as mangani-ferous iron ores. Of the mangani-ferous iron ores 11,462 tons, averaging 11 per cent. of manganese, and 189,574 tons, averaging 4 per cent. of manganese, were from the Colby mine, Michigan. In addition to the above, some 60,000 tons of argenti-ferous manganese ores, valued at 10 dols. a ton, chiefly for the silver contained in them, were produced in the Rocky Mountain region.

Aluminium.

The past year was more promising than ever before for the production of cheap aluminium. The production of metallic aluminium as an industry distinct from the production of alloys began towards the close of the year, and 500 pounds had been made up to December 31; the production of 3,000 pounds since then indicates that the industry may continue. The exact amount of alloys produced by the Cowles process has not been furnished, but was not markedly different from the product of 1887, when 18,000 pounds of aluminium contained in bronze and ferro-aluminium were produced. The price for metallic aluminium declined to as low as 4.50 dols. per pound for less favoured brands.

Platinum.

Including the platinum and iridium separated from gold by the assay offices and that saved in placer gold mining, the product was about 500 ounces, valued at 2,000 dols.

FUELS.

Coke.

The production of coke in the United States in 1888 was 8,527,560 tons, valued at about 14,000,000 dols. Pennsylvania produced by far the largest amount, the Connellsville region alone producing 4,955,553 tons; West Virginia, 528,533 tons; Alabama, 518,511 tons; Tennessee, 385,693 tons; and Virginia, 149,099 tons.

Petroleum.

The product of petroleum in the United States in 1888 was 27,346,018 barrels (of 42 gallons each), valued at about 24,598,559 dols. Of this amount Pennsylvania produced 16,491,083 barrels; Ohio, 10,010,868 barrels; West Virginia, 119,448 barrels; California, 704,619 barrels; and other States 20,000 barrels.

MISCELLANEOUS.

Cement.

The amount of cement produced in 1888 is less than for 1887, being 6,253,295 barrels for 1888, valued at 72½ cents per barrel, making 4,533,639 dols. as the value of the year's product.

Phosphate Rock.

The production declined to 433,705 long tons, but the total value increased slightly to 1,951,673 dols. on account of better prices. The trade in manufactured fertilisers was very prosperous.

Salt.

The industry shows only slight changes. In 1888 the production was 8,055,881 barrels of 280 pounds, valued at 4,377,204 dols. In 1887 the product was 8,003,962 barrels, worth 4,093,846 dols. Kansas became a commercial source of salt in 1888, producing 155,000 barrels, with a prospect of still greater increase in 1889.

Bromine.

The product was 307,386 pounds, worth 95,290 dols., an increase from 199,087 pounds in 1887, worth 61,717 dols. The price remained at 31 cents per pound.

Borax.

The production was restricted to 7,589,000 pounds, worth 455,340 dols., at 6 cents per pound for the average quality. In 1887 the product was 11,000,000 pounds, worth 5 cents per pound.

Sulphur.

The sulphur refinery in Utah was partially burned. This and litigation over the property prevented any production in 1888. The supply came principally from Sicily, with small importations from Japan. It was practically all made into sulphuric acid.

Pyrites.

Production 54,331 long tons, valued at the mines at 167,658 dols., a slight increase in quantity over the previous year.

Barytes.

The production from Missouri, Virginia, and New York increased to 20,000 long tons, worth at the mines 110,000 dols. In 1887 the product was 15,000 long tons, worth 75,000 dols.

Gypsum.

The domestic supply comes principally from Ohio and Michigan, with smaller amounts from New York, Virginia, Kansas, Colorado, California, Dakota, and Utah. The product in 1888 was 96,000 short tons of crude gypsum, valued at 430,000 dols. A large portion of the supply is imported from Nova Scotia, where 126,118 tons, worth 121,579 dols., were produced in 1888.

Ozokerite.

From the region of Soldier's Summit, Utah, about 20,000 pounds of crude mineral wax were produced, worth 1,000 dols. in New York, where the material was sold. An increase is probable in 1889.

Soapstone.

Production about 15,000 tons, worth 50,000 dols. before shipment.

Asphaltum.

The product of 1888 includes 700 tons of gilsonite mined in Utah, 3,100 tons of ordinary asphaltum, principally from California, and 50,000 tons of bituminous rock quarried in California for pavements in competition with asphaltum; total value, 331,500 dols.

Feldspar.

The consumption for potters' use declined to 8,700 long tons, worth, in Trenton, New Jersey, 50,000 dols. In 1887 10,200 long tons were produced, worth 56,100 dols.

Flint.

For potters' use the consumption was 16,250 long tons. Including that for sand-paper and for glass, the consumption was about 30,000 tons, worth, unground, 175,000 dols.

Potters' Clay.

The consumption included 18,000 long tons of kaolin or china clay, 5,250 tons of ball clay, and 13,500 tons of fire-clay, worth altogether 300,000 dols.

Mica.

Owing principally to the use of smaller sizes in stoves, the production of sheet mica decreased from 70,500 pounds in 1887 to 48,000 in 1888, valued at 70,000 dols. There is increased demand for mica waste.

Mineral Paints.

The product, including ochre, metallic paints, and small amounts of umber and sienna, increased to 24,000 long tons, valued at 380,000 dols.

Graphite.

The production of pure graphite was limited to Ticonderoga, New York, and is reported as unchanged. The total production of pure material was 400,000 pounds, worth 33,000 dols. Small amounts of less pure material for foundry facings, &c. were produced in North Carolina, and at Cranston, Rhode Island.

Fluorspar.

The production, limited to the neighbourhood of Rose-clare, Illinois, and Evansville, Indiana, is reported at 6,000 tons, worth 30,000 dol., an increase of 1,000 tons over 1887.

Infusorial Earth.

The product came principally from Maryland, and amounted to 2,500 short tons, worth, before shipment, 12,500 dol.

Zircon.

During 1887 and 1888, 25 tons of zircon were mined, principally in Henderson county, North Carolina, and sold for 10,000 dol., for the manufacture of incandescent gas burners. About 4 tons of monazite, one ton of allanite, 600 pounds of samarskite, and 500 dol. worth of yttrium minerals were produced for the same use. About 6 tons of monazite and 5 tons of cerite were also imported.

Mineral Waters.

Amount sold in 1888, 9,628,568 gallons, valued at 1,709,302 dol. In 1887 the product was 8,259,609 gallons, worth 1,261,473 dol.

Totals.

The total value of the minerals produced in 1888 was 591,659,931 dol. It is recognised that this is the sum of the values of substances taken in various stages of manufacture, and hence not strictly comparable with each other; still it is the most valuable means for comparing the total products of different years. The result is an increase of nearly 50,000,000 dol. beyond the value of the product in 1887. In that year nearly every mineral industry showed an increase, and hence an increased total was evident. But the fact that the increase was so very large was due to rather exceptional conditions in a few important industries, and it could not reasonably be expected that a similar combination of circumstances would result in even a larger total value for 1888. Nevertheless, the unprecedented stimulus given to the production of copper by an artificial price increased the total value of that product nearly 13,000,000 dol., or nearly enough to offset the decline in the total value of pig iron. The other important factors in the increase were coal and the other fuels which followed the increased quantity of metals. With the anticipated decline of copper to the normal demand, a decline in the total value of the product in 1889 will not be inconsistent with the natural development of our mineral resources.

Metallic Products of the United States in 1888.

	Quantity.	Value.
		Dols.
Pig iron, spot value..... Long tons	6,489,738	107,000,000
Silver, coining value..... Troy oz.	45,783,632	59,135,000
Gold, coining value..... "	1,604,927	33,175,000
Copper, value at New York City..... Lb.	231,270,622	33,833,954
Lead, value at New York City..... Short tons	180,555	15,924,951
Zinc, value at New York City..... "	55,903	5,500,855
Quicksilver, value at San Francisco..... Flasks	33,250	1,413,125
Nickel, value at Philadelphia..... Lb.	195,182	115,518
Aluminium, value at Philadelphia..... "	19,000	65,000
Antimony, value at San Francisco..... Short tons	100	20,000
Platinum, value (crude) at New York City..... Troy oz.	500	2,000
Total.....	..	256,245,403

Non-metallic Mineral Products of the United States in 1888 (spot values).

	Quantity.	Value.
		Dols.
Bituminous coal..... Long Tons	91,100,398	122,197,311
Pennsylvania anthracite..... "	41,624,610	89,020,483
Building stone.....	..	25,500,000
Lime..... Barrels	49,087,000	24,543,500
Petroleum..... "	27,346,018	24,508,550
Natural gas.....	..	22,662,128
Cement..... Barrels	6,253,295	4,533,630
Salt..... "	8,055,881	4,377,204
Limestone for iron flux.... Long Tons	5,438,000	2,719,000
South Carolina phosphate rock..... "	433,705	1,951,073
Zinc-white..... Short Tons	20,000	1,600,000
Mineral waters..... Gals. sold	9,628,568	1,709,302
Borax..... Lb.	7,589,000	155,340
Gypsum..... Short Tons	96,000	430,000
Manganese ore..... Long Tons	25,500	255,000
Mineral paints..... "	21,000	380,000
New Jersey marls..... Short Tons	600,000	300,000
Pyrites..... Long Tons	54,331	167,658
Flint..... "	30,000	175,000
Mica..... Lb.	48,000	70,000
Corundum..... Short Tons	580	91,620
Sulphur..... "	..	..
Precious stones.....	..	61,850
Gold-quartz, souvenirs, jewellery, &c.	..	75,000
Crude barytes..... Long Tons	20,000	110,000
Bromine..... Lb.	307,386	95,230
Feldspar..... Long Tons	8,700	50,000
Chrome iron ore..... "	1,500	20,000
Graphite..... Lb.	400,000	33,000
Fluorspar..... Short Tons	6,000	30,000
Slate ground as pigment..... Long Tons	2,500	25,000
Cobalt oxide..... Lb.	12,266	18,411
Novaculite..... "	1,500,000	18,000
Asphaltum..... Short Tons	53,800	331,500
Asbestos..... "	100	3,000
Rutile..... Lb.	1,000	3,000
Total.....	..	328,914,528

Résumé of the Values of the Metallic and Non-metallic Mineral Substances produced in the United States in 1888.

	Dols.
Metals.....	256,245,403
Mineral substances named in the foregoing table...	328,914,528
	585,159,931
Estimated value of mineral products unspecified...	6,500,000
Grand total.....	591,659,931

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ended 30th June.	
	1888.	1889.
	£	£
Metals.....	1,531,621	1,450,566
Chemicals, dyestuffs, and tanning materials.....	562,257	567,433
Oils.....	449,834	483,526
Raw materials for non-textile industries.....	3,224,516	3,422,180
Total value of all imports.....	30,478,854	29,294,015

SUMMARY OF EXPORTS.

	Month ended 30th June.	
	1888.	1889.
	£	£
Metals (other than machinery).....	3,193,072	3,193,849
Chemicals and medicines.....	614,442	641,474
Miscellaneous articles.....	2,575,291	2,501,830
Total value of all exports.....	19,042,845	18,612,506

IMPORTS OF METALS.

	Month ended 30th June.	
	1888.	1889.
	£	£
Copper ore.....	88,969	54,341
„ regulus and precipitate.....	258,140	98,193
„ unwrought and part wrought.....	216,419	87,886
Iron and steel:—		
Iron ore.....	181,967	215,729
„ bar, angle, bolt, and rod.....	89,318	86,299
Steel, unwrought.....	6,583	11,923
Lead, pig and sheet.....	118,369	127,792
Pyrites of iron or copper.....	106,549	111,361
Quicksilver.....	113,074	133,501
Tin.....	127,842	190,852
Zinc.....	59,984	62,055
Other metals.....	165,277	270,634
Total value of metals.....	1,531,621	1,450,566

IMPORTS OF CHEMICALS.

	Month ended 30th June.	
	1888.	1889.
	£	£
Alkali.....	4,551	3,497
Bark for tanners' and dyers' use.....	17,104	40,460
Brimstone.....	16,698	19,350
Chemical products unenumerated.....	116,190	110,253
Cochineal.....	1,442	2,293
Cutch and gambier.....	28,407	88,673
Dyes (coal tar):—		
Aniline.....	17,430	24,217
Alizarine.....	16,960	23,175
Other coal tar dyes.....	1,629	795
Indigo.....	41,705	40,484
Madder, garancine, and munjeet.....	1,259	1,050
Nitrate of soda.....	73,226	13,186
Nitrate of potash.....	22,159	7,148
Valonia.....	28,845	60,472
Other articles.....	175,532	132,380
Total value of chemicals.....	562,257	567,433

IMPORTS OF OILS.

	Month ended 30th June.	
	1888.	1889.
	£	£
Cocoanut.....	3,012	4,823
Olive.....	42,993	84,534
Palm.....	94,333	79,789
Petroleum.....	127,153	165,947
Seed of all kinds.....	24,031	34,492
Train, blubber, and sperm.....	36,663	42,027
Turpentine.....	49,203	19,860
Other articles.....	72,356	52,052
Total value of oils.....	449,834	483,526

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES.

	Month ended 30th June.	
	1888.	1889.
	£	£
Bark, Peruvian.....	31,177	29,590
Bristles.....	46,410	55,869
Caoutchouc.....	134,142	99,266
Gum arabic.....	30,509	14,155

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES—continued.

EXPORTS OF CHEMICALS.

Month ended 30th June.

Month ended 30th June.

	1888.	1889.
	£	£
Gum, lac, seed, shell, &c.	20,358	10,063
Gutta-percha	20,812	27,580
Hides, raw, dry	137,738	118,385
" " wet	113,645	104,632
Ivory, teeth, &c.	42,393	17,795
Manures, guano	43,849	18,883
" bones	23,432	13,833
Paraffin	35,671	27,249
Paper materials:—		
Linen and cotton rags	51,639	35,717
Esparto and other fibres	104,309	84,520
Pulp of wood	60,716	51,392
Rosin	21,734	22,890
Tallow and stearine	176,783	165,764
Tar	3,185	1,743
Wood and timber:—		
Hewn	337,764	373,404
Sawn, split, planed, &c.	988,328	1,358,830
Staves	59,670	46,036
Mahogany	50,356	11,428
Other articles	692,895	702,946
Total value of raw materials for } non-textile industries	3,224,516	3,422,480

Besides the above, drugs to the value of 53,578*l.* were imported during the month, as against 51,075*l.* in June 1888.

EXPORTS OF METALS OTHER THAN MACHINERY.

	Month ended 30th June.	
	1888.	1889.
	£	£
Brass	30,545	42,393
Copper, unwrought	136,257	200,258
" wrought	30,765	77,969
" mixed or yellow metal	28,423	47,310
Hardware and cutlery	259,071	220,799
Iron and steel	2,341,049	2,249,173
Lead	52,594	54,393
Plate, plated, and gilt wares	33,322	30,299
Telegraphic wires	61,219	45,189
Tin	76,084	37,050
Zinc	6,849	11,160
Other articles	136,894	178,356
Total value of metals	3,193,072	3,193,849

	1888.	1889.
	£	£
Alkali	134,431	123,882
Bleaching materials	50,338	43,692
Manures (chemical)	140,997	175,580
Medicines	77,211	72,816
Other articles	211,442	641,474
Total value of chemicals ...	614,442	641,474

EXPORTS OF MISCELLANEOUS ARTICLES.*

	Month ended 30th June.	
	1888.	1889.
	£	£
Gunpowder	31,251	18,224
Candles	15,420	17,594
Caoutchouc manufactures	88,065	82,375
Cement	101,418	91,945
Earthenware and porcelain	182,512	150,160
Red pottery and stoneware	9,215	15,808
Glass, plate	28,616	19,812
" flint	25,291	19,662
" bottles	36,673	31,508
" other kinds	12,253	12,628
Leather, unwrought	108,321	93,969
" wrought	25,755	23,556
Seed oil	124,088	120,375
Oil and floor cloth	64,180	57,554
Painters' colours and materials	132,552	131,315
Paper of all kinds	161,543	154,986
Rags for paper-making	40,154	37,357
Soap	34,695	39,524
Total value of exports of mis- } cellaneous articles	2,575,291	2,501,850

* Articles of chemical interest only are given in this table, hence the items and totals do not agree.

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

9903. H. T. Green. Means for evaporating saline and other saccharine solutions, and other liquids and semi-liquid substances. June 17.

9975. A. J. Boulton.—From P. Varin. Filters. June 17.

10,096. F. G. Harvey. See Class XVI.

10,251. T. Geutzen and A. Wegener. Filters. Complete Specification. June 24.

10,361. H. H. Lake.—From La Société Anonyme des Parfums Naturels de Cannes, France. An improved method or process of and apparatus for the lixiviation of various materials. June 25.

10,385. R. Fölsche. An improved centrifugal. June 26.

10,423. J. V. Davis. Improvements in hydrometers, and in apparatus in connexion therewith. Complete Specification. June 27.

10,521. G. H. Barrus. Improvements in apparatus for determining the quantity of moisture in, and measuring the heat of steam. Complete Specification. Date applied for under Patent Act, 1883, sec. 103, November 30, 1888, being date of application in the United States.

10,560. W. A. Cox. Improvements in calcining or roasting furnaces. June 29.

10,679. T. Whittaker. Perforated grinding mills for reducing to fine powder hard grindable substances. July 2.

10,686. H. J. Haddan.—From J. P. y Rodoreda and E. P. y Rodriguez, Spain. Machinery for triturating and crushing substances. July 2.

10,907. W. P. Thompson.—From N. Notkin, Russia, and P. Marix, France. New or improved method of distilling products by means of steam, and classifying or separating them according to their respective points of vaporisation, and apparatus therefor. July 6.

10,910. W. P. Thompson.—From W. Schleicher, Germany. Improvements in heating or annealing furnaces with retorts. July 6.

10,945. J. Vickers, T. Vickers, and J. Vickers, jun. Apparatus for feeding fuel to and in furnaces. July 8.

10,955. J. Johnston. Apparatus for heating, drying, and other purposes. Complete Specification. July 8.

11,104. J. Carr. Improvements connected with the manufacture of illuminating gas from coal. July 10.

11,121. S. A. Mackie. Improvements in the manufacture of artificial fuel. July 10.

11,125. F. Sanders. Improvements in retorts for producing gas. July 10.

11,164. F. T. Schmidt. Improvements in the method of and apparatus for consuming smoke. July 11.

COMPLETE SPECIFICATIONS ACCEPTED.*

1888.

8852. J. E. Hall. Apparatus for consuming smoke and economising fuel. June 26.

9450. H. T. Hilliseher. Apparatus for mixing gases and regulating the pressure or flow thereof. July 10.

10,361. E. Bazin. Means and apparatus for producing cold. July 10.

11,268. E. Theisen. Condensing apparatus. July 17.

11,888. W. H. Northcott. Machinery for compressing air and gases. June 26.

12,112. T. Smith. See Class II.

12,188. T. Cain. See Class II.

12,318. J. Jardine and J. Ferguson. Gas and air reversing valves for regenerative, smelting, and other furnaces. July 17.

12,784. B. E. R. Newlands. See Class XVI.

13,885. R. Siekel. Promoting consumption of smoke and suppressing combustion in boiler tubes and other flues. June 26.

15,060. F. F. Clarke.—From F. F. Clarke. Apparatus for compressing air or other gas. June 26.

15,675. T. McDougall and J. Jardine. Apparatus for incinerating spent alkaline lyes or other waste products containing carbonaceous matter. July 17.

17,521. E. J. T. Digby. Means for manufacturing crucibles, &c. June 26.

1889.

681. The Native Guano Co., Lim., and C. E. Robinson. Apparatus for measuring liquids. July 3.

2528. W. Hucks. Method and apparatus for centrifugally separating solids and other matter from liquids. June 26.

7548. C. Salamon. Process for drying, desiccating, and roasting. July 3.

9200. A. Keddle. Improvements relating to thermometers. July 17.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

9916. A. M. Levy. Improvements in carburettors or apparatus for enriching or producing gas. June 17.

9956. C. Armitage. Improvements in means for revivifying the agents used in the purification of coal gas. June 17.

10,101. W. J. Pughley. Improvements in the manufacture of fuel. Complete Specification. June 20.

10,164. W. Crookes and F. I. Ricardo-Seaver. Improvements in the treatment of water-gas. June 21.

10,256. A. J. Boulton.—From W. G. Wood, Canada. Improvements in manufacturing gas. Complete Specification. June 24.

10,277. J. Dewar and B. Redwood. Improvements in the distillation of mineral oils and like products, and apparatus for that purpose. June 24.

10,327. J. Ward. Lighting gas by means of a spontaneously inflammable gas. June 25.

10,340. S. Clarke. Improvements in night lights. June 25.

10,392. H. J. Haddan.—F. F. Amoroso, Italy. Improvements relating to the burning of liquid fuel in boiler furnaces and the like. June 26.

10,488. J. H. R. Dinsmore. Improvements in or connected with apparatus used in the manufacture of gas from coal and analogous substances. June 28.

10,514. F. Hulwa. A manufacture of briquettes or block fuel. June 28.

10,581. J. C. Johnson. A new or improved producer for making ordinary producer-gas and water-gas and coke. June 29.

10,658. W. P. Thompson.—From A. Mason, United States. Improved method and apparatus for burning culm or pulverised coal. July 2.

10,659. W. P. Thompson. — From A. Mason, United States. Improved process for burning coal and hydrocarbon fuel, and apparatus therefor. July 2.

10,660. W. P. Thompson. — From J. Wilson and A. Mason, United States. Improvements in or appertaining to appliances for burning hydrocarbons.

10,661. W. P. Thompson. — From J. Wilson and A. Mason, United States. Improved process for burning petroleum and other hydrocarbons, and apparatus therefor. July 2.

10,697. G. Bower. Improvements in the production or manufacture of hydrogen gas. July 2.

10,700. J. W. Rock, C. G. Moore, J. H. Wood, and J. B. Nicholson. An improved gas-making apparatus. Complete Specification. July 2.

10,829. R. van Steenberg. Improvements relating to the manufacture of gas, and to apparatus therefor. July 4.

11,007. T. F. Fernandez. The prompt, absolute, and efficacious detection of any escape or leakage of the gas called or known as "water-gas," by incorporating, impregnating, blending or impregnating with, or communicating or imparting to, the said gas the odoriferous properties of musk. July 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

9239. T. Nicholson. Gas and coke producers, and apparatus for collecting the bye-products. June 26.

10,224. The Gaseous and Liquid Fuel Supply Company, Limited, and Thwaite. The generation of gaseous fuel, and combustion thereof. June 26.

11,631. J. Frodsom and A. McLinden. Combustion of gas in blast furnaces, &c. July 10.

12,112. T. Smith. Apparatus for extracting coke from coke ovens, lime from lime kilns, &c. July 10.

12,188. T. Cain. Means for economising fuel, increasing the heating properties of the products of combustion, and preventing escape of black smoke. July 10.

12,281. J. Cunningham. Apparatus for charging gas retorts. July 10.

12,518. H. S. Maxin. Apparatus for naphtholising or carburetting illuminating and other gas. July 10.

12,608. L. Mond and C. Langer. Obtaining hydrogen. July 10.

13,074. W. Kusnezoff. Apparatus for the purification of gas. July 10.

1889.

6567. W. Deighton. Gas-producer apparatus and appliances for the manufacture of water-gas and other gases. July 17.

7531. H. J. Newcome. Condensing, purifying, and abating smoke from ordinary fires. July 3.

8179. A. Runge. Charging trough for gas retorts, and apparatus for raising and operating the same. July 17.

8192. J. von Langer and L. Cooper. Generating water-gas and producer-gas. June 26.

8519. V. B. D. Cooper. Manufacture of gas for heating and other purposes. July 17.

9061. B. van Steenberg. Manufacture of water-gas and apparatus therefor. July 10.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

10,999. R. F. Craig. Improvements in obtaining acetic acid or acetates from wood or other organic substances yielding it. July 9.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

10,630. B. Willecox. — From The Farbenfabriken vorm. F. Bayer and Co., Germany. Improvements in the manufacture of anthraquinone sulpho-acids. July 1.

10,934. The Clayton Auline Co., Lim., and C. Dreyfus. The preparation of new sulphonic acids suitable for the manufacture of colouring matters. July 6.

11,000. H. H. Lake. — From Wirth and Co., agents for K. Ochler, Germany. Improvements in the production of colouring matters. July 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

12,563. J. V. Johnson. — From The Farbenfabriken vorm. F. Bayer and Co. Manufacture of diethylmercaptol and of a sulphone therefrom. July 3.

12,796. O. Huray. — From The Farbwerke vorm. Meister, Lucius, and Brünig. Production of green and bluish-green colouring matters. July 10.

1889.

3628. A. Bang. — From Dahl and Co. Production of dinitrodibenzylbenzidine and dinitrodibenzyltolidine and transformation of the same into diamidodibenzylbenzidine and diamidodibenzyltolidine respectively. July 10.

7588. A. Bang. — From Dahl and Co. The production of paranitrobenzylsulpho acid and also azo-colouring matters from the amidobenzylsulpho acid corresponding to this nitro compound. June 26.

9384. H. D. Kendall. Production of colouring matter from coal-tar products. July 10.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

9904. R. S. Burn. An improved method of treating cotton fibre or masses of cotton fibres preparatory to being worked up into yarn, for weaving or manufacturing purposes; applicable to fibres, animal or vegetable, other than cotton. June 17.

9946. R. Armitage. Improvements in the process of and apparatus for dyeing, dressing, and winding wett for weaving. June 17.

10,010. C. Puech. Process for separating the wool from pieces of rabbit skins and other skins of a similar kind. June 18.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

9919. H. H. Leigh.—From G. I. Lepaulard and E. P. Huard, France. An improved dyer's mordant. June 17.

9946. R. Armitage. *See* Class V.

10,360. E. Maertens. Improvements in the dyeing, scouring, or like treatment of yarn or other fibrous materials, and in apparatus therefor. June 25.

10,993. B. Willeox.—From The Farbenfabriken vorm F. Bayer and Co., Germany. Improvements in the manufacture of tannin compounds, more especially intended for printing purposes. July 8.

11,098. T. O. Arnfield. Improvements in and connected with apparatus for dyeing, washing, and otherwise similarly treating yarn in hanks. July 9.

COMPLETE SPECIFICATION ACCEPTED.

1888.

13,175. W. E. Heys.—From C. Vandermeirsche. Apparatus for dyeing and similarly treating textiles and fibres in all stages of preparation. July 17.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

10,142. A. S. Ramage. Method of preparing iron oxides from ferrous solutions. June 21.

10,205. A. Reyckler. A method of preparing binoxide of manganese. June 2.

10,554. T. Parker and A. E. Robinson. Improvements in and connected with the utilisation of sulphate of iron galvanising pickle. June 29.

10,909. S. Dyson and H. Dyson. Improvements in treating certain liquors or solutions containing chromic oxide or its salts, and in obtaining chromate of soda therefrom. July 6.

11,247. G. I. J. Wells.—From S. Pick, Galicia. Improvements in or appertaining to the treatment of the waste liquor from ammonia-soda works. July 13.

11,268. J. Meikle, jun. Improvements in and relating to the recovery and utilisation of carbonic acid. July 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

12,135. C. Netto.—From C. Winkle. Manufacture of artificial cryolite and similar compounds. June 26.

12,543. W. White. Manufacture of chloride of aluminium with other chlorides. July 3.

13,070. B. Willeox.—From The Badische Anilin und Soda Fabrik. Production and retention of chlorine in liquid state, suitable for transport or storage, and apparatus therefor. July 17.

1889.

8045. H. E. Newton.—From L. O'Brien. *See* Class X.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

9960. D. Lucas. Printing upon and decorating china, earthenware, glass, and other surfaces. Complete Specification. June 17.

9979. E. Leak and H. Aynsley. Improvements in the manufacture of grooved shields used in supporting pottery-ware while being fired. Complete Specification. June 17.

10,088. The Broseley Tiles Co., Lim., and J. Crump. Improvements in the manufacture of earthenware quarries or tiles. June 20.

10,322. W. Lutwyche. Improvements in the manufacture of translucent enamel, and in the application of the same in relief for the decoration of glass, metal, or any ceramic ware. Complete Specification. June 25.

10,887. D. Chapman. Improvements in casting or forming articles of pottery, including china and earthenware. July 5.

11,064. E. E. Cousins.—From B. E. Olsen, Canada. Improvements in fusible compounds suitable for the manufacture of drain pipes, flushing chambers, and the lining of conduits. July 9.

11,127. J. W. Barker. An improved method of enamelling and glazing the bowls of clay tobacco pipes. July 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

12,450. H. A. Paveley. Utilisation of waste and other glass. July 17.

12,596. W. J. Temple, F. W. Rogers, C. W. Trotman, and T. F. Hobbs. Enamelling or decorating slate, marble, &c. June 26.

18,577. W. H. Turner. Painting or printing upon earthenware. July 17.

1889.

8403. W. J. Bleuko. Process and apparatus for producing sheet glass with or without ripples or designs upon one surface. July 17.

9645. H. J. Allison.—From C. C. Gilman. Manufacture of porous earthenware. July 17.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

9927. H. H. Lake.—From C. T. Lee, United States. An improved compound suitable for the manufacture of various articles by moulding. Complete Specification. June 17.

10,122. D. Ker. A new kerb for street or road paving, and for other purposes. June 21.

10,282. A. E. L. Skazenger. Improvements in paving. June 24.

10,378. C. Coops. Improvements in paving. June 26.

10,824. J. Brunton and L. Griffiths. Improvements in apparatus for mixing the materials used in the manufacture of artificial stone, concrete, and the like. July 4.

10,914. H. W. de Lespare and W. H. Shafto. Improvements in the manufacture of concrete for ordinary, useful, ornamental, and artistic purposes. July 6.

10,997. J. B. King. Material for the treatment of walls and the like. Complete Specification. July 9.

11,128. G. Batchelor. Improvements in arrangements for drying slurry by the waste heat from cement kilns. July 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

9761. J. S. Palmer. Plastic wall decoration composition. July 10.

10,586. A. McLean. Blocks or slabs for paving. June 26.

13,211. J. Rust. Vitreous material for paving, &c. July 17.

18,771. W. Millar, G. M. R. Layton, and T. Grover. Fireproof building construction. July 17.

1889.

961. C. J. Widwark. Manufacture of cement. July 17.

X.—METALLURGY, MINING, &c.

APPLICATIONS.

9905. H. A. Becker. Improvements in the conversion of crude iron into malleable iron and steel, and apparatus therefor. June 17.

9987. The Alkaline Reduction Syndicate, Lim., and A. B. Cunningham. Improvements in the treatment of zinc ores. June 18.

10,154. J. C. Bull. Improvements in the manufacture of copper alloys. June 21.

10,159. A. Piat. Improvements in furnaces for melting metals. June 21.

10,224. J. Powell. Improvements in or connected with ingot moulds. June 22.

10,274. H. Cave. An improved process and apparatus for the amalgamation of gold and silver contained in their ores. June 24.

10,279. R. E. Evenden. A new or improved apparatus for washing and separating gold and some other minerals and substances. Complete Specification. June 24.

10,288. H. H. Lake.—From O. B. Peck, United States. Improvements in apparatus for use in decomposing metallic salts and for desulphurising ores. Complete Specification. June 24.

10,298. J. H. Pollok. Improvements in the wet method of extracting gold. June 25.

10,394. J. Harper. Improvements in the treatment of gold and silver ores by the hydrometallurgical, or wet method. June 26.

10,422. A. W. Dennes.—From D. Dennes, United States. Improvements in barrels for treating auriferous, argentiferous, and other ores by means of chlorine, bromine, or any other suitable reagents. June 27.

10,437. T. Parker and A. E. Robinson. Improvements in the manufacture of phosphorus. June 27.

10,472. J. Y. Johnson.—From C. Pieper, Germany. Improvements in compound steel armour plates, and in the manufacture thereof. June 27.

10,496. F. W. Rose.—From T. K. Rose and D. Demer, United States. An improved apparatus for obtaining the solution of precious metals from their ores after they have been under treatment by some reagent. June 23.

10,639. H. Ritter von Dahmen and A. S. Collin. Process and apparatus for the production of metallic aluminium from oxide and silicate compounds, such as corundum, bauxite, kaolin, and the like. July 1.

10,835. T. Hydes. Improvements in the treatment of blast-furnace slag and other slags, and in the apparatus therefor. July 5.

10,836. T. Hydes. Improvements in the treatment of blast-furnace slag and other slags, and in the apparatus used therein. July 5.

10,991. P. H. Adams, jun., and O. T. X. Adams. Improvements in apparatus for use in decomposing metallic salts and desulphurising ores. Complete Specification. Date applied for under Patent Act, 1883, sec. 103, December 8, 1888, being date of application in the United States.

11,020. P. H. Adams, jun., and O. T. X. Adams. Improvements in apparatus for use in decomposing metallic salts and desulphurising ores. Complete Specification. Date applied for January 3, being date of application in the United States.

11,021. P. H. Adams, jun., and O. T. X. Adams. Improvement in plant for use in smelting ores. Complete Specification. Date applied for January 3, being date of application in the United States.

11,055. H. S. Holt.—From J. Clegg, United States. Improvements in alloys. July 9.

11,083. P. H. Adams, jun., and O. T. X. Adams. Improvement in plant for use in smelting ores. Complete Specification. Date applied for January 3, being date of application in the United States.

11,202. R. Welford. Improvements in the method and apparatus for treating ores. July 12.

11,237. J. H. Pollok. Improvements in the extraction of gold from ores. July 12.

11,266. W. H. Luther. Improvements in and relating to baths for and pickling of metallic plates and other articles for galvanising purposes. July 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

9570. T. W. Helliwell. Process of treating steel or iron, or a combination thereof, so as to prevent oxidation. June 26.

9848. J. Sumnerhill. Carburising and coating iron or steel, in the form of sheets, wrought or cast plates, or manufactured articles. June 26.

10,223. J. S. MacArthur, R. W. Forrest, and W. Forrest. Extracting gold and silver from ores, &c. July 17.

10,262. M. Gledhill. Forging metal cylinders, armour plates, &c., and apparatus therefor. June 26.

10,785. W. G. Foster. Manufacture of sodium and potassium, and apparatus therefor. July 3.

11,512. P. M. Parsons. Metallic alloys. July 3.

12,074. Le Comte E. de Rotterdam. Extracting gold, silver, and other metals from refractory ores, sands, and residues. June 26.

12,293. G. Allan and T. Turner. Manufacture of cast anchors, and moulds for casting anchors and shanks of cast steel or alloy. July 10.

12,337. R. C. Thompson. Recovery of tin, spelter, solder, &c., from scrap tin plate and other coated metal wares. July 10.

13,125. W. White. Manufacture of sodium and potassium. July 10.

13,182. C. A. Burghardt. Reduction of zinc oxides. July 17.

13,358. Sir H. H. Vivian. Manufacture of plates, &c., from alloys of copper and nickel by rolling at a red heat. July 17.

13,359. H. Doetsch. Extraction of copper from copper ores. July 17.

14,916. I. Beardmore. Distributing or regulating valve of regenerative gas furnace for steel melting, &c. June 26.

1889.

8045. H. E. Newton.—From L. O'Brien. Process for making metallic sulphates in solution. July 3.

8856. H. H. Lake.—From C. M. Ball, S. Norton, and A. T. Porter. Separation of magnetic ores from phosphorus and other impurities, and apparatus therefor. July 17.

9187. H. H. Chandler. Flux for coating iron or steel with copper and for welding copper. July 10.

9176. A. A. Lockwood and H. Chappel. Treatment of auriferous and argentiferous materials, and apparatus therefor. July 17.

XL.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

5994. E. Maigrot and J. Sabates. See Class XVI.

10,061. G. J. Atkins. Improvements in apparatus for separating gold and other metals from their ores by the aid of electricity. June 18.

10,209. J. Zacharias and F. Marx. Improvements in electrical accumulators or storage batteries. June 22.

10,517. E. Frankland, N. Story-Maskelyne, A. H. Hough, and D. G. FitzGerald. Improvements in elements for voltaic batteries. June 28.

10,695. H. H. Lake.—From C. A. Hussey and E. H. Brown. Improvements in electric batteries. July 2.

10,696. H. H. Lake.—From C. A. Hussey and E. H. Brown. Improvements in electric batteries. July 2.

10,775. A. Weleker. An improved exciting liquid for electric batteries. July 3.

10,822. G. Button and W. E. Wyeth. Improved apparatus for extracting gold and silver from their ores by electrical amalgamation. July 6.

10,889. E. M. H. Andreoli. Improvements in the electrolytic production of hydrochlorite of sodium. Complete Specification. July 5.

11,011. W. P. Thompson.—From P. H. Alexander, United States. Improvements in storage batteries. July 9.

11,049. J. J. Wood. Improvements in dynamo-electric machines, in part applicable to electro-motors. July 9.

11,070. J. Y. Johnson.—From A. L. Riker, United States. Manufacture of elements or plates for secondary batteries. July 9.

11,242. Siemens Brothers and Co., Limited.—From Siemens and Halske, Germany. Improvements in dynamo-electric, magneto-electric, and electro-dynamic machines. July 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

11,479. T. Parker and A. E. Robinson. Manufacture of iodine by electrolysis. July 10.

12,907. T. Parker and W. Lowrie. Dynamo-electric machines. July 10.

13,000A. T. M. Sargent and O. R. Sivete. Electric batteries. July 17.

13,215. W. Clarke.—From L. Maiche. Electric batteries. July 3.

18,751. G. C. Dymond.—From C. Gassner. Galvanic batteries. July 3.

1889.

1557. C. H. Mehner. Dry galvanic cells. July 3.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

10,419. A. Harrison and W. T. Thorp. An improvement in making soap for washing purposes. June 27.

10,587. J. Roots. An improved lubricating compound July 1.

11,079. E. Edwards.—From M. A. Krause and J. Lewandowski, Germany. Improvements in compounds for reducing the heat caused by the friction of journals and the like, and in the method of preparing and using the said compound. July 9.

11,272. R. Hunt. Improvements in treating crude cottonseed oil, and oils containing resinous matter and free fatty acids to obtain oil, resinous colouring matter, and soap. July 13.

11,292. H. Earich. A new or improved process for producing hard potash and similar soap from solid or liquid fats. July 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

9857. J. J. Bowley. Manufacture of soap and detergents. July 3.

12,001. J. Crossley. Composition of soap for cleansing and disinfecting purposes. June 26.

1889.

5680. G. R. B. Kempton. Blue soap for laundry washing. June 26.

8196. R. O. Englaub. Apparatus for rectifying glycerin. June 26.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

10,086. W. Walker.—From W. E. Sendey, France. An improved process for the manufacture of sulphate of lead, and apparatus therefor. June 20.

10,124. C. A. Burghardt. Improvements in the preparation or treatment of paints, pigments, dry colours, bronze, or metallic powders, and leaves and other similar substances. June 21.

10,368. W. Cromack. Improvements in the manufacture or composition of paints. June 26.

10,428. L. M. Lamb and D. Boyd. Improvements in lacquers and varnishes. June 27.

10,858. E. S. Baldwin.—From J. Smith, New Zealand. A new composition for waterproofing textile fabrics, and as a paint for wood and other surfaces. Complete Specification. July 5.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

10,110. J. Hauff. Means for freeing skins, kips, and hides from lime, and for causing the same to swell. Complete Specification. June 20.

10,223. W. D. Goode. Improved apparatus and process for curing or tanning skins, kips, and hides. June 22.

10,326, G. A. H. Gabet. Process for separating the constituent elements of bones, that is phosphoric acid, lime, ossein, and fat. June 25.

10,900, W. G. Richardson. An improved manufacture of liquid waterproof glue. July 6.

10,968, B. Nicholson and T. Palmer. The treatment of tanning and other vegetable extracts for decolourising the same. July 8.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

9994, E. Maigrot and J. Salates. Improvements in apparatus for the manufacture of sugar by electricity. Complete Specification. June 18.

10,096, F. G. Harvey. Improvements relating to the evaporation or concentration of sugar and other liquids, and to apparatus therefor. June 20.

11,136, S. Pitt.—From L. W. Tracey, United States. Improvements in evaporators or apparatus for the treatment of cane juice. July 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

12,784, B. E. R. Newlands. Means or apparatus for drying slabs of sugar, applicable for heating and cooling other articles and for analogous purposes. July 17.

1889.

8622, C. Steffen. Apparatus for producing white sugar. July 17.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

10,620, J. H. Carpenter. A vacuum yeast separator, skimmer, and press. July 1.

10,667, W. W. Mutter and W. Dawson. Improvements in or relating to distillers' safes, said improvements being also applicable for check-sampling the spent wash at outlets of "patent" stills. July 2.

10,740, E. Larsen. An improved method of facilitating the drying of distillers' spent wash and similar matter. July 3.

10,762, T. Vogel. Improvements in apparatus for treating yeast. July 3.

10,891, J. Sleeman. Improvements in the method of malting grain, and in machinery or apparatus therefor. July 5.

10,988, J. Sleeman. Improvements in the method of malting and drying grain, and in machinery or apparatus therefor. July 8.

11,180, J. Sleeman. Improvements in the method of malting and drying grain, and in machinery or apparatus therefor. July 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

12,642, A. T. Christophe. Rectification of alcohol. July 3.

13,212, L. Groezinger. Producing extract of hops and preparing beverages therefrom. June 26.

15,261, W. Kuhn. Apparatus for Pasteurisation of beer, wine, &c. June 26.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

10,208, A. N. Ford. Improvements in treating eggs. 22 June.

10,352, G. A. Brinck and A. W. Rhenström. Improvements in food preparations. 25 June.

10,789, F. McIntyre. An improved process for the preservation of foods. 4 July.

B.—Sanitary Chemistry.

10,843, M. Lunn. Improvements in the treatment of sewage and of the residual precipitate. 5 July.

C.—Disinfectants.

10,575, E. Serrant. The preparation of sozolic acid. 29 June.

COMPLETE SPECIFICATION ACCEPTED.

1888.

B.—Sanitary Chemistry.

11,841, A. N. Bertram. Destroying the noxious fumes arising from chemical manufactures. 17 July.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

9,927, H. H. Lake.—From C. T. Lee. See Class IX.

10,427, J. Neville. Improvements in blotting-paper. 27 June.

10,914, J. R. Thame and H. Sanguinetti. Improvements in the manufacture of hollow ware from paper or like pulp, and in apparatus employed therein. 6 July.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

12,502, W. Hall. Apparatus for straining paper pulp, &c. 10 July.

1889.

8946, J. Husnik. Production of semi-transparent designs on or in paper by means of gelatin relief printing. 10 July.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES,
AND EXTRACTS.

APPLICATIONS.

10,280. H. H. Lake.—From La Société Anonyme des Parfums Naturels de Cannes, France. An improved process of recovering volatile solvents retained in substances treated therewith. June 24.

11,099. T. Parker and A. E. Robinson. Improvements in the manufacture of carbon bisulphide. July 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

11,479. T. Parker and A. E. Robinson. *See* Class XI.

13,169. C. W. E. Kolbe. Manufacture of salols. July 17.

XXI.—PHOTOGRAPHIC PROCESSES AND
MATERIALS.

APPLICATIONS.

9921. H. Devevil and W. Gallagher. Improvements in photographic negatives and sensitised plates for use in photo-illustrative processes. Complete Specification. June 17.

10,393. J. S. Fairfax.—From F. Crane, United States. Improvements in or relating to films or supports for photographic negatives or prints. June 26.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

10,312. C. O. Lundholm. Improvements in the manufacture of dynamite. June 25.

10,376. C. O. Lundholm and J. Sayers. Improvements in the manufacture of explosives. June 26.

11,084. C. E. Kelway. Improvements in explosive shell and torpedo fuses. July 10.

11,090. F. H. Snyder. Improvements relating to the manufacture of waterproof pellets and other pieces or charges of explosive material. July 10.

11,102. W. H. A. Kitchen and J. G. A. Kitchen. A new explosive to be called "Cycene," intended to be used as a substitute for gunpowder or other explosives used for blasting or other like purposes, or for shells used in connexion with ordnance. Complete Specification. July 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

9799. J. A. Wanklyn. Smokeless explosives. July 17.

10,722. A. V. Newton.—From A. Nobel. Explosive compounds. June 26.

12,697. G. Trench. Pyrotechnic signals for use at sea. July 10.

THE JOURNAL OF THE Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 8.—Vol. VIII.]

AUGUST 31, 1889.

[Non-Members 30/- per annum; Members
21/- per Set of extra or back numbers;
Single Copies (Members only) 2 6.]

The Society of Chemical Industry.

Past Presidents:

Sir H. E. Roscoe, M.P., LL.D., V.P.R.S.	1881—1882.
Sir Frederick Abel, C.B., D.C.L., F.R.S.	1882—1883.
Walter Weldon, F.R.S.	1883—1884.
W. H. Perkin, Ph.D., F.R.S.	1884—1885.
E. K. Muspratt	1885—1886.
David Howard	1886—1887.
Prof. James Dewar, F.R.S.	1887—1888.
Ludwig Mond	1888—1889.

COUNCIL FOR YEAR ENDING JULY, 1890.

President: Sir Lowthian Bell, Bart., F.R.S.

Vice-Presidents:

R. Forbes Carpenter.	S. H. Johnson.
Prof. F. Clowes, D.Sc.	Ludwig Mond.
Sir J. Neilson Cuthbertson.	Dr. Hugo Müller, F.R.S.
Prof. James Dewar, F.R.S.	Dr. W. H. Perkin, F.R.S.
Jas. Duncan.	Dr. Edw. Schunck, F.R.S.
Dr. John Evans, F.R.S.	Prof. W. A. Tilden, F.R.S.

Ordinary Members of Council:

L. Archbutt.	B. E. R. Newlands.
S. B. Boulton.	Jno. Pattinson.
Jno. Brock.	Jno. Spiller.
Jno. Calderwood.	E. C. C. Stanford.
Alexander M. Chance.	J. C. Stevenson, M.P.
A. E. Fletcher.	A. Norman Tate.

With the Chairmen and Secretaries of Sections.

Honorary Treasurer:

E. Rider Cook, East London Soapworks, Bow, E.

Honorary Foreign Secretary:

Dr. Ferdinand Harter.

General Secretary: Charles G. Cresswell.

Offices:

Palace Chambers, 9, Bridge Street, Westminster, S.W.

THE JOURNAL.

Publication Committee:

The President.

Sir F. A. Abel, F.R.S.	Prof. A. K. Huntington.
A. H. Allen.	F. Hurter, Ph.D.
G. H. Bailey, D.Sc., Ph.D.	Ivan Levinstein.
Joseph Bernays, M.I.C.E.	Prof. R. Meldola, F.R.S.
H. Brunner.	Ludwig Mond.
W. Lant Carpenter.	E. K. Muspratt.
Prof. Frank Clowes, D.Sc.	B. E. R. Newlands.
W. Y. Dent.	C. O'Sullivan, F.R.S.
Prof. Jas. Dewar, F.R.S.	John Pattinson.
John Heron.	W. H. Perkin, Ph.D., F.R.S.
D. B. Hewitt, M.D.	Sir H. E. Roscoe, M.P., F.R.S.
David Howard.	John Spiller.
Prof. J. J. Hummel.	A. Norman Tate.
	Thomas Tyrer.

Editor:

Watson Smith, The Owens College, Manchester.

ASSISTED BY THE FOLLOWING STAFF OF

Abstractors:

T. L. Bailey, Ph.D.	Chas. A. Kohn, Ph.D.
G. H. Beckett.	F. W. T. Krohn.
D. Bendix.	T. A. Lawson, Ph.D.
E. Bentz.	J. Walter Leather, Ph.D.
E. E. Berry.	A. Liebmann, Ph.D.
E. J. Bevan.	D. A. Louis.
Bertram Blount.	W. Macnab.
Arthur G. Bloxam.	J. M. H. Munro, D.Sc.
C. H. Bothamley.	H. S. Pattinson, Ph.D.
E. G. Clayton.	H. T. Penternmann.
Julius B. Cohen, Ph.D.	S. G. Rawson, D.Sc.
C. F. Cross.	A. Ree, Ph.D.
A. R. Davis.	F. W. Renant.
W. W. Haldane Gee, B.Sc.	Edward Simpson.
C. Napier Hake.	A. J. Smith, B.Sc.
Oswald Hamilton.	Oscar J. Steinhart, Ph.D.
John Heron.	A. L. Stern, B.Sc.
Bertram Hunt.	A. Studer, Ph.D.
C. C. Hutchinson.	Bertram Thomas.
D. E. Jones, B.Sc.	Eustace Thomas.
W. E. Kay.	V. H. Veley, M.A.
A. J. King, B.Sc.	R. Lloyd Whiteley.
F. S. Kipping, D.Sc.	A. Wingham.

NOTICES.

On and after the 30th of September the Editor's address will be "University College, Gower Street, London, W.C.," instead of Owens College, Manchester, as heretofore.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Sportswood, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January 1883, and January, February, and April 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once, stating price required, with Mr. Cresswell. The stock of all other numbers is at present sufficient for the Council's requirements.

Post Office Orders in payment of subscriptions should in all instances be made payable at the General Post Office, London.

CHANGES OF ADDRESS.

Archbold, Dr. Geo., 1/o Phenix; 250, West 14th Street, New York City, U.S.A.

Bishop, Fred., 1/o Edinburgh; c/o Linlithgow Oil Co., Ltd., Linlithgow, N.B.

Brown, Jas. T., 1/o Fulham; 260, King's Road, Chelsea, S.W.

Bullough, T. A., 1/o Ditton; 50, Peel House Lane, Farnworth, Widnes.

Campbell, Andl., 1/o Linlithgow; c/o Burnah Oil Co., Ltd., Raigoon, Burnah (14, Thirlestane Road, Edinburgh, until Sept. 7).

Collins, W. Hepworth; Journals to 14 and 15, Bradford Chambers, Mawdsley Street, Bolton.

Cresswell, C. G., 1/o Putney; Emyngarth, Ashted, Surrey.

Evans, Reginald E., 1/o Woodford; Analytical Laboratory, Stratford-on-Avon.

Giles, W. B.; Journals to 9, Belmont Villa, Leyton, E.

Hamburger, Dr. S., 1/o St. Helens; c/o Z. Hamburger Söhne, Posen, Germany.

Hammill, M. J., 1/o Denton's Green; Elm House, Cressington, near Liverpool.

Harrison, Chas., 1/o Hall; 67, Surrey Street, Sheffield.

Hastings, Hugh; Journals to Consterdine Place, Baxter Street, Kidderminster.

Hibbert, Walter, 1/o West Kensington; 14, Goldhurst Terrace, South Hampstead, N.W.

Hohenhausen, J. von; Journals to 28, Delaunays Road, Higher Crumpsall, Manchester.

Isherwood, Oswald, 1/o Salford; Milton Street, Broughton, Manchester.

Liversedge, A. J., 1/o Glasgow; c/o Mirrlees, Watson, and Varyan Co., Ltd., Monument Station Buildings, London, E.C.

Radenmacher, H. A., 1/o Zurich; Sulphite Fibre Mills, West Carrollton, Ohio, U.S.A.

Scott, Wm., 1/o Paris; c/o Alex. McKenzie, Hoddesdon, Herts.

Sexton, Prof. A. Humboldt, 1/o Rutherglen; 38, Bath Street, Glasgow.

Weldon, W. P. R., 1/o Cambridge; 1, Hoe Villas, Elliot Street, Plymouth.

Welsh, Jas., 1/o Newton Heath; Kinder Printworks, Hayfield, near Stockport.

Wolner, Dr. Robt., 1/o Liverpool; c/o Stamer, Noack, and Co., Billwänder a. d. Bille, Hamburg, Germany.

CHANGE OF ADDRESS REQUIRED.

Brin, A., 1/o 9, College Street, Lambeth, S.E.

Deaths.

Cuthbert, H. W., of 88, Bishopsgate Street Within, E.C. August 17th.

Smith, Chas., of Greenock; at 347, Pollokshaws Road, Glasgow; aged 22. August 13th.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.

H. E. Armstrong.

W. Lant Carpenter.

W. Crowder.

W. J. Dibdin.

C. Graham.

S. Hall.

C. C. Hutchinson.

R. Messel.

B. E. R. Newlands.

B. Redwood.

T. Royle.

John Spiller.

Wm. Thorp.

C. R. Alder Wright.

Hon. Local Sec. and Treasurer:

Thos. Tyrer, Garden Wharf, Battersea, S.W.

ERRATUM.

On p. 519 of the July number, col. 1, line 14 from foot, for "inches" read "metres."

Liverpool Section.

Chairman: F. Hurter.

Vice-Chairman: A. Norman Tate.

Committee:

J. Campbell Brown.

H. Brunner.

E. Carey.

H. Deacon.

T. Fletcher.

H. Gaskell, jun.

F. Gossage.

S. Hamburger.

W. D. Herman.

D. McKechnie.

G. Shack-Sommer.

Henry Tate.

Hon. Treasurer: W. P. Thompson.

Hon. Local Secretary:

Dr. C. A. Kohn, University College, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Newcastle Section.

Chairman: T. W. Stuart.

Vice-Chairman: P. P. Bedson.

Committee:

Alfred Allhusen.

G. T. France.

G. Gatheral.

John Glover.

T. W. Lovibond.

John Patkinson.

H. R. Procter.

B. S. Procter.

W. W. Procter.

W. L. Remoldson.

C. H. Ridsdale.

J. E. Stead.

Hon. Local Secretary and Treasurer:

Dr. J. T. Dunn, The School, Gateshead.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Nottingham Section.

Chairman: Sir John Turney.

Vice-Chairman: L. Archbutt.

Committee:

Jno. R. Ashwell,
F. Clowes,
J. B. Coleman,
W. A. Curry,
H. Forth,
E. Francis.

J. M. C. Paton,
S. J. Pentecost,
C. Spackman,
H. J. Staples,
J. T. Wood.

Treasurer: S. V. Holgate.

Hon. Local Secretary:

R. L. Whiteley, University College, Nottingham.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Communication.

ON THE PRECIPITATION OF COPPER AS SULPHOCYANIDE IN ASSAYING.

BY FRANK JOHNSON, F.G.S., E.L.C.

(Chief Chemist to the Tharsis Mines, Spain.)

IN the assay of copper ores and cupreous liquors it is almost invariably necessary to separate the copper from iron, zinc, or other metals as a preliminary to its estimation by any of the well-known methods.

This separation is usually performed by the use of sulphuretted hydrogen, hyposulphite of soda (sodium thio-sulphate), and occasionally of metallic zinc or iron.

During the last few years I have tried many experiments with the object of attaining a means of separation involving, for the assay, the least possible time, care, and manipulation. The result of my labours is the following method, which I have employed with success for many thousands of assays during the last four years, and which I find perfectly suited to the copper assay of Spanish pyrites and the copper liquors produced therefrom.

The ore is dissolved in any suitable acid, the excess of which should be mainly boiled off. The semi-fluid residue is diluted with about 20 times its volume of cold water and sulphocyanide of ammonium added to the extent of at least three times the weight of the copper possibly present. This will produce with the ferric salts a deep red colouration, then stannous chloride solution is added until bleaching ensues, and a liquid more or less turbid with precipitated cuprous sulphocyanide and the insoluble portion of the ore results.

I find 5 grms. a very convenient quantity to take of ordinary cupreous pyrites of $\frac{1}{2}$ to 5 per cent. copper, and I add to the solution 5 cc. of ammonium sulphocyanide solution of 100 grms. per litre commercial crystallised salt. This quantity is safely sufficient for the precipitation of $\frac{1}{2}$ 3 gm. copper, and is not enough when diluted by the assay to about 200 cc. to have any solvent effect on the cuprous sulphocyanide precipitated. If the colour of the ore or its solution indicates the presence of more than the above-named amount of copper, proportionately more sulphocyanide solution must be added.

Stannous chloride solution is made by dissolving commercial protochloride in hydrochloric acid to saturation, and is kept in a bottle containing rods of metallic tin. This solution is added to the assay immediately after the sulphocyanide. Being very strong, about 10 cc. are usually sufficient to discharge the colour due to ferric sulphocyanide.

A good close filter-paper is now required—perfectly free also from all traces of colour. Munktell's are the best of those I have yet tried, though other Swedish papers approach it closely.

The assay is filtered through a paper of 5 or 6 inch diameter which is washed with water containing about one per cent. of commercial hydrochloric acid—either partially, by one rinse round, or thoroughly, according to the intended subsequent treatment.

Before proceeding to describe the most convenient ways of estimating the copper, I may say that though it is safest to leave as little excess of acid as possible when evaporating the dissolved ore, enough must be left to allow of the complete solution of the saline products when water is added. In the diluted solution as much as five per cent. of free acids may be present, either sulphuric, hydrochloric, or nitric, though if much of the latter exists in the liquid care must be taken that its temperature be below 100° F. when the sulphocyanide is added or a mutually destructive reaction would occur. Below 100° F. nitric acid may be present without further inconvenience than the production of a dark colour in the liquid after reduction with tin, due, I believe, to some compound of iron with nitric peroxide.

Returning to the assay—on the filter is caught the cuprous sulphocyanide, the gangue of the ore, and traces of stannic hydrate; my usual routine is now to give one wash with acidulated water (one per cent. muriatic acid), allow that to run through, raise the filter-paper carefully by its edge, double and fold together, and drop the paper with its contents back into the dissolving flask, neglecting the traces of filtrate still clinging to the paper.

A dilute acid mixture is made of 1 part nitric acid, 1 hydrochloric, and 1 water; 50 cc. of this are poured on the wet filter and the flask is placed on a hot plate to boil gently for about a quarter of an hour, when all red fumes should have disappeared and the paper have become quite reduced to pulp. About a quarter of the bulk may be evaporated, but not more, as it is essential to avoid the action of strong acids on the paper.

Ammonia is now added to the assay, and when fairly cool it is titrated with solution of cyanide of potassium, standardised preferably with copper dissolved, precipitated as sulphocyanide, and dissolved as above, for the best paper often produces a faint yellowish colour in the finished assay, more especially if the ammoniacal solution is left in contact with the paper pulp for a long time before being titrated. This colour is of no consequence if present also in the standardisation.

The above (with, of course, the usual precautions of cyanide assaying, viz. quantity of copper, acids, ammonia, &c., and temperature same in standardisation as in assays) is what I have found to be the quickest method of assaying poor ores and liquors containing zinc accurately to within about one per cent. on the copper present.

The solubility of cuprous sulphocyanide in the acid supernatant liquid is only 2 or 3 parts per million, and may be quite disregarded if standardisation of the cyanide solution be performed with an approximately equal quantity of copper similarly dissolved and separated.

In filtering a precipitated assay it is important to notice if the filtrate is perfectly clear. Frequently the first few drops passing are turbid, in which case this portion must be returned to the filter. Occasionally when washing the filter the dilution of the filtrate causes a separation of stannic hydrate, which, however, is easily distinguished from the turbidity due to cuprous sulphocyanide.

Cuprous sulphocyanide is soluble in hot dilute nitric acid, being converted into a cupric solution which even after long boiling contains cyanogen in a form which interferes with the cyanide titration, causing a much less amount of cyanide to be required than would ordinarily be the case. If, however, both nitric and hydrochloric acids be used, diluted in the above-mentioned proportion with water, and the assay be boiled until all red fumes have disappeared, the resulting liquid can be safely assayed by the cyanide process.

The solution produced by dilute nitric acid alone cannot be assayed by electrolysis for the same reason unless it be first evaporated to dryness and strongly heated. The electrolytic assay can be applied to the solution in mixed acids by filtering from the paper pulp and evaporating with 1 or 2 cc. of sulphuric acid, taking up the residue with water and electrolysing.

I have performed the electrolytic assay many times prepared by the former and also by the latter of these means, and I find the latter very much more convenient. The paper pulp is reserved after washing and mixed with the liquid exhausted by electrolysis, ammonia being then added, the traces of copper left in the liquid and those in the paper pulp are estimated together colorimetrically.

The electrolytic assay with preliminary sulphocyanide separation has a good feature in that no arsenic, antimony, or bismuth are deposited with the metallic copper, nor have I ever noticed any blackening or other discolouration of the deposited copper even when left under the influence of the current for double the usual time, *i.e.*, two days.

Cuprous sulphocyanide is readily soluble in a solution of ferric sulphate, cupric salt, ferrous salt, and ferric sulphocyanide resulting. If this solution be acidified with sulphuric acid and a solution of potassium permanganate run in from a burette the red colour becomes lighter, changes to a brown, then to the blue due to cupric sulphate, and lastly a pink tint is produced by one drop of permanganate in excess. I find this reaction gives a very accurate and speedy means of assay. To apply it the following means are used:—

The paper, containing cuprous sulphocyanide and insoluble portions of the ore, is well washed, first once or twice with the dilute hydrochloric acid above mentioned, and then with hot water. The filter is raised, dropped back into the dissolving flask as before, and 50 cc. of acid ferric sulphate solution poured upon it. This solution contains about 100 grms. of ferric sulphate and 50 cc. H_2SO_4 per litre. The assay is slightly agitated to promote mixing of the contents of the paper with the solution. Permanganate solution is now run in until, after fresh agitation, the solution remains brown or olive-green. It smells strongly now of hydrocyanic acid and is taken to a sink chamber, heated, and allowed to simmer for 5 or 10 minutes, when probably the red-brown colour will have partly returned. 200 or 300 cc. of cold water are now added and the permanganate titration completed. A good strength for the permanganate solution is 20 grms. per litre. If the first pink colouration be taken as the finishing point, though it is soon discharged, the accuracy of the assay is not affected by the reducing power of the paper pulp. This may easily be verified by treating a clear paper with 50 cc. ferric solution, diluting with cold water as before, and adding permanganate. I have always found one drop suffice to produce a transient pink colour. The chief inconvenience about this assay is the evolution of hydrocyanic acid during titration. Where one or two assays only are to be performed there is no trouble, as only traces escape from each flask before it is heated. The check assays, of which I have performed some dozens by this process, usually agreed with the electrolytic assay or with the weighed amount of copper introduced to within $\frac{1}{2}$ per cent.

I have not as yet tried any experiments upon the application of this means of separation as a preliminary to the iodide assay, but I suppose that the liquid prepared as already described for permanganate titration, by careful washing and solution in dilute acid mixture, would, if nearly neutralised and sodic acetate added, yield a suitable medium for the iodide and hyposulphite assay.

No mention has here been made of reducing agents other than stannous chloride, as I have found no other approaching it in convenience. Sulphurous acid can be used if very little ferric iron be present, but otherwise it is very slow in its action. Hyposulphite of soda is for various reasons unsuitable.

In preparing the stannous chloride solution time must be allowed for the metallic tin immersed to precipitate any traces of copper present in the commercial salt. If the clear solution be then siphoned off it is easy to leave behind the black flocks adhering to the rods of tin.

In conclusion I have only to express my hope to have some criticism from those who may give a practical trial to the procedure here recommended.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements Connected with or Applicable to Baths or Vessels containing Liquids used in Electro-plating or Dyeing, or the Electrolyte of Storage Batteries and the like. E. Hopkinson and D. Appleton, Manchester. Eng. Pat. 8966, June 19, 1888. 8d.

By means of a circulating pump the surface liquid is drawn off and forced out through the perforations of a delivery pipe arranged near the bottom of the tank, thus maintaining an uniform density.—B. T.

Improvements in Weighing Scales or Balances. C. H. Bartlett, Bristol. Eng. Pat. 11,555, August 10, 1888. 8d.

ONE improvement is intended to prevent injury from jarring to the agate-stones used as bearing surfaces for the knife-edge centres, by the use of a spring or spring cushion made of metal or india-rubber. The two drawings attached to the specification show how this improvement may be applied either to a balance of the "Roberval type" or to hanging scales. A second improvement relates to a method of obtaining a very fine adjustment in a "Roberval" balance by means of a moveable weight.—E. S.

Improvements in Apparatus for Purifying Water in or for Use in Steam Boilers. J. Pollock, Belfast. Eng. Pat. 18,556, December 19, 1888. 8d.

A PERFORATED chest or chamber having within it a bar or bars of copper is introduced into the steam-boiler, and balls of zinc are allowed to roll upon the copper bar or bars, the copper and zinc being both kept clean by the motion of the balls. The chemical or galvanic action going on inside the chest prevents corrosion of or deposit of scales upon the boiler-plates.—B. T.

An Improved Drying, Desiccating, and Roasting Apparatus. C. Solomon, Brunswick, Germany. Eng. Pat. 7149, April 29, 1889. 6d.

A ROTATING drum, tapering towards both ends, is fed at one end through its hollow shaft with the materials to be treated, the gaseous and other matter for effecting the drying and other processes entering by the hollow shaft at the opposite end. The drum is made in two halves, connected together, each half being provided internally with helical or screw-like surfaces arranged in opposite directions, by which means the material is intimately mixed, and held in suspension whilst the gaseous products of combustion are driven through the apparatus to act upon it. The temperature may be observed by a "pyrometer," and the progress made ascertained by withdrawing a sample through an opening usually closed by a suitable cover. When the operation is completed a slide is drawn outward and allows the contents of the drum to fall into a receptacle. A drawing accompanies the specification.—E. S.

* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	3d.
Above 8d., and not exceeding 1s. 6d.	1d.
" 1s. 6d., " " 2s. 4d.	13d.
" 2s. 4d., " " 3s. 4d.	2d.

II.—FUEL, GAS, AND LIGHT.

Water-Gas. J. F. Bell. A Paper read at the Spring Meeting of the Midland Association of Gas Managers, held at Matlock Bath, May 16, 1889.

This paper embodies the results of the author's investigations into the comparative values of water-gas and ordinary coal-gas. After remarking that the patents so profusely taken out at the present day are almost identical with those of years ago, he goes on to point out that in America, where they have an abundance of anthracite coal well adapted for making water-gas, and plenty of cheap oil for carburetting it, the average price is 10s. 6d. per 1,000 cubic feet against 9s. 6d. per 1,000 cubic feet of coal-gas, and that the number of companies making water-gas is gradually decreasing. An average sample of water-gas contains by volume: hydrogen, 48 per cent.; carbonic oxide, 41 per cent.; carbonic acid, 6 per cent.; and nitrogen, 5 per cent.; or a total of 89 per cent. combustible gases, against 96½ per cent. in ordinary 17-candle coal-gas. Water-gas has a thermal value of only 291 B.T.U. per cubic foot (B.T.U. = lb. of water heated 1° F.) against 673 for coal-gas, so that to produce the same calorific effect, where both are available, less than half the latter will do as much as the former. Theoretically, if the whole calorific value of a ton of coke could be obtained as water-gas, 76,000 cubic feet should be produced, but in practice only about 23,000 cubic feet are obtained, the difference being chiefly represented by the sensible heat of the gases evolved, and the heat consumed in making producer gas during the intervals while the fuel is not hot enough to decompose steam advantageously. This producer gas, which the author distinguishes by the name of "producer water-gas," contains about 20 per cent. of carbonic oxide, and may be utilised to evaporate water, &c., &c. Its thermal value is only 73 B.T.U. per cubic foot, so it will be seen that if any practical value is to be obtained from it, it

must be used before its sensible heat has been lost by cooling. There is one respect in which water-gas has a decided advantage over coal-gas as a heating agent: its temperature of combustion is 4,320° F. against 3,970° F., a very valuable feature where intense local heat is required. It has been proposed that gas companies should supply a cheap fuel gas consisting of a mixture of coal-gas, water-gas, and producer water-gas, but the author does not think the scheme will answer. A ton of coal, first gasified in the usual way, and then used for the production of water-gas, would yield:—

	Cubic ft. B.T.U.	
Coal-gas.....	10,000 × 673 =	6,730,000
Water-gas.....	12,000 × 291 =	3,492,000
Producer water-gas..	42,000 × 73 =	3,066,000
Total.....	64,000	298
		13,288,000

Although this mixture is much superior to ordinary producer gas, the very fact of having to cool so large a volume for distribution means too great a loss in sensible heat for the process to work economically. Moreover, the cost of distributing so bulky a gas would be very heavy, and it is doubtful if the demand would justify the outlay that would be required. In the States the chief illuminating agent employed to carburet water-gas is naphtha, of which from 5 to 5½ gallons are required per 1,000 cubic feet. This alone would cost in England about 15d. per 1,000 cubic feet of gas produced. The author has but a poor opinion of the Falmehjelm incandescent system (this Journal, 1886, 424; 1888, 23 and 112; 1889, 533 and 534). He considers the magnesia combs too frail, and, apart from this, does not think the general public will ever adopt an arrangement which necessitates so much attention and such frequent renewals. With respect to the comparative costs of production, some interesting figures are given. Taking the capital laid out in plant for making and distributing 100,000,000 cubic feet of either kind of gas per annum as equal to 3*l.* 10s. per ton of coal, the costs work out somewhat as follows:

	Cost of Coal-Gas per 1,000 Cubic Feet.		Cost of Water-Gas per 1,000 Cubic Feet.
Manufacture (including gas making, purifying, repair, and maintenance of works, &c.)	d. 6·0	One-half this amount	d. 3·0
Distribution (including repair and maintenance of mains, services, &c.)	2·0	.....	2·0
Rates and taxes.....	2·0	.....	2·0
Management	0·8	.....	0·8
Total working expenses.....	10·8	.....	7·8
Coals—10,000 cubic feet of gas—at 10s. per ton less 65 per cent., being net amount received for residuals, leaving net cost of coal 3s. 6d. per ton	4·2	Coke—23,000 cubic feet of gas—at 10s. per ton with no residual products.....	5·2
Total coals and working expenses..	15·0	.....	13·0
Interest on capital, 35,000 <i>l.</i> at 5 per cent.....	4·2	Two-thirds of this amount	2·8
Depreciation and renewal.....	1·8	.....	1·2
		Add cost of naphtha for carburetting the water-gas (allowing for extra quantity of gas made by the naphtha).....	17·0
			13·0
Total cost per 1,000 cubic feet	21·0		30·0

From this it will be seen that carburetted water-gas costs 2s. 6d. per 1,000 cubic feet, against 1s. 9d. for coal-gas. The cost of the uncarburetted gas is only 1s. 5d. per 1,000 cubic feet, it is true, but against this is its low thermal value. The author concludes by saying that he "can conceive of no

commercial undertaking that has less chance of success, as now proposed, than the manufacture and distribution of water-gas in competition with coal-gas in England." Appended are some valuable tables showing the figures upon which the above results are based.

TABLE A.—CONSTITUENTS BY VOLUME AND WEIGHT OF ORDINARY 17-CANDLE POWER COAL-GAS; ALSO ITS CALORIFIC VALUE, &c.

Constituents of Coal-Gas.	Vol. Per Cent.	Weight of Gases at 60° F. and 30 in. Bar.	Weight of Constituents of Coal-Gas.	Heat of Combustion of Gases per Lb.	Calorific Value of Coal-Gas.	Oxygen required for Combustion.	Products of Combustion.
Hydrogen (H ₂)	Cub. Ft. 43'00	1 C. Ft. = Lb. 0'00531	Lb. 0'261	B.T.U. 61,500	B.T.U. 16,051	Cub. Ft. 21'5	OH ₂ CO ₂ N ₂ 49 .. 94
Marsh gas (CH ₄)	37'00	0'04246	1'571	24,020	37,755	74'0	74 37'0 284
Benzene (C ₆ H ₆)	1'30	0'20700	0'269	18,000	31,821	31'0	13 16'5 117
Propylene (C ₃ H ₆)	1'20	0'11150	0'131	21,200			
Ethylene (C ₂ H ₄)	2'50	0'07420	0'185	21,500			
Carbonic oxide (CO)	5'25	0'07430	0'390	4,400	1,716	2'5	.. 5'0 10
Nitrogen (N ₂)	3'25	0'07430	0'242	..	..	..	.. .. 3
Carbonic acid (CO ₂)	0'50	0'10083	0'051	..	..	..	.. 0'5 ..
Oxygen, &c. (O ₂)							
	100'00	..	3'103	..	67,323	132'0	136 59'0 508

Calorific value of 1 cubic foot of coal-gas = 673 B.T.U.

Weights of gases after combustion—

OH₂..... 136 × 0'0478 = 6'501 lb. CO₂..... 59 × 0'1167 = 6'855 lb. N₂..... 508 × 0'0743 = 37'744 lb.

Temperature of resultant gases after combustion, if the exact quantity of air required is supplied..... } $t = \text{Heat disengaged} - \text{Heat absorbed in maintaining OH}_2 \text{ in gaseous state.}$
 $\Sigma = (\text{Weight of constituents} \times \text{specific heats.})$

$$\therefore t = \frac{67,323 - 7,398}{(6'501 \times 0'712) + (6'855 \times 0'301) + (37'744 \times 0'222)} = \frac{59,925}{15'08} = 3,970^\circ \text{ F.}$$

B.T.U. = pounds of water heated 1° F.

TABLE B.—CONSTITUENTS BY VOLUME AND WEIGHT OF WATER-GAS MADE FROM COKE; ALSO ITS CALORIFIC VALUE, &c.

Constituents of Water-Gas.	Vol. Per Cent.	Weight of Gases at 60° F. and 30 in. Bar.	Weight of Constituents of Water-Gas.	Heat of Combustion of Gases per Lb.	Calorific Value of Water-Gas.	Oxygen required for Combustion.	Products of Combustion in Cubic Feet.
Hydrogen (H ₂)	Cub. Ft. 45'00	1 C. Ft. = Lb. 0'00531	Lb. 0'255	B.T.U. 61,500	B.T.U. 15,682	Cub. Ft. 24'0	OH ₂ CO ₂ N ₂ 48 .. 90
Carbonic oxide (CO)	41'00	0'07430	3'046	4,400	13,402	20'5	.. 41 78
Carbonic acid (CO ₂)	6'00	0'11682	0'701	..	..	..	.. 6 ..
Nitrogen, &c. (N ₂)	5'00	0'07430	0'372	..	..	..	.. .. 5
	100'00	..	4'374	..	29,084	44'5	48 47 173

Calorific value of 1 cubic foot of water-gas = 291 B.T.U.

Weights of gases after combustion—

OH₂..... 48 × 0'0478 = 2'294 lb. CO₂..... 47 × 0'1167 = 5'485 lb. N₂..... 173 × 0'0743 = 12'854 lb.

Temperature of resultant gases after combustion, if the exact quantity of air required is supplied..... } $= \frac{29,084 - 2,546}{(2'294 \times 0'712) + (5'485 \times 0'301) + (12'854 \times 0'222)} = \frac{26,538}{6'137} = 4,320^\circ \text{ F.}$

TABLE C.—CONSTITUENTS BY VOLUME AND WEIGHT OF GASES PRODUCED WHEN AIR IS BLOWN INTO GENERATOR, CALLED "PRODUCER WATER-GAS."

Constituents of Producer Generator Gases.	Vol. Per Cent.	Weight of Gases at 60° F. and 30 in. Bar.	Weight of Constituents of Producer Gas.	Heat of Combustion of Gases per Lb.	Calorific Value of Producer Generator Gas.	Oxygen required for Combustion.	Products of Combustion in Cubic Feet.
Hydrogen (H ₂)	Cub. Ft. 2'00	1 C. Ft. = Lb. 0'00531	Lb. 0'0106	B.T.U. 61,500	B.T.U. 652	Cub. Ft. 1	OH ₂ CO ₂ N ₂ 2 .. 4
Carbonic oxide (CO)	20'00	0'07430	1'4860	4,400	6,538	10	.. 20 38
Carbonic acid (CO ₂)	3'00	0'11682	0'3505	..	..	..	.. 3 ..
Nitrogen, &c. (N ₂)	75'00	0'07430	5'5725	..	..	..	.. .. 75
	100'00	..	7'4196	..	7,290	11	1 23 117

Calorific value of 1 cubic foot of producer generator gas = 73 B.T.U.

Weights of gases after combustion—

OH₂..... 2 × 0'0478 = 0'096 lb. CO₂..... 23 × 0'1167 = 2'684 lb. N₂..... 117 × 0'0743 = 8'693 lb.

Temperature of resultant gases after combustion, if the exact quantity of air required is supplied..... } $= \frac{7,290 - 106}{(0'096 \times 0'61) + (2'684 \times 0'27) + (8'693 \times 0'21)} = \frac{7184}{3135} = 2,290^\circ \text{ F.}$

TABLE D.—CONSTITUENTS, CALORIFIC VALUE, &c. OF VARIOUS GASES.

Name of Gas.	Composition by Volume per Cent. in Cubic Feet.							Weight of 100 Cubic Feet.	Combustible Gases by Volume.	Calorific Value per Cubic Foot.	Air required for Combustion per Cubic Foot.	
	H ₂	CH ₄	C ₂ H ₄	&c.	CO	CO ₂	&c.	N ₂	Lb.	Per Cent.	B.T.U.	Cub. Ft.
Coal-gas	49	37	5		5½	0½		3½	3.163	96.25	673	6.37
Water-gas	48	..	..		41	5		6	4.374	89.00	291	2.13
Producer gas.....	9	2	..		25	5		59	6.959	11.00	132	1.01
Producer water-gas.....	2	..	..		20	3		75	7.420	22.00	73	0.53

—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, &c.

Decomposition of the Neutral Fats by Heating under Pressure. C. Engler and S. Seidner. Dingl. Polyt. J. **27**, 515—526 and 572—576.

This is a continuation of the researches of the first named bearing on the problem of the formation of petroleum (Ber. **21**, 1816). An operation on the large scale was conducted in a patented apparatus of Krey's for distillation under pressure. The oil treated was that obtained from the Menhaden fish (*Clupea Tyronum*) of specific gravity 0.930, and consisting chiefly of tri-olein. The course of the distillation was as follows: the first evolution of gas was noticed at the expiration of five hours, shortly after this distillation commenced, the temperature being 325°, the pressure 10 atmospheres. The specific gravity of the distillate varied from 0.875 to 0.855. As the temperature gradually rose to from 400° to 425° the pressure sank to 4 atmospheres, the distillate running at the gravity 0.830—0.813.

The aggregate results of the first distillation were as follows:—Distillate, 339 kilos.; carbonaceous residue, 65 kilos. The difference of the sum of these from 492 kilos., the original weight of oil, *i.e.*, 88 kilos., represents the gases evolved and unavoidable loss. Of the 339 kilos. of distillate, 217 kilos. richer in undecomposed tri-olein, and of higher specific gravity, were redistilled with the following results:—

	Kilos.
Distillate	197
Residue	12
Gases and loss	8
	<u>217</u>

In the end the total weight of oily distillate amounted to 299 kilos.; of aqueous distillate 20 kilos. were collected. The distilled oil is of brownish colour with a marked green fluorescence, and does not appear to contain acrolein. A measured volume of the oil treated with various reagents in succession, showed the following diminutions, corresponding with the removal by combination of groups of constituents:—

	Vol. per Cent.
Water	0.4
Potash (alcoholic).....	4.8
Sulphuric acid	20.8
Mixture of the above with fuming acid	9.6

Fractional distillation of the distilled oil gave the following results:—

	Fraction.		
	Below 150°.	150°—300°.	Above 300°.
Volume, per cent.....	20.5	57.5	15.0
Weight "	25.9	58.0	16.1
Specific gravity	0.712	0.817	..

The mean percentage of saponifiable constituents in the original distillate may be taken at 5.7.

Experiments on the small scale, admitting of accurate measurements, were carried out in sealed glass tubes bent at an angle, the limb containing the oil being heated in an air-bath, the other projecting into the air, and being kept cool thereby. A comparison was instituted under these conditions, between the fish oil described above and synthetical tri-olein. Particulars below:—

(a.) *Fish Oil*.—Quantity taken 40 grms.

	Grms.	Per Cent.	Specific Gravity.
Gaseous products..	3.56	8.9	..
i. Distillate*	25.20	63.0	(0.837)
ii. Distillate†	6.60	16.5	(0.876)
Residue	4.64	12.6	..

* Of which 6.6 per cent. saponifiable.

† By heating residue from i. over naked flame.

(b.) *Tri-olein*.—Quantity taken 35.5 grms.

	Grms.	Per Cent.	Specific Gravity.
Gaseous products..	3.55	10.0	..
i. Distillate*	24.80	69.8	(0.815)
ii. Distillate.....	5.00	14.1	(0.853)
Residue.....	2.15	6.1	..

* Of which 5.4 per cent. saponifiable.

Under the condition of heating in a sealed tube the process of distillation takes place within the limits of temperature 365°—425°, the pressure, estimated from the volume of the gaseous products, amounting to from 20 to 25 atmospheres. The quantity of water formed is estimated at 1—3 per cent.

Constituents of the Distillate.—(a.) *From fish oil*.—In addition to the pentane, hexane, and heptane previously isolated (Dingl. Polyt. J. **269**, 138) the authors have separated: secondary hexane or di-isopropyl; secondary heptane or ethylisamyl; octene, secondary octane or di-isobutyl, and nonane. The percentage of olefines estimated from the results of treatment of the oil with sulphuric acid, amounts to 37 (by vol.). Acetylenes are probably also present. The evidence as to the presence of aromatic hydrocarbons is doubtful.

(b.) *From Tri-olein*.—For the better investigation of these products a quantity of 6 kilos. was subjected to distillation. The resulting oil differed from that obtained from the fish oil in respect of specific gravity, which is 0.780; the lower gravity being probably due to a lesser proportion of unsaturated hydrocarbons. The authors isolated from this product some hydrocarbons of the methane series, *e.g.*, normal hexane and heptane, concluding as the result of their investigation a general similarity of the constituents of this oil to those of the product described under (a.).

Composition of the Gaseous Products of the Distillation.
—The mean composition of the gaseous mixture evolved in the experiments in the sealed glass tubes was found to be as below:—

	Per Cent.
Carbonic anhydride.....	17.4
Olefines.....	7.8
Carbonic oxide.....	34.5
Methane.....	38.3
Residue (difference)	2.0

The gases evolved under the condition of distillation at the ordinary atmospheric pressure are differently proportioned. The following numbers express the mean composition of the mixture:—

	Per Cent.
Carbonic anhydride	26.7
Olefines.....	11.4
Carbonic oxide.....	31.9
Methane.....	25.2
Residue (difference)	1.8

The increase of the methane at the expense of the carbonic anhydride, under the condition of distillation under pressure, is noteworthy. This result was confirmed by comparative distillations of oleic acid under the two sets of conditions; the gaseous mixtures evolved being analysed with the following results:—

	Burner.	Specific Gravity.	Flashing Point.	Mean Luminosity.	Consumption per Candle per Hour.
Artificial petroleum from fish oil.....	{ a } { b }	0.8025	26.5	{ 13.2 } { 9.2 }	2.32 2.44
Pennsylvanian petroleum.....	{ a } { b }	0.8034	25.0	{ 8.56 } { 7.78 }	4.6 3.65

The luminous effect of the artificial petroleum is high with a relatively low consumption of oil.

In conclusion, the authors discuss the bearings of their researches upon the problem of the natural origin of the petroleum. They afford as yet only approximations to the proof of their theory of the "animal" origin of the mineral oils.

From experiments on the destructive distillation of mussels, the authors conclude that the pyrogenetic process—which they assume—must have preceded in geologic time by fermentation at the expense of the nitrogenous constituents, and an accumulation of the residual fatty components of the animal bodies.—C. F. C.

IV.—COLOURING MATTERS AND DYES.

Thioflavin. A. Schenrer. Soc. Ind. de Mulhouse. Sitzungsber. May 8 and 22, 1889.

This is a new basic yellow colouring matter made by Casella and Co. It is soluble in water and alcohol and very soluble in acetone, acetic acid, and acetic acid. It is easily fixed with a tannin mordant. Good results are obtained on cotton by the following process:—40 parts of thioflavin, 50 of tannin, 50 of water, 100 of acetic acid, 60 of acetic acid, and 700 of gum solution are taken. The goods after treatment are steamed and passed through tartar-emetic. Thioflavin thus yields a fast and bright yellow comparable with chromate of lead, and possesses moreover the valuable property of not running into the white of the fabric in printing. Its fastness to light is about equal to that of vat-indigo. Schenrer pronounces this yellow dyestuff superior to all other yellow dyes that are fixed by tannin. It is derived

	High Pressure.	Atmospheric Pressure.
Carbonic anhydride.....	26.0	37.2
Olefines.....	2.9	12.5
Carbonic oxide.....	23.5	38.6
Methane.....	43.6	9.3
Residue (difference)	2.0	2.4

Illuminating Oil from the Products of Distillation.—The crude product from the distillation of the fish oil was redistilled, and the portion distilling between 140°—300°, amounting to about 60 per cent. of the original, separately collected and purified by agitating successively with dilute sulphuric acid, water, and soda-lye.

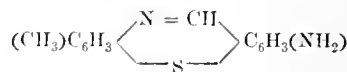
This purified oil—the authors' artificial petroleum—was nearly colourless, with a pale blue fluorescence, specific gravity 0.8025, flashing point 26.5° (Abel), specific viscosity 1.006 (water 1.0). The latter number is noteworthy, being sensibly less than for the natural petroleum.

The following are the details of photometric comparisons of the artificial with Pennsylvanian petroleum, the burners employed being—(a) Schuster and Baer's. (b) Wild and Wersel's. The standard of luminosity was the German normal paraffin candle.

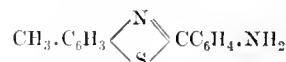
from a class of new yellow dyestuffs consisting of the ethylated or methylated derivatives of dehydrothiitoluidine (Dahl's). (See Jour. Soc. Dyers and Colourists, 1889, 107.)
—W. S.

On the Constitution of Primidine. W. Pfitzinger and L. Gattermann. Ber. 22, 1063—1068.

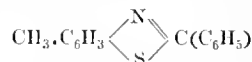
ACCORDING TO GREEN the constitution of dehydrothiitoluidine is—



The authors, however, contend that the formula—



explains far more satisfactorily the properties of this base. By diazotising the base and boiling its alcoholic solution a body is obtained, crystallising in long colourless needles, melting at 122° C. It has to be considered as *Benzoyl p-m-Amidothiocresol*—

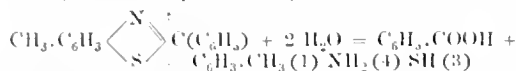


belonging to the class which Hofmann obtained by treating acid anilides with sulphur, or which were prepared by Jacobsen by oxidising thioanilides with potassium ferri-cyanide.

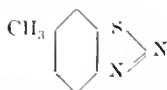
Hess has obtained a body from *p-m-amidothiocresol* identical in every respect with the above, and the authors further prepared synthetically the same compound according to Jacobsen's method. Thiobenzotoluidine, melting at 188° C., dissolved in caustic soda, was poured into a solution

of potassium ferrieyanide. A precipitate separated which, after recrystallisation from dilute alcohol, melted at 122° C., and was in every respect identical with benzenyl-*p*-*m*-amidodihydroresol from dehydrothiitoluidine.

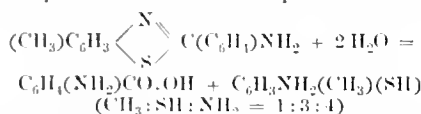
By melting this compound with caustic potash the following reaction ought to take place:—



When 2.3 grms. of the purified compound were added to 5 grms. of fused caustic potash, it was after some time dissolved, the mixture suddenly solidifying. From its clear aqueous solution hydrochloric acid precipitates a colourless crystalline body, melting, after purification, at 122.5° C., which was proved to be benzoic acid. The hydrochloric acid solution was precipitated by sodium bicarbonate, and a crystalline compound was thus obtained, which, however, rapidly decomposed. It was therefore converted by nitrous acid into its diazosulphide, crystallising from petroleum spirit in large plates, melting at 42°–43° C., and identical with a body recently obtained by Jacobsen and Ney of the formula—

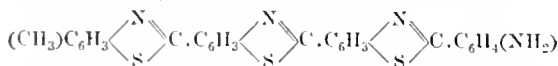


* Dehydrothiitoluidine itself ought to yield under similar treatment paramidobenzoic acid and *p*-*m*-amidodihydroresol—

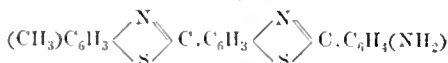


Experiments proved this hypothesis to be quite correct.

When the primuline base itself is fused with caustic potash at 250°–270° C., and its aqueous solution, after acidulation with hydrochloric acid, is treated with nitrous acid, a considerable quantity of a yellow precipitate is formed which was separated by filtration. The filtrate yielded with an alkaline solution of β-naphthol a yellowish-red colouring matter, and contained probably diazoparamidobenzoic acid. The residue consisted of two bodies, one soluble and one insoluble in carbonate of soda. The latter proved to be the before-described diazosulphide, melting at 42°–43° C. The former is, perhaps, the carbonic acid of the phenylenediazosulphide. The primuline base probably owes its existence to the combination of two molecules of dehydrothiitoluidine—



or to the combination of one molecule of dehydrothiitoluidine with one molecule of paratoluidine—

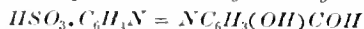


The authors will continue the research, and endeavour to decide which is the correct interpretation of this compound.

—A. L.

On Azo Compounds from Salicylic Aldehyde, Salicylic Alcohol, and Salicylic Amide. E. Tummey. Ann. 251, 174–187.

P-Azobenzene sulphonic acid, salicylic aldehyde—

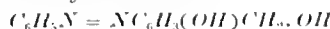


was obtained in the usual way; it melted at 232°–235° C. With hydroxylamine and phenylhydrazine it forms the compounds characteristic of the aldehydes. Bromine decomposes it and produces diazosulphanilic acid and dibromosalicylic aldehyde, melting at 85° C. The author prepared further:—

M-Azobenzene sulphonic acid, salicylic aldehyde, melting above 270° C.

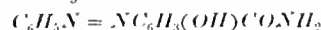
Azobenzene salicylic aldehyde melting at 128° C.

Azobenzene salicylic alcohol—



melting at 143°–144° C.

Azobenzene salicylic amide—

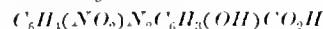


melting at 235° C.

P-Azobenzene sulphonic acid, salicylic amide.—A. L.

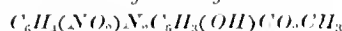
On Azo Compounds of Salicylic Acid. L. Gebeck. Ann. 251, 188–196.

Azonitrobenzene salicylic acid—



melting at 237° C., was obtained from meta-nitraniline and salicylic acid.

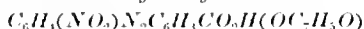
Azonitrobenzene salicylic methyl ether—



yellow needles, melting at 167° C.

Azonitrobenzene salicylic ethylether orange needles melting at 186° C.

Azonitrobenzene benzoylsalicylic acid—



yellow needles, melting above 240° C.

If azonitrobenzene salicylic acid be reduced in alkaline solution with zinc dust *Hydrazoaniline*, $\text{C}_2\text{H}_5\text{N}_2$, melting at 111° C., is formed. On heating azonitrobenzene salicylic acid with aniline a compound, $\text{C}_6\text{H}_5\text{N}_2\text{C}_6\text{H}_3(\text{C}_6\text{H}_5)(\text{NHC}_6\text{H}_5)$, is formed, crystallising in red-brown needles melting at 197° C.

Alpha-azonaphthalene salicylic acid, yellow needles, melting at 212° C. On heating with aniline a body of the formula $\text{C}_{10}\text{H}_7\text{N}_2\text{C}_6\text{H}_3(\text{C}_6\text{H}_5)(\text{NHC}_6\text{H}_5)$ is formed, forming in benzene solution red-brown crystals melting at 197° C.

Beta-azonaphthalene salicylic acid, small yellow needles, melting at 233° C. On boiling with aniline a body of the formula $\text{C}_{10}\text{H}_7\text{N}_2\text{C}_6\text{H}_3(\text{C}_6\text{H}_5)(\text{NHC}_6\text{H}_5)$ is obtained, crystallising from benzene in brown plates which melt at 236° C.

—A. L.

On α-Naphthol Sulphonic Acids. F. Bender. Ber. 22, 993–1,000.

The following sulphonic acids have been hitherto obtained from α-naphthol:—

(1.) Monosulphonic acid of Schäffer and Baum. (2.) So-called α-naphthol-α-sulphonic acid prepared also from naphthionic acid. (3.) Liebmann's monosulphonic acid. (4.) Disulphonic acid, yielding dinitronaphthol on nitration. (5.) Disulphonic acid, which can be nitrosated, and is capable of yielding azo-dyes. (6.) Trisulphonic acid of the Badische Anilin und Soda Fabrik.

Nos. 1 and 2 combine with diazo-compounds, form dinitronaphthol, and well crystallising nitroso-derivatives, which on nitration yield dinitronaphthol.

No. 3 forms azo- and diazo-colouring matters—on nitration comparatively little dinitronaphthol sulphonic acid is formed; the nitroso-compound crystallises well, and produces on nitration dinitronaphthol sulphonic acid.

No. 4 yields neither azo- nor nitroso-compounds; on nitration dinitronaphthol is formed.

No. 5 produces azo-compounds and nitroso-compounds; on nitration dinitronaphthol sulphonic acid is formed as with Liebmann's acid; the nitroso-compound, however, can be easily nitrated.

No. 6 forms neither azo- nor nitroso-compounds; on nitration dinitronaphthol sulphonic acid is formed.

The disulphonic acid No. 4 must have the constitution $[\text{OH}:\text{SO}_3\text{H}:\text{SO}_3\text{H} = 1:2:4]$.

By boiling with acid two monosulphonic acids are formed, identical with No. 1 and No. 2. Schäffer's monosulphonic acid like α-nitroso-α-naphthol does not form a

green colouring matter with ferric chloride and nitrous acid, and contains therefore the sulphonic group in the position 2, while α -naphthol- α -monosulphonic acid under the same conditions does yield a green colouring matter, and has to be considered as the "4" monosulphonic acid. The action of nitrous acid, nitric acid, and diazo-compounds on the different naphthol sulphonic acids renders it possible to analyse mixtures of them without any further separation. Such a mixture is converted into the calcium salts, acidulated, and a nitrated solution of a nitrite is added, until nitrous acid is not any more absorbed after standing for some time. Or a solution of diazoxyline is added until a sample after acidulation with sulphuric acid, precipitation with salt, and filtration does not form any more colouring matter with diazoxyline. Thus it is found how much of the α -naphthol has been converted into sulphonic acids, yielding nitroso- and azo-compounds.

Titration with diazoxyline may lead to mistakes when Liebmann's acid is present, as it combines with two molecules of the diazo-compound.

The acids which can be thus estimated are 1, 2, 3, and 5. There remain 4 and 6, and to separate these, the filtrate from the xyldine colour is nitrated, and the quantities of dinitronaphthol and dinitronaphthol sulphonic acid are estimated. To decide whether Nos. 1 and 2 are present with 5, the nitroso-derivatives of the calcium or barium salts are nitrated, and the quantities of dinitronaphthol and dinitronaphthol sulphonic acid are estimated. If, furthermore, the difference in the yield of dinitronaphthol and its sulphonic acid compounds obtained once by nitrating the whole mixture; secondly, by first removing the sulphonic acids capable of forming azo-dyes, be known, the quantities of Nos. 1, 2, and 5 can be readily estimated.

The following are the results of a great many experiments on the sulphonation of α -naphthol. The monosulphonic acids Nos. 1 and 2 disappear rapidly. Even following Schäffer's method, the disulphonic acid No. 4 is formed.

On using an excess of strong (especially fuming) sulphuric acid, the sulphonation proceeds in the following manner:—

Monosulphonic acid (Nos. 1, 2), disulphonic acid (4), trisulphonic acid (6), disulphonic acid (5).

On using little ordinary sulphuric acid, only little trisulphonic acid is formed, but the disulphonic acid (4) is changed into the isomeric compound (5).

Monosulphonic acid (1), (2), disulphonic acid (4), disulphonic acid (5). On heating strongly, the disulphonic acid is changed into the monosulphonic acid (3), decomposition taking place and sulphurous acid escaping.—A. L.

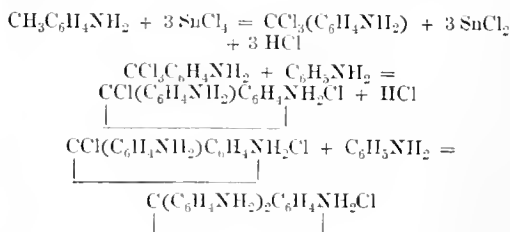
Synthesis of Rosanilines from Aromatic Amines by the Action of Substances yielding Halogens. O. Mühlhäuser. Dingl. Polyt. J. **272**, 376—382.

AFTER discussing the cases in which mixtures of different aromatic amines are capable of yielding rosanilines, having regard to the constitution of the former, the author gives various tables showing the action of halogens, metallic and metalloïd halogen compounds, and bodies producing halogens as dehydrating agents in the formation of these dyes. The tables, which are too extensive to be reproduced here, show the case in which any one of these dehydrating agents acts on a given mixture of different amines with production of rosanilines.

As regards the metallic chlorides their action often consists in giving up part of their chlorine. Thus SnCl_4 becomes SnCl_2 , and CuCl_2 becomes CuCl . In the class of metalloïd halogen compounds suitable for the above purposes, carbon hexachloride is the most important, C_2Cl_4 and CHCl_3 being also used. Again, mixtures of hydrochloric acid with weak oxidising agents, e.g., ferriyanide, ferric oxide, &c. are suitable; here, of course, it is the halogen set at liberty which acts as the condensing medium.

An explanation is given of the manner in which halogen-carriers effect condensations. Ferrous chloride, which is pre-eminently suited for these purposes, is said to generate chlorine in presence of HCl and nitrobenzene; ferric chloride is formed which yields part of its chlorine to the aromatic base, and this process is repeated so long as

nitrobenzene remains in the mixture. Finally, the author illustrates by means of several equations the changes which he believes to take place in the above processes. Thus, in the formation of pararosauiline he formulates the following phases—



—A. R.

PATENTS.

The Manufacture of Diethylmercaptol and of a Sulphone therefrom. T. J. Johnson, London. From The Farbenfabrik vorm. F. Bayer and Co., Elberfeld, Germany. Eng. Pat. 12,563, August 31, 1888. 4d.

THE patent describes the production of diethylsulphone diethylmethane by oxidising the product obtained by condensing diethylketone with ethylmercaptan by means of hydrochloric or sulphuric acid. 14 kilos. of ethylmercaptan and 10 kilos. of diethylketone are saturated with dry hydrochloric acid gas, the mixture being cooled by water or ice. The formation of the mercaptol is completed in a few hours. On the addition of water it separates as an oil and is purified by washing with sodium hydrate, drying with calcium chloride and rectification in vacuo. It boils at 225° — 230°C . and possesses a strong odour. To convert it into the sulphone, 1 kilo. is dissolved in 50 kilos. of water and a solution containing 4 kilos. of permanganate, 1 kilo. of concentrated sulphuric acid, and 80 kilos. of water, is slowly added. The oxidation is complete when the solution becomes colourless. The filtrate on evaporation yields the diethylsulphone diethylmethane in the form of silvery scales, melting at 87° — 89°C . The product is tasteless and odourless, slightly soluble in cold water, but readily soluble in hot water, ether, alcohol, and similar solvents.—T. A. L.

Improvements in the Manufacture of Colouring Matters. O. Huray, London. From G. C. Zimmer, Mannheim, Germany. Eng. Pat. 13,798, September 24, 1888. 6d.

PHENYL- β -NAPHTHYLAMINE monosulphonic acid (Merz and Weith, Ber. **13**, 1300), when combined with tetrazo-diphenyl or tetrazo-ditolyl, yields colouring matters which dye unmordanted cotton blue shades of red. The operation is effected in two stages. One molecule of the tetrazo salt is combined with one molecule of the monosulphonic acid above mentioned, forming an insoluble compound. This is then combined either with a second molecule of the sulphonic acid or with a phenol or amine or with their sulphonic or carboxylic acids. The following are some examples given. 28 kilos. of benzidine sulphate are diazotised in 600 litres of water with 14 kilos. of sodium nitrite and 40 kilos. of hydrochloric acid. This solution is then poured into 600 litres of water containing 32 kilos. of phenyl- β -naphthylamine sodium sulphonate and 35 kilos. of sodium acetate. The brown intermediate product thus formed is added to 26 kilos. of sodium naphthionate and 10 kilos. of sodium carbonate dissolved in 900 litres of water. The whole is then agitated for 12 hours, boiled, filtered, and the colouring matter salted out. It dyes cotton a bluish-red. By substituting 31 kilos. of tolidine sulphate for the benzidine, a much bluer colour is produced. A bluish-violet colouring matter is formed by reacting with the intermediate compound described above on β -naphthol disulphonic acid (R salt) in an alkaline solution, and a still bluer colouring matter is obtained by employing α -naphthol- α -sulphonic acid in place of the R salt.—T. A. L.

Improvements in and relating to Colouring Matters.

H. H. Leigh, London. From R. G. Williams, Albany, New York, U.S.A. Eng. Pat. 4565, March 15, 1889. 6d.

ONE molecule of a tetrazo compound of diphenyl, ditolyl, dixyl, stilbene, fluorene, naphthalene, or their sulphonic acids, is combined with one molecule of one of the present known sulphonic acids of naphthylamine, and the intermediate compound thus formed is combined with one molecule of an alkylised oreinol or its sulphonic acid, or with one molecule of the product which is formed by combining oreinol with sodium chloride (Watts, VI., 885; De Luyne, Zeits. für Chemie, [2], IV., 703). This compound is formed by saturating a 5 per cent. solution of oreinol with salt, slightly acidulating it with hydrochloric acid and boiling the solution until it shows a green fluorescence on the addition of soda. The solution is filtered from tar and is ready for use. The derivatives of oreinol employed are the mono-, di-, or tri-methyl, ethyl, amyl, or acetyl oreinols. The method of working is similar to that usually employed, and the colouring matters produced belong to the Congo red and benzopurpurine class.—T. A. L.

The Production of Azo-Colouring Matters from Diamidobenzylbenzidine and Diamidobenzyltolidine. A. Bang, Leeds. From Dahl and Co., Barmen, Germany. Eng. Pat. 7587, May 7, 1889. 4d.

DIAMIDODIBENZYL BENZIDINE and diamidodibenzyltolidine yield tetrazo derivatives by the action of nitrous acid. When these are combined with naphthionic acid or with β -naphthylamine- β -sulphonic acid, bluish-red dyestuffs are produced, with β -naphthylamine- β -sulphonic acid an orange dyestuff, and with a mixture of the latter and naphthionic acid a scarlet is formed. 42.2 kilos. of diamidodibenzyltolidine are diazotised with 60 kilos. of hydrochloric acid and 14 kilos. of sodium nitrite, and slowly added to a solution of 21.4 kilos. of sodium naphthionate and 40 kilos. of sodium acetate. The formation of the intermediate compound takes about one hour and at the end of this time a solution of 24.4 kilos. of sodium β -naphthylamine- β -sulphonic acid is run in and the mixture allowed to stand eight days, during which time it must be frequently stirred. The mixture is then neutralised with soda and the colouring matter salted out, filter-pressed and dried.

—T. A. L.

The Production of Paranitrobenzylsulpho Acid and also Azo-Colouring Matters from the Amidobenzylsulpho Acid corresponding to this Nitro-Compound. A. Bang, Leeds. From Dahl and Co., Barmen, Germany. Eng. Pat. 7588, May 7, 1889. 4d.

IF *p*-nitrobenzylechloride be heated with neutral sodium sulphite it is converted into *p*-nitrobenzylsulphonic acid. 17.1 kilos. of *p*-nitrobenzylechloride and 25.5 kilos. of sodium sulphite are heated for two days with 30 kilos. of water in an enamelled boiler provided with a reflux condenser. At the end of this time a yellowish solution results, which on cooling deposits crystals of sodium nitrobenzylsulphonate. This is purified by recrystallisation and yields on reduction the corresponding amido-compound, which hitherto has not been used for the production of dyestuffs. It combines with tetrazo salts, forming dyestuffs whose dye-baths are exhausted by unmodified cotton. Various combinations can be made, of which the following is an example. 18.4 kilos. of benzidine or an equivalent amount of tolidine, diamidostilbene, or diamidostilbene sulphonic acid are diazotised with 60 kilos. of hydrochloric acid and 14 kilos. of sodium nitrite and added to a solution of *p*-amidobenzylsulphonate of sodium and 14 kilos. of sodium acetate. To this intermediate product is then added a solution containing 24.6 kilos. of sodium naphthionate and the mixture is allowed to stand eight days, then neutralised with soda and the dyestuff precipitated with salt, filter-pressed and dried. The same compound may also be formed by combining the tetrazo derivative first with naphthionic acid and afterwards with *p*-amidobenzylsulphonic acid.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

PATENT.

Improvements in Treatment of Sisal Hemp and Analogous Fibres for Textile Purposes. A. W. Montgomery, New York, U.S.A. Eng. Pat. 5582, April 2, 1889. 6d.

THE inventor claims "cleaning sisal and analogous fibres and preparing the same for spinning after the ultimate fibres have been separated from each other, and the preliminary cleaning effected, which consists in combing or heckling said fibres to remove the remaining foreign adhering matter before oil has been applied thereto and of subsequently oiling said fibre." By this means a saving of oil is effected and an improved quality of fibre is obtained.

—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Dyed Artificial Silk from Pyroxylin. H. Koechlin, Soc. Ind. de Mulhouse Sitzungsber. May 8 and 22, 1889.

A SAMPLE of the new artificial silk (this Journal, 1889, 539) dyed with rhodamine was exhibited. It possessed more gloss and beauty than silk. The new textile fibre is made in Lyons by a patented process (Ger. Pat. 38, 368). According to Koechlin's description the solution of pyroxylin is pressed through narrow apertures of the diameter of silk threads, and the fibres are then agitated in water, by which a kind of coagulation is effected. The material is then partially denitrated. It possesses the same lustre as silk, but is stated by Koechlin to show a less degree of tenacity.—W. S.

Notes on Lead in Water. C. Rawson. J. Soc. Dyers and Colourists, 5, 58—61.

A SERIES of dyeing experiments were made on wool with a few of the brighter coal-tar colours and on indigo, with a view of ascertaining the effect of small quantities of lead in the water used. For further details of the experiments see page 638.

Observations relating to Indigo Dyeing by the Hydrosulphite Process. D. Dawson. J. Soc. Dyers and Colourists, 5, 93—98.

THE author advocates an analytical examination of the ingredients for making up a hydrosulphite vat, in order to attain to greater certainty in the results. He finds that only free sulphurous acid will react with zinc to produce hydrosulphite, and consequently an equivalent of sulphuric acid should be used along with sodium bisulphite in order to liberate all the sulphurous acid. For the estimation of the reducing power of a hydrosulphite solution the preference is given to titration with a solution of sulphindigotic acid. The acidity of the sodium bisulphite solution is ascertained by the quantity of carbonic acid evolved on treatment with sodium bicarbonate, and the total sulphurous acid present is estimated by titration with bichromate solution.

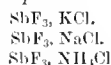
In the discussion following the reading of the paper, it was pointed out that the shade of colour given by the hydrosulphite vat differs from that given by the wood vat or the ferrous sulphate vat, and that this difference results from the destruction of the red constituent of ordinary indigo by the action of the hydrosulphite vat; but the hydrosulphite method offers advantages, such as ease of manipulation and a greater exhaustion of the bath, by which it is able to supersede the old processes in many cases. An alternative method of examining sodium bisulphite, and one which is capable of very accurate results, is

to titrate with standard solutions of acid and alkali, using on the one hand methyl orange as indicator, and on the other phenolphthalein. "With methyl orange as indicator bisulphite of soda is the neutral salt, but with phenolphthalein it is normal sulphite of soda."—G. H. B.

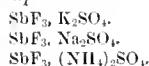
"Antimony Salt" as a Substitute for Tartar-Emetic.
D. Paterson. J. Soc. Dyers and Colourists, 5, 78—79.

This salt, possessing the composition $\text{SbF}_3 + (\text{NH}_4)_2\text{SO}_4$, is one of the new group of antimony-fluoride double salts discovered by E. de Haën (see this Journal, 1887, 727; 1888, 206, 207, 566, 624, 841). There are two groups of crystallised combinations, the constitution of which will be understood from the formulae:—

Chloride Group—



Sulphate Group—



The last mentioned salt is the one employed, as it possesses greater advantages for dyeing and printing purposes than any of the others, and is now being extensively used as a substitute for tartar-emicetic or oxalate of antimony. It is very poisonous and must be kept in wooden or clean copper vessels, as it attacks earthenware or glass. The goods are mordanted with sumac, gall nuts, or tannic acid as with tartar-emicetic, then they are passed through the solution of the salt; for 1 kilo. of tartar-emicetic only 0.9 kilo. of antimony salt is used, and for 1 kilo. of antimony oxalate only 0.5 kilo. of antimony salt is required. For experimental dyeing, 40 grains (*sic*) of antimony salt and 10 grains of soda crystals to the litre of water are sufficient. More brilliant colours are obtained by the use of the new substance, and its ready solubility is advantageous. Compared with tartar-emicetic its use effects a saving of 48 per cent.—G. H. B.

Industrial Position of Hydrogen Peroxide. C. F. Göhring.
Chem. Zeit. 13, 560—561.

HYDROGEN peroxide is now employed for bleaching silk, feathers, hair, ivory, bones, bristles, &c., and will doubtless soon be used for bleaching wool, and, if it was cheaper, even cotton.

For bleaching delicate materials, such as wool, feathers, &c., it should not be too strong; a solution of 1 in 10 is strong enough, and a bleaching vat of this solution may be used for quite a long time if the strength be kept up by fresh additions of hydrogen peroxide. The purer the peroxide is the better it will work, and care should be taken to avoid the presence of things which decompose it and, of course, render it useless, such as metals, even a nail, iron rust, &c. The strength of a solution is very easily estimated by titration with permanganate. As a general disinfectant it is not convenient, but is suitable for distribution as spray in sick rooms.—D. A. L.

Dyewoods and Extracts; their Use and Abuse. L. Bruchl.
Textile Colourist, 1889, No. 114 *et seq.*

AN industry of no small dimensions has been developed in the course of the past 20 years, the object of which is to extract the important active substances contained in the dyewoods, and thus to reduce the latter to a more convenient form. Owing to their easier application, the dyewood extracts have gradually gained numerous friends, and their employment has increased accordingly. Paradoxical as it may seem, a distinct line of demarcation cannot be drawn between the dyewood extracts and the tanning extracts, since many tanning materials are at the same time dyestuffs used in dyeing and printing, such as quercitron, sumac, and catechu. The property of the tannic acids to give coloured precipitates with metallic oxides, and, on the other hand, to precipitate artificial dyestuffs, either alone or in their combinations as metallic tannates, and thus

to act as simple or compound mordants, has caused them to be introduced into the dyeing and printing industries.

Since the value of such tanning and dyeing materials depends upon the quantity and quality of the tannic acids contained in them, it is important for the practical man to know the properties of these tannins. But it is to be regretted that science has not yet advanced far enough to speak with accurate knowledge of the tannic acids. Contradictory opinions are universally maintained. Tannic acid itself never serves for the manufacture of leather, because it is no tanning substance at all, being capable of forming simill-leather products, but not real leather. The employment of tannic acid is reserved for the dyeing and printing industries, together with some others.

Tannic acid has thus far only been manufactured from nut-galls. The value of tanning materials and of some dyeing substances being determined by the quantity of tannic acid contained therein, and the tannic acid of nut-galls (actual percentage of tannin) being accepted as a standard, it is evidently of importance to exactly know the constitution of tannic acid. But on this point the opinions of chemists are widely divergent. If we compare all the literature published on tannin matters, we come finally to the conclusion that there must be very different kinds of tannin. Whether the behaviour of all these tannins towards metallic salts, glue, animal skins, permanganate of potash, &c. be the same, we do not know whether the densities or the aqueous solutions of these tannins correspond or not. It can only be said that as long as "tannin" can only be understood as a collective name, it is absolutely inadmissible to take "chemically pure tannic acid" for the starting point if for the determination of the quantity of tannin in dyeing and tanning materials.

The high percentage of so-called active tannin cannot always be a gauge for the value of an extract or dyeing material.

The author divides the dyewoods into two groups, viz., (a), such as are principally useful on account of the colouring matters contained in them; (b), such as are used on account of their tannin as well as their colouring matter. To the former belong logwood, brazilwood, fustic, &c.; to the latter, quercitron and sumac.

LOGWOOD.

In text-books, even such as have been published by prominent authorities, as well as in the practice, we often find the statement made that the name of the wood is at once the criterion of its value, and thus the brands San Domingo, Yucatan, Monte Christo, and Laguna are generally considered the best, and the others are described as of inferior value. The author found this not to be a correct proceeding, as shown in the following table:—

Name and Mark of Woods.	Per-centage of Water.	Per-centage of Ashes.	Per-centage of Yield of Extract.	Per-centage of Combustible Matter.
Yucatan logwood	13.00	1.09	20.20	65.71
Laguna logwood'	12.38	0.96	21.00	65.66
Domingo logwood,	13.19	1.88	14.02	70.73
Monte Christo logwood, 1884	13.20	2.94	18.75	65.11
Monte Christo logwood, 1887	14.70	1.03	14.00	70.27
Fort Liberté logwood, 1886—87	13.10	0.82	20.33	65.75
Fort Liberté logwood, 1887	10.12	0.88	16.00	73.00
Fort Liberté logwood, 1885—86	12.11	2.03	17.45	68.41
Fort Liberté logwood, J.B., 1887	11.84	1.03	18.00	69.13
Yucatan logwood, E.J. ...	14.51	1.20	17.34	66.95
Domingo logwood, D. ...	13.71	2.14	19.30	64.85
Jamaica wood	14.10	1.14	18.70	66.06
Jamaica wood	12.70	1.30	18.00	68.60
Jamaica wood roots	15.30	2.30	10.70	71.70

The value of a dyewood depends upon the quantity of colouring matter contained in the wood. Ordinarily, the manufacturer of extracts takes the yield of extract as the gauge of value of the wood, and the same opinion prevails in the analyses of several chemists, and with numerous dyers, who boil out their bought wood, and judge it by the specific gravity of their decoctions. This largely adopted opinion seems the more peculiar, as there is an essay of Chevreul's extant since 1810, showing that the yield of extract from the wood is not identical with its tinctorial value. Besides variable quantities of colouring matter, there are also organic and mineral substances variably present in logwood. It follows from this that these substances are present in the extracts obtained and thus increase the quantity but not the tinctorial value of the latter. The colouring matter of logwood is present: first, in an oxidised state; second, as hæmatestin and hæmatoxylin; third, as glucoside. The oxidised portion is produced by the alteration of the wood in the air, which causes the dark colouring of the woods and of the decoctions. This oxidation may have proceeded more or less far; from some wood decoctions common salt precipitates a resinous black substance, whilst with other decoctions the precipitates are only of a light brick red colour. This oxidation of the dyewood in the air extends not only to the transformation of hæmatestin and hæmatoxylin into higher grades of oxidation, but to the glucosides also, which are thereby partly converted into hæmatoxylin and hæmatestin and the higher grades of oxidation, and thus first assume the colouring character of a dyestuff. In estimating the quality of a wood, the only rational way is to take the actual quantity of colouring matter present into consideration, and not the total extract. This basis of valuation, however, is not adopted by all manufacturers of extract and numerous dyers for want of knowledge. The author found that the so-called low grades of logwood (such as those from Jamaica) are sometimes worth more than prime San Domingo and Monte Christo logwoods, and that even with equal yields of extract, one wood may have a greater tinctorial value than another. It is advisable, therefore, for the dyer, as well as for any consumer of logwood, to examine the article offered and not to allow himself to be deceived by high-sounding names. In order to determine the tinctorial value of the extracts obtained from various classes of wood, the author made comparative dye trials, and found that a high yield does not correspond to a high tinctorial value. He digested the extracts obtained, with ether, then with alcohol, took up the remaining insoluble residue with water, and made dyeing experiments with each extract. He thus found that the alcoholic and ethereal extracts were rich in colouring matter, while the residue taken up by water was the poorest, while that no more colouring matter could be detected in it by the most delicate reagents, and that it principally consisted of mineral compounds, sugars, and other organic—non-colouring—substances.

TABLE II.

Name and Mark of Woods.	Alcoholic Extract.	Ethereal Extract.	Residue	Yield of Extract.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Yucatan logwood	37.46	60.12	2.42	20.20
Laguna logwood	47.95	51.37	0.68	21.00
Domingo logwood	53.47	44.95	1.58	11.02
Dominzo logwood, O....	50.32	43.81	5.81	13.30
Monte Christo logwood, 1884.....	60.32	32.00	7.78	18.75
Monte Christo logwood, 1887.....	54.10	34.72	11.18	14.00
Fort Liberté logwood, 1886-87	54.11	41.89	4.00	20.33
Fort Liberté logwood, 1887.....	47.92	50.00	2.18	16.06
Fort Liberté logwood, 1885-86.....	35.17	59.72	5.21	17.45
Fort Liberté logwood, J.B., 1887	34.81	59.24	5.95	18.00
Yucatan logwood, E.J....	38.51	58.34	3.15	17.34
Jamaica wood	50.50	42.20	6.30	18.70
Jamaica wood	50.71	43.05	6.24	18.00
Jamaica root-wood.....	30.12	52.99	16.89	10.70

The dyeing experiments with two brands of San Domingo wood (with 98.42 per cent. of colouring matter and 14 per cent. yield, and with 94.13 per cent. of colouring matter, and 19.30 per cent. yield) showed that the brand with 14 per cent. yield gave more favourable results than that with 19.30 per cent. yield. The two brands of Jamaica wood are nearly equal in yield and residue, as well as in the dyeing result, while Jamaica root-wood is much weaker, even when a quantity of wood corresponding with the extract yield is taken for dyeing (instead of 5 grms. of wood, 8.7 grms. of root-wood); the intensity of the dye only approaches the shade produced by 5 grms. of Jamaica wood when 14 grms. of root-wood are employed. If we calculate the quantity of wood of equal dyeing power according to the amount of insoluble residue, using 5 grms. of Jamaica wood, the calculation for root-wood will give the figure 13.55 grms., which comes very near the value ascertained practically at any rate, nearer than the figure 8.7 grms. as calculated from the yield of extract.

Another error constantly occurring in valuations of wood is that of taking the samples inaccurately. The samples presented to the chemist or dyer by the agents or dealers are mostly insufficient in quantity, and therefore unsuitable for ascertaining the actual value of the wood.

The author took from a lot of Fort Liberté logwood 10 samples of about 1 kilo. each, had them chipped, and determined their extract yields as follow:—

I.	II.	III.	IV.	V.
Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
21.3	18.35	15.7	18.4	16.1
VI.	VII.	VIII.	IX.	X.
Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
19.8	11.4	10.15	15.9	12.75

giving an average yield of 15.88 per cent. of extract. A sample of about 1 kilo. taken from a mass of about 20,000 kilos. of this cargo of wood (after chipping) gave a yield of 18.3 per cent. of extract; that is, much better than the average of the 10 samples of wood. On working up this wood on the large scale, the yield of extract was about 18 per cent. It is advisable, therefore, never to buy the supply on the strength of small samples, but always to judge the value of a wood according to the results obtained with a sample of at least 100 kilos. For the dyer, to whom the woods are almost exclusively offered in a chipped condition, the valuation by means of a small lot of about 100 kilos. is pretty sure; the consumer, however, who must buy the wood in the log, cannot be too cautious. The dyer is also often offered so-called oxidised or fermented dyewoods for sale, the price of such woods generally being somewhat higher than that of unfermented wood.

The fermentation or oxidation of the wood has for its object the transformation of the colouring matters of lower degrees of oxidation contained in logwood—such as hæmatoxylin and the glucosides—into bodies of higher degrees of oxidation—such as hæmatestin, &c. For this purpose the dyewoods are reduced to small fragments, chipped or ground, then wetted, and then exposed to the action of air and moisture in heaps of from $\frac{1}{2}$ to 1 metre in height. As soon as the reaction begins, heat is developed in the interior of the heaps, and in order to prevent over-oxidation, they must be at once turned over with the shovel. This operation is continued for several weeks, and the oxidation is considered complete when the glucosides and hæmatoxylin are entirely transformed into hæmatestin. This phase is marked by certain external appearances—such as a dark red colour of the wood after drying, with a light beetle-green lustre, and a wine-like odour of the wet wood. On boiling a sample of this wood with distilled water, the decoction must be dark straw-yellow, and turn claret-red on the addition of a trace of ammonia or sodium aluminate. When the colour strikes into blue, over-oxidation has already taken place, and the wood is of inferior

value. According to Schützenberger and the practical observation of English manufacturers, the oxidation process ought not to be continued longer than 6 to 8 weeks; for every 100 kilos. wood, 60 to 64 litres of water are to be used for moistening. The value of 6 lb. of logwood thus treated is equal to that of 10 lb. of newly chipped wood. In order to accelerate the oxidation, chemical reagents are sometimes dissolved in the water used for moistening, such as potassium chlorate and oxalic acid, ammonia, soda, ammonium phosphate, urine, potassium chromate, &c. The action of these reagents is tolerably strong, and can materially accelerate the oxidation, though at the cost of the quality of the dyewood. The yield of extract obtained from such oxidised woods is always higher than that of unoxidised woods, the shade in dyeing is deeper, but the fastness to washing and fulling, and resistance of the colours to light, are considerably diminished. By means of oxidising experiments executed at the same time, and as uniformly as possible, and by comparative dye-trials with the various products of oxidation, examining and exposing the dyed patterns for two minutes to the action of a chlorine bath (chloride of lime) at 0.05° B., and determining the yields of extract, the author arrived at the results shown in Table III. The table shows plainly in what ratio the tinctorial value or rather the extract yield of the wood increases by the employment of the oxidisers, but also the ratio of decrease in the fastness of the colours obtained to light and chlorine. While for a material which was dyed with unoxidised wood, 30 days were required to completely decolourise it, this result was already obtained in 18 days, in the case of wood which was simply oxidised by water and air. The shades obtained with oxidation products—oxidised by means of chalk, soda, and potassium chlorate—faded in ten days, and showed little resistance to chlorine. The poorest results were obtained with urine and potassium chromate; the latter, especially, oxidised the wood very quickly, so that in 8 or 12 days it was already almost completely oxidised, and the dyestuff very readily soluble in water, the wood thus obtained possessing all the properties which the dyer values; but the fastness to light and chlorine was extremely limited. Cotton yarn dyed black with this wood had the much-desired deep black tone, but, like the cotton cloth mordanted with alumina, it had become grey-yellow after an exposure to light of only five days. Urine gave similar results, and the same results were obtained by oxidation experiments with ammonium phosphate, silicate of soda, &c.

TABLE III.

Oxidising Agent.	Colour upon Alumina Mordant.	Yield of Extract per Cent.	Resistance to Light; Days.	Chlorine.
Unoxidised wood	Blue.	16.5	30	Un-changed.
Water and air	Blue.	17.8	18	Altered.
0.5 per cent. chalk	Violet blue.	18.4	10	Strongly altered.
0.25 per cent. potassium chlorate and oxalic acid	{ Violet } { blue. }	17.5	10	{ Strongly altered.
0.1 per cent. potassium chromate	{ Violet.	18.0	5	{ Dis-coloured.
0.25 per cent. soda'	Violet.	17.6	10	Strongly altered.
Urine	Violet blue.	18.0	8	Strongly altered.

The conclusion to be drawn from these experiments would be that a rational oxidation of the wood can at the best be effected by water and air, while oxidation by the agents enumerated is always effected at the cost of the fastness of the colour, and therefore objectionable.

Another method of oxidation worthy of notice is that by means of glue. This method is based upon the principle of precipitating the tannin-like compounds contained in

logwood by a solution of glue, and thus presenting the colouring matter pure, or purified, for use. Doubting the efficacy of glue, the author made experiments in this direction, and had his doubts confirmed. The compounds resembling tannin, which are present in some kinds of logwood, do not belong to the series of substances which are precipitated by glue, but are in their properties more similar to gallic acid, which is not precipitated by glue. The colouring matter itself, however, has a considerable affinity for glue; it is attracted by glue, although only in small quantities, mechanically as well as chemically, and is readily deposited from a decoction of the wood, on cooling, in the form of a flaky precipitate. The precipitation is promoted by the addition of a few drops of sulphuric acid. Dyeing experiments with wood oxidised by glue gave always slightly weaker results than with the same class of wood oxidised by water and air. The fastness to light and chlorine remained unaltered. This oxidising method is therefore, at least, a waste of glue. There are some kinds of logwood which contain traces of a tannin precipitable by glue, but the quantity of this tannin is so exceedingly small that its separation scarcely compensates for the colouring matter, which is at the same time precipitated by the glue.

In non-oxidised woods, if the latter are in good condition, the highest percentage of water which they contain is 15, while in freshly-oxidised and dried woods the minimum figure is always above 15 per cent., varying between 15 and 20 per cent. The method on which the dyer relies for examining his dyeing materials is that of dyeing patterns, the cotton piece goods dyer using prepared pieces of cotton cloth, the yarn dyer cotton yarn, and the wool dyer woollen piece goods or yarn. The examination upon prepared cotton piece goods is carried out as follows:—In a water or oil bath, which can be heated by steam or by gas-jets, are contained therein a number of tin-lined copper or glass beakers, of about 1 litre each capacity. Into these beakers equal quantities of the wood are introduced, say 0.5 gm., $\frac{1}{2}$ to $\frac{3}{4}$ litre water added, and a swatch of material entered, upon which stripes of alumina, iron, and a mixture of these two mordants have been printed, or a strip of material treated with iron mordant. Of such printed material a strip of the width of the piece and 10 cm. long is sufficient for 0.3 gm. to 0.5 gm. of wood; an equal piece of material mordanted with acetate of iron for black will do, but the quantity of wood must be regulated accordingly. Before entering, the swatches are moistened with water; after entering, the temperature of the dye-bath is raised, whilst briskly stirring, within one hour, to 75° C., and in another 15 minutes to the boiling point. For stripes the dyeing is then finished, but for black the dyeing is continued at the boil for about 10 minutes longer.

The dyed samples are now taken out, carefully washed, and dried in a drying chamber. By dyeing at the same time a sample with a wood of known quality for comparison, the value of the wood to be tested can be accurately determined to 1—2 per cent. by graduating the quantity of wood. This method of determining the tinctorial value will in most cases be satisfactory for the cotton dyer as well as the wool dyer. If, however, mordanted material cannot be had, the following method will give as satisfactory results:—

Enter 20 grms. of cotton yarn, bleached or unbleached, as convenient, into the beakers, with 5 grms. of wood for each, and boil for one hour, replacing the evaporated water with boiling water. Then take up the swatches from the baths, wring, shake off the adhering particles of wood (so that the liquid dripping off and the particles of wood fall back into the beakers) and enter the bath I. (for each sample of wood a separate mordant bath must be prepared)—viz., 1 litre cold water, 0.5 gm. copper sulphate; turn for five minutes, wring, shake out, and re-enter the dye-bath, to which 1 gm. of soda ash has been added, and boil for five minutes; then pass again into the copper mordant bath and the dye-bath (without adding more soda), boil for the same period, and enter bath II., consisting of 1 litre cold water and 0.8 gm. iron; turn for 10 minutes, wring, return to the dye-bath, to which now 1 gm. precipitated chalk has been added; boil for 15 minutes, lift, rinse, and dry. By comparing the shades obtained with various woods, their tinctorial value can thus be so accurately

determined that for an experiment on the large scale with the best kind of wood ascertained the basis is given. By this dyeing trial, which is not difficult to execute, the dyer can at all events protect himself from considerable losses in purchasing his stocks of logwood, as well as against the loss of a larger quantity of cotton, which would possibly occur in experimenting on a large scale.

Although it cannot be denied that the oxidation or fermentation of the wood offers several advantages, particularly when the wood is directly used in dyeing, the question of oxidation of the wood presents different features in so far as the manufacture of extracts is concerned. The manufacturer who furnishes his extracts to various branches of industry must also consider their wants, and the different purposes for which his extracts are used, and that in many cases an extract in which the dyestuff is oxidised to a high degree will not answer the purpose. A highly oxidised extract would, especially in printing woollen and textile fabrics, meet with little favour.

In the oxidation of the wood it cannot be avoided that (as is proved by the high extract yields), besides the oxidation of the dyestuff, transformations occur also with other substances contained in the wood, which greatly decrease their solubility in hot water, but which on the extract cooling down, as well as on adding chemical agents, are separated out. On boiling colours for printing, the inadaptability of highly-oxidised extracts manifests itself by the colours becoming gritty either immediately on cooling or in the colour boxes of the roller printing machines; the engraving of the rollers, plates, or blocks becomes clogged,

the print indistinct, and after continued use the colour coagulates and becomes watery. The author having made extensive experiments in this direction, found that extracts which had been purified by allowing them to settle showed a greater tendency to give coagulating colours than ordinary extracts do.

Every printwork chemist is aware that old colours never give good printing results, for the reason that the hæmato-metallic lake, which has already been formed in the colour, is present in the higher degrees of oxidation, and being but incompletely insoluble in acids cannot penetrate the fibre, and the colour being only superficially fixed upon the fibre in the steaming operation, has less power of resistance against washing, scouring and soaping operations, than a black which is developed from freshly-prepared colours.

If now the colouring matter of logwood is already present in the extract as hæmatein, and its higher degrees of oxidation not as glucoside convertible into hæmatein, in the preparation of colours, lakes of higher degrees of oxidation are produced from the beginning, which, in the first place, cause less fastness of the colour, and in the second place a clogging of the engravings, and, therefore, renders the colours or the extract less adaptable to printing purposes. Practical comparative experiments with differently prepared extracts have most completely confirmed this theoretical conclusion.

The author employed for the comparison extracts from the Jamaica brand taken from wood of the same cargo, shipped from the same place, and obtained the following results:—

Mode of Oxidation of Wood and Extracts.	Fastness to Light.	Fastness to Washing.	Fastness to Chlorine.	Remarks.
I.—Non-oxidised wood extract	25 days.	Good.	Normal.	Normal.
II.—Extract oxidised in the air	20 days.	Not as good as I.	Less so.	{ Soils the white of the tissues.
III.—Extract from wood oxidised in the air with water	20 days.	Ditto.	Ditto.	Ditto.
IV.—Extract from wood oxidised with chalk...	15 days.	Worse than I. and II.	Less than I. and II.	{ Soils the white of the tissues.
V.—Extract from wood oxidised with chrome } and potash	10 days.	Very little.	Less than II.	{ Colour readily coagulates.
VI.—Extract from wood oxidised with potas- sium chlorate and oxalic acid	10 days.	Ditto.	Ditto.	Ditto.
VII.—Extract from wood oxidised with urine...	10 days.	Ditto.	Ditto.	Ditto.

As in preparing the extracts used for these experiments with the colours, the greatest possible uniformity was observed, the results obtained prove the assertion that oxidised woods and their extracts, and extracts oxidised in the air, are less applicable to printing than non-oxidised extracts. Lakes and inks obtained with dyewood extracts will naturally be similar, the application of which is partly based upon the principle governing textile printing.

The previous oxidation of the wood is only to be recommended when the object is to produce dark extracts regardless of other properties.

On the other hand, by previous oxidation, the shades which the extracts can give with the various mordants are materially influenced. It is a fact known to every dyer that with some extracts of logwood, certain colours, especially pearl grey, are absolutely unobtainable, while by using another extract they are obtained exactly to shade. Comparative experiments which were made in this direction also proved that the previous oxidation of the wood, or the extracts, may modify the shade which the extract gives on dyeing with alumina, iron, copper, and mixed mordants. It is difficult to give names to the variety of shades obtained, but a sample-card plainly shows the numerous modifications, and it can only be said in general that with the same depth of shade the tones which oxidised extracts give with alumina mordants will always be violet—i.e., strike into red, and very much differ from the blue tone which is obtained by using non-oxidised wood extracts. Woods and extracts oxidised with

potassium chromate always give dyes which greatly resemble those produced with indigo substitute (which is easy to understand from the process of manufacturing indigo substitute). The same, or rather similar colours, are obtained on dyeing with extracts, if the wood or extract has been previously oxidised with chlorates or hypochlorites, such as chloride of lime. A deep blue tone is obtained with extracts in the preparation of which the wood was first oxidised with silicate of soda.

The assertion of many a dyer and printer, that he can only use a certain brand of extract, is not, therefore, to be ranked among the prejudices of which dyers often possess their share, but this assertion is justified, as has been seen, by the method of manufacturing extracts.

The principal adulterants of logwood extract are: molasses, dextrin, Glauber's salt, chalk, tannin extracts, such as chestnut, quebracho, sumac, divi-divi, and quercitron extracts, &c.

In liquid extracts, up to sp. gr. 1.256—1.312, Glauber's salt and chalk can be detected by the character of the sediment which always settles down from such extracts, and in which mostly a pulverulent deposit of chalk or of the sodium salt in crystals is found. For this reason these salts are only added in large quantities to solid extracts, and then usually along with other adulterants; besides, the colour of the solution and the constituents of the ash are sufficient indications by which to suspect the purity of the extract. Molasses and dextrin may be suspected if there is an abundant sediment, the former also if there is an increase of ash, and molasses can be discovered by the peculiar

odour, but in this errors are apt to be made. The author thinks that it is not safe to decide by the quantity of ash whether an extract is pure or adulterated, because there may occur highly adulterated extracts which yield a very small quantity of ash, while actually pure extract may give 5 to 8 per cent. ash. When dealing with the woods, it was shown that from the extracts prepared from some classes of wood upwards of 7.62 per cent. of ash was obtained, while from other woods the extract gave a result of only 1.08 per cent. of ash. In the same manner since the quantity of incinerable substance contained in an extract depends upon the class of the wood, the method of manufacturing the extract influences the quantity of ash. Extract works, whose filtering arrangements are imperfect, will invariably furnish extracts giving a higher percentage of ash. The following table shows the percentage of ash of extracts prepared from different woods by different methods:—

Name of Wood.	Extracted without Pressure in Extractor.	Extracted with $\frac{1}{2}$ Atmos. Pressure.	Extracted with $1\frac{1}{2}$ Atmos. Pressure.	Extracted with 10 Atmos. Pressure.
Yucatan wood	Per Cent. 1.98	Per Cent. 2.01	Per Cent. 2.74	Per Cent. 3.50
Laguna logwood ..	1.52	1.71	2.67	3.05
Fort Liberté logwood	1.08	1.09	1.84	2.15
Jamaica wood.....	2.33	2.35	2.94	3.72
San Domingo logwood	3.52	3.67	4.51	5.10
Monte Christo logwood.....	6.40	6.47	6.91	7.23
Jamaica root wood	7.02	7.70	8.10	8.51
Mixture of different woods	2.27	2.20	3.01	3.71

If it is possible, therefore, with these experimentally made extracts to obtain percentages of ash from the same class of wood, which range from 1.52 to 3.05 per cent., it is evident that in working on the large scale the difference must be still more considerable. From this table it will be seen that pure extracts obtained from different classes of wood can vary, as to their contents of incinerable substances, from 1.08 to 7.62 per cent.

The substances used as adulterants of extracts, such as molasses, greatly vary in the percentage of ash, and there are sugar molasses met with in commerce with only 8 per cent. ash, while others (osmotised molasses) show over 20 per cent. ash.

The detection of Glauber's salt and chalk does not belong to the most difficult problems for the analyst; different, however, is the question of the qualitative and quantitative determination of molasses and dextrin, which can only be determined on the basis of the proportion of sugar contained in these substances. Many methods have been suggested for the estimation of molasses, but the following seems to be most successful: 1—5 grms. of extract dried at 100° C. are extracted with absolute alcohol until a small quantity of the alcohol with sodium aluminate gives no longer any reaction with hæmatestin; the alcoholic extract is preserved. In the residue, besides the substances insoluble in alcohol which occur in extracts, there is contained the sugar of the molasses and dextrin originally present in the extract.

As a normal extract may contain 0.25—0.5 per cent. grape sugar, but never cane sugar, its detection in the residue after the alcoholic extraction is the surest proof of the presence of molasses; in the same manner, if there is a surplus of over $\frac{1}{2}$ to 1 per cent. starch sugar or grape sugar, the presence of a substance containing starch sugar or grape sugar may be inferred.

This method is used largely for the qualitative determination of saccharine matter in the extracts.

The alcoholic extract is now evaporated to dryness, the residue dried at 100° C., the mass obtained extracted with

ether, and the weight of the ethereal extract ascertained, the portion which is insoluble in ether being separately weighed. The comparison of these weights (etheral and alcoholic extracts) with those obtained by an examination of a pure, unadulterated logwood extract carried out in the same manner, shows whether there has also been an adulteration with chestnut extract. Chestnut extract yields to ether almost nothing, while it is readily soluble in alcohol; it is, therefore, easy to understand that, in the suspected extract, less substance soluble in ether and more substance soluble in alcohol is found than in pure, unadulterated extracts.

In order to ascertain if the suspected extract differs not only by the comparatively large quantity of matters soluble in alcohol, but also by their nature, from the pure extract, it now seems necessary to make the residues obtained by evaporation the subject of a direct comparative examination. For our purpose, however, this is unnecessary, since a comparative result is speedily arrived at by comparative dye trials. The products of the two extracts which are soluble in alcohol and in ether must, with equal weights, dye to the same shade equal surfaces of cotton cloth or equal weights of cotton, if they have the same composition. As regards the course of examination upon cotton cloth and tissues, the same tissues printed in stripes, as referred to when dealing with the woods, may be used, but for a tissue which is printed in stripes with different mordants, for each $10 \times 60 = 600$ sq. cm. of material, 0.1 gm. solid extract should be used; for the same quantity of material mordanted with acetate of iron 0.25—0.3 gm. extract is enough to obtain a good dyeing result. By comparative dye trials, made with the alcoholic and ethereal extraction products, the value of the extracts can, by graduation of this quantity, be accurately determined to 1—2 per cent.

A direct comparison of different extracts without previously extracting them with ether and alcohol, will not in all cases allow of an exact estimation of the extract. An accurate result will only be obtained if the adulterants are dextrin and molasses, Glauber's salt, &c.; but if admixtures containing tannin are present in the extracts, errors will always occur, which are caused by the colour reaction of the tannin with the mordants, and which may lead to entirely wrong conclusions regarding the value of the extract. In these cases it is recommended that a separation of the tannin from the colouring matter of the hæmatestin be effected (when extract of chestnut, quebracho or divi-divi is present) in the manner above stated, or, if this is not practicable, a dye trial upon yarn as described when dealing with the woods, be made, but with the addition to the dye-bath of extract of quercitron or sumac in the proportion of 25 per cent. of the quantity of extract. Since the tannic acid of sumac as well as of quercitron has a greater affinity for the mordanted fibre than the tannins of chestnut, quebracho and divi-divi extracts, the action of these tannins is thus minimised, and thus a more accurate valuation of the extract is rendered possible. Even in case of adulteration with sumac or quercitron (which seldom occurs on account of the price of the products), by the liberal addition of quercitron and sumac to the dye-bath a surplus of tannin is accumulated which the fibre is unable to absorb, so that in this case also the results will be more reliable.

Reliable results are also obtained by Trimble's colorimetric method, which is as follows:—A solution is prepared of 1 gm. of solid extract, dried at 100° C. in 1 litre of distilled water, and also one of 2 grms. sulphate of copper sulphate per litre of water. (Palmer states that it is found in practice necessary that the water for dilution should be three-fourths distilled water and one-fourth town's water, no doubt a trace of lime being necessary for the production of the blue lake of logwood and copper oxide.) Then 1 cm. of the extract solution is heated with 10 cm. water and 1 cm. copper solution, and quickly brought to boil, poured into a graduated cylinder, and filled up with distilled water to 100 cm. For this preparation a pure extract is to be used. The sample to be examined is treated in the same manner, and the liquid in a cylinder diluted with distilled water, until both liquids, when looked at from above, show exactly the same depth of colour. (Palmer (Textile Colourist, 11, 56) says the cylinders should be looked at at right angles to

the length of the cylinders. Results thus obtained are accurate to 2 per cent.) From the height of the column of liquid in the cylinder the value of the sample under examination is then easy to estimate. The test liquor must be renewed every ten minutes, because it rapidly changes in colour.

This method gives good results in the case of adulterants which do not react with copper salts; but when tannin-like adulterants are present, higher values will always result for the extract to be examined, because the tannin influences the colour reaction by the formation of a dark coloured tannate. If the molasses used for the adulteration is rich in salt, especially in carbonate of lime, an alteration of the reaction is also caused which may lead to wrong results. (The foregoing is contradicted by Palmer, *loc. cit.*) Although the enumerated methods cannot give accurate analytical results, yet with sufficient practice in examinations of extracts, and by the use of several methods, a pretty correct estimation of the quality and tinctorial value of an extract can be formed, which is in most cases sufficient for the practical colourist.

The addition of tannin extracts to logwood extracts, especially that of chestnut and quebracho extracts, is, apart from the undesirable alteration of the tone, injurious in so far as the colours are thereby rendered unfit for printing. Colours prepared with such extracts easily coagulate, besides the engravings of the printing rollers are clogged by the tannin of the chestnut and quebracho extracts, and the print indistinct despite the use of sharp doctors and brushes. If the addition is in considerable proportion, the colours coagulate on long standing; in some cases even (when the colours are strongly acid) upon the tissue, and the print runs or bleeds. The case is similar with quercitron and sumac, although not to the same extent. The addition of divi-divi to logwood extracts always causes bad impressions, and the doctors as well as printing rollers are scratched by such extracts.

Although molasses seems to be the most neutral addition, there are cases recorded where with an extract adulterated with 20 per cent. molasses, no black could be obtained. With molasses containing a high percentage of sugar, the sugar reduces the chlorates in steaming the goods, and, therefore, prevents the development of the colours. Besides, such colours stick in the engraving of the rollers, the colours upon the tissue dry badly, and the addition of molasses to logwood extracts therefore as regards printing colours gives rise to very justifiable complaints.

The impossibility of making an exact quantitative analysis of a logwood extract greatly favours the practice of adulterating extracts.

Another product is the commercial "hematein." This product is not, as the name would lead one to suppose, pure hematein, but a pulverulent extract, and that not always of the first quality. Under this name also products with 25–40 per cent. of admixtures are to be found. Since logwood extracts containing admixtures of extracts of chestnuts and sumac, molasses, &c., are hard to pulverise, and, if this should be successfully done, always gives a viscid and never a dry powder, either chalk or extract of quebracho is used for mixing the extract intended for hematein. Such extract dries very readily, and after pulverisation, has the light coffee-brown colour which is required for hematein.

EXTRACT OF FUSTIC.

This extract is mostly adulterated with dextrin, molasses, sulphate of zinc, glycerin, starch-sugar, alum, extract of turmeric, aniline dyestuffs, and nitroalizarin (Alizarin orange).

The determination of sulphate of zinc and of alum is pretty easy. The presence in the ash of alumina shows the adulteration with alum. The determination of sulphate of zinc, especially of small quantities, is more difficult, and the ash of the extract brought to a white heat will often cause errors. The presence of larger quantities of

this salt in extracts of fustic manifests itself by the turbidity of the extract solution.

Pure extract of fustic dissolves in the proportion of 1 to 300 in water (distilled- and well-water), with a light yellow colour. For the detection of zinc, the extract dried at 110° C. is lightly charred, then finely powdered and boiled out with nitric acid. In the decoction zinc is easily determined in the usual way. If the extract was adulterated with alum, the latter can also be determined in the nitric acid solution.

The determination of extract of turmeric is based upon the property of this extract to dye wool directly without a mordant, which property the colouring matters of fustic do not possess. The wool fibre has not the property of being directly dyed by the colouring matters of fustic, but the animal fat adhering to it acts as a feeble mordant for these colouring matters. The latter must, therefore, be very carefully removed from the fibre before a tissue is used for a test of this kind. The most suitable material for such tests is well-scoured white woollen cashmere.

One gram. of the extract under examination is dissolved in 50 ccm. hot water, diluted to $\frac{1}{2}$ litre with cold distilled water, and poured into a porcelain dish. The cashmere is then entered, the liquid is brought to the boil in a quarter of an hour under constant stirring, and after boiling five minutes the piece is taken out and well washed. If then its colour is pure white, no trace of turmeric was contained in the extract under examination. If the colour of the tissue is yellow, then adulteration with turmeric or aniline dyestuffs has taken place. For a closer examination the cashmere is extracted with alcohol, and the latter evaporated to a few ccm. A part of it is used for testing for aniline dyestuffs possibly present; if there are none, only the adulteration with turmeric is possible. To be sure, however, in cases of adulteration with alum, in which case fustic would dye directly, the following tests are made:—

Reagent.	Turmeric.	Fustic.
Stannous chloride...	Reddish precipitate.	Light yellow precipitate.
Acetate of lead.....	Chestnut brown.	Reddish yellow.
Ferric sulphate	No precipitate; solution coloured brown.	Black precipitate; solution coloured brown, afterwards turning olive green.
Caustic alkalis.....	Brown colouration.	Dark orange colouration, but no precipitate.
Mineral acids	Red colouration; no precipitate; on diluting the colouration disappears, and the dyestuff separates out in yellow flakes.	A light yellow precipitate is formed.

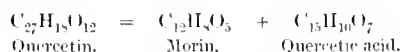
More difficult than the determination of turmeric is the ascertaining of an adulteration with quercitron. There is absolutely no literature on this subject, and the author has not yet succeeded in discovering an accurate method, and resorts to dye trials.

Wool is not directly dyed by extract of quercitron, and alum is but a feeble mordant for quercitron upon wool. Quercitron produces with alum only a feeble colouring, whilst fustic gives a deep yellow colour. Tin, especially stannous chloride in presence of an acid, such as tartaric, oxalic, or hydrochloric acid, dyes in combination with quercitron a deep orange upon wool, while fustic gives delicate shades.

The difference in the behaviour of quercitron and fustic extracts towards alum and tin salt affords us some points for the possible detection of quercitron in extract of fustic. A piece of white woollen cashmere, 10 cm. by 20 cm. dyed in a mixture of 0.5 gram. of extract, 0.2 gram. of alum, 0.5 gram. of stannous chloride, 0.5 gram. of oxalic acid in 1 litre of water, if

compared with a pattern dyed with an extract adulterated with quercitron will show different results, which difference manifests itself by the greater intensity of colour of the adulterated extract. If now a swatch of the same size be dyed in the extracts under comparison, but with alum mordant alone, the adulterated extract will give weaker colourings than the pure extract of fustic. With some practice in comparative dye trials even the percentage can be determined with approximate certainty. Although this method does not yield quantitative results, it is sufficiently accurate for many cases occurring in practice.

A determination of quercitron as to its containing tannic acid and of different properties of the extract is not practicable, as there are two colouring matters contained in extract of fustic, one of which, the morin, as the investigations of Hlasiwetz and Pfannmüller, &c., prove, behaves analogous to quercitron. Hlasiwetz states, and proves, that quercitron contains the elements of morin and quercetic acid, and thereby explains the analogy of the behaviour of morin and quercetin:—



The other colouring matter contained is extract of fustic, moritannic acid, or machurin, has the decided character of a tannic acid. With the extracts of fustic, therefore, all reactions peculiar to tannic acids can be obtained.

The determination of saccharine admixtures, as molasses, syrup, dextrin, is carried out in an analogous manner as stated, when dealing with logwood extracts, that is, by extracting the products with absolute alcohol, and determining the sugar or dextrin in the residue.

As with logwood extracts, the practice of excessive adulteration is carried on with extracts of fustic. Prime qualities are mostly already mixtures containing for every 100 parts of extract of fustic 15 parts of admixture (15 per cent.). With second qualities 30 per cent. is reached. As an illustration, the following method of manufacture will serve to show what takes place in practice,

For the production of fustic extract pure fustic is not employed, but a mixture of about 95 per cent. of fustic and 5 per cent. of quercitron bark. Since the best fustic, as will shortly be seen, yields at the most only 15 per cent. of solid extract, while quercitron bark often gives 30 per cent. of solid extract, it follows that most extracts of fustic which are offered in the market as pure, contain already from the start 10 per cent. of admixture.—W. S.

The Composite Indophenol-Indigo Vat. E. Noeltling. Chem. Zeit. 13, 725.

In reply to the criticism of Kertész (see this Journal, 1889, 539), the author states that his experiments, on the basis of which he made the assertion that an economy of 25 per cent. was realised with the composite vat as against the pure indigo vat, were made at the works of Koechlin, Baumgartner, and Co., and that H. Koechlin, the manager of the works, confirms his statement. Koechlin is of opinion that the vats used by Kertész were probably too alkaline, and excess of alkali prevents the fibre from absorbing either indophenol or indigo. Koechlin and Galland have lowered the cost of reduction of the composite vat by replacing the more expensive tin salt by zinc dust. With this improvement the concentrated vat is now prepared as follows:—10 kilos. of a good quality of indigo are mixed with 33 litres of warm water and allowed to stand 24 hours; then 2 litres of caustic soda of sp. gr. 1.348 are added, the mixture well agitated and placed in the grinding-mill along with 3 kilos. 300 grms. of indophenol. This mixture is ground for 12–24 hours and afterwards put into a barrel of a capacity of 500 litres; then 48 litres of sodium bisulphite of sp. gr. 1.374 are added and well mixed, after which 9 kilos. of zinc dust (containing at least 90 per cent. of zinc), which has been stirred with 10 litres of water, are gradually added, followed by 30 litres of caustic soda of sp. gr. 1.348, which are slowly mixed, and finally the barrel is filled up with water. The dye vat for dark shades is made by taking the contents of two such

concentrated vats and adding them to 4,000 litres of water, previously placed in the vat, along with a solution of sodium hydrosulphite, prepared by mixing together 12½ litres of sodium bisulphite of sp. gr. 1.374, 2 kilos. of zinc dust, 8 litres of caustic soda, and 25 litres of water.

Thirty pieces of cloth, each of 100 metres length, are usually dyed together. They are given three passages through the vat, being alternately immersed for three minutes and exposed to the air for four minutes. After the third passage they are chromed in a cold solution containing 2 grms. of bichromate of potash per litre, rinsed and dried. Each piece absorbs 950 grms. of indigo during the dyeing, and this amount must be replaced by adding to the vat 4 litres of the concentrated vat.

For paler shades of blue, only ½ or ¼ as much of the concentrated vat need be used.

With regard to the economy of the composite vat, whereas each piece of cloth requires 250 grms. of indigo and 83 grms. of indophenol for a full shade of colour, 400 grms. of indigo, used by itself, are required for the same shade. With indigo alone, the cost per piece amounts to 5.60s., whilst the cost with the composite vat is 4.33s., namely, 3.50s. for indigo and 0.83s. for indophenol. Adding to these sums the costs of reduction, as calculated by Kertész, namely, 0.48s. per kilo. of indigo with lime and zinc dust, and 1.10s. with sodium hydrosulphite, the relative costs will be 4.70s. per piece with the composite vat against 5.70s. with indigo alone. It is suggested that the cost of reduction in the case of the hydrosulphite vat, as given by Kertész, is too high, which is probably explained by the higher prices of zinc dust and bisulphite in Hungary.—E. B.

The Composite Indophenol-Indigo Vat. Report presented to the Industrial Society of Mulhouse by G. Galland. Meeting of May, 1889.

THE hydrosulphite vat of Schützenberger and de Lalande is found most suitable for the reduction of the mixture of indophenol and indigo. The method adopted by Koechlin, Baumgartner, and Co., of Loerrach, is then given, as reported in the preceding abstract.

After a vat has been in use some time it is advisable to ascertain its condition by a dye-test on the small scale, so that the amount of hydrosulphite necessary to replenish the vat may be added. This mode of setting the vat is more simple than any other, and possesses the advantage that the vat remains clear. The dyed blue can be discharged by the chromic acid method like ordinary indigo.

The presence of both indophenol and indigo in a sample of dyed cloth is easily shown on treatment with alcohol, which dissolves the indophenol, leaving the indigo on the fibre.—E. B.

PATENT.

An Improved Process and Apparatus for Cleansing Wool and other Textile Products. I. Singer and M. W. Judell, Adelaide, S. Australia. Eng. Pat. 2532, February 20, 1888. (Amended Specification.) 8d.

THE process consists in passing wool automatically and continuously through successive baths of bisulphide of carbon, whereby the grease is completely removed. A full description of the process and apparatus has already appeared in this Journal, 1889, 24–29. For the emendations the specification must be consulted. Six claims are withdrawn.—E. J. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Manufacture of Sodium Sulphide. J. V. Esop. Zeits. f. angew. Chem. 1889, 284—286.

SODIUM sulphide is generally made either by double decomposition or by reduction of sodium sulphate. The former process was described by W. Weldon (this Journal, 1882, 129—130). Another process of double decomposition is that of barium sulphide and sodium sulphate, but this process is only practicable where there is a ready sale for barium sulphate as "blanc fixe." As regards the reduction of sodium sulphate, this article is ground to a coarse powder, mixed with coal-dust in the proportion of 3 to 2, and the mixture heated in a reverberatory furnace. The furnace is 6 metres long, 2 metres wide, 1·7 metres high, and well lined with fire-brick. The bed is divided into two portions, that next to the fire-bridge for the reduction, and the other for the preliminary heating of the charge, which may consist of 150 kilos. of sodium sulphate and 100 kilos. of coal. About 1½ hours are required for the reduction of this charge. At the end of the operation the fluxed mass is run into iron boxes which are well closed, in order to prevent oxidation. Perhaps a revolving furnace may yet be employed for the reduction, although a few experiments in this direction gave unsatisfactory results. The mass obtained from the furnace weighs about 110 to 115 kilos., and contains up to 60 per cent. of sodium sulphide. Its appearance should be red and porous, but not grey and dense. The cooled mass is broken up into large balls, and thrown into lixiviating vats, arranged and fitted on the same principle as black-ash vats. The lixiviation is performed with warm water, and the liquor running from the strongest vat stands at 32° B. It is allowed to settle for an hour or so, and afterwards run into shallow iron crystallising pans, where, after four or five days, a copious crop of yellow or brown crystals is formed having the formula $\text{Na}_2\text{S} + 9\text{H}_2\text{O}$. The mother-liquor is siphoned off and again boiled down to 31° B. for further crystallisation. The large crystals formed are broken up, allowed to drain, and ultimately jigged in a centrifugal machine, whereby they obtain a lighter appearance. Dark crystals are washed with light concentrated liquor, which improves their appearance. The salts obtained during the concentration of the liquors, owing to their oxidation, are employed in the furnace in the place of sodium sulphate.—S. H.

Manufacture of Sodium Nitrite. J. V. Esop. Zeits. f. angew. Chem. 1889, 286—288.

SODIUM nitrite is one of the most important chemicals used in the manufacture of azo-dyes. There exist several methods for its manufacture, all of which are based on the reduction of sodium nitrate by means of lead. For this purpose the latter is fused and poured on iron plates in thin layers. After cooling, the lead plates are rolled up, and weighed out in parcels for use. The lead should be free from zinc and antimony. The sodium nitrate is then fused in shallow cast-iron pans fitted with a mechanical agitator, and when the mass is thoroughly fused, two and a half parts of lead are added at short intervals for each part of sodium nitrate (95—96 per cent. NaNO_3). The reduction ensues immediately. The thin leaves of lead fuse easily, and are oxidised to yellow lead oxide (litharge). After some time a further amount of lead is added, as an excess of lead is necessary, and the agitation of the fused mass is continued for at least three-quarters of an hour, in order to obtain a product of high strength. The mass has a tendency to stick to the sides, and great care must be exercised to remove these crusts with an iron spatula, as the slightest inattention causes the burning through of the pan. If the crusts turn reddish, it is a certain sign that the pan is in great danger of being destroyed. These crusts must at once be covered by a fresh quantity of nitrate, and the fire withdrawn if necessary. The whole process of fusion is finished in about 3½ hours. A sample drawn should test at least 90 per cent. of sodium nitrite. The mass after cooling is lixiviated in wrought-iron tanks with water or weak liquor. As soon as

the solution stands at 36 to 38° B. it is siphoned off and neutralised with nitric acid of 1·029 specific gravity. The liquor is then concentrated to 12 or 13° B., allowed to clarify for three or four hours, and ultimately run into lead-lined wooden tanks. Crystals of a light yellow colour quickly make their appearance, which are deprived of their adherent moisture in the customary manner. The mother-liquor, in conjunction with other liquors, is again boiled down to crystallisation. In this way crystals are obtained of the following percentage:—

	NaNO_2
	Per Cent.
1st crystallisation.....	95·9 to 95·5
2nd "	94·8 to 95·0
3rd "	94·2 to 94·5
4th "	94·0 to 94·2

By drying at 60° C. their percentage is increased to 96 per cent. If a purer product be required, it must be re-crystallised. Some difficulty is experienced in working up the mother-liquors. If crystals of only 94 per cent. of NaNO_2 , or below that strength, be obtained, the mother-liquors must be concentrated by themselves in pan No. 2. Here crystals, containing 86 to 92 per cent. of NaNO_2 , are produced, which are employed for enriching the strength of fresh liquors. If the crystals from pan No. 2 sink below 80 per cent., their mother-liquors must be concentrated separately in pan No. 3, whereby crystals containing 50 to 75 per cent. of NaNO_2 are obtained. These serve for enriching the liquors in pan No. 2. Weaker crystals are returned to the melting pot and treated with lead. Nevertheless, it is sometimes difficult to avoid the formation of salts, which require a special treatment in every case, as, for instance, the following tests show:—

	I.	II.	III.
NaOH	16·89	11·84	10·32
Na_2CO_3	22·00	17·66	15·17
NaNO_2	20·52	22·09	21·25
NaNO_3	16·23	19·07	20·36
NaCl	6·05	8·24	8·78
Na_2SO_4	17·39	15·54	16·02
Insoluble.....	7·23	6·96	7·05

The lead oxide, obtained as a by-product, is washed, and afterwards converted into the different lead preparations of commerce, or reduced to metallic lead, when it returns to the process.—S. H.

Action of Acids on the Thiosulphates. Berthelot. Compt. Rend. 108, 971—978. (Compare this Journal, 1889, 541.)

DILUTE solutions of boric acid and sodium thiosulphate remain mixed without decomposition, even after several days; hence, the heat of neutralisation of thiosulphuric acid is probably greater than the heat of formation of borax, viz., 11·6 cal. Acetic acid (30 grms. per litre) has no immediate action on the thiosulphate. A very slight decomposition sets in after a few minutes, rendering the liquid opalescent; but even after several days it makes little progress. Dilute sulphuric acid and sodium thiosulphate, both one-eighth normal strength, mixed in equivalent proportions at 11° C., disengage at the moment of mixture + 0·1 cal., the liquid remaining clear. Almost immediately afterwards the solution becomes turbid, with precipitation of sulphur and an absorption of heat of - 0·2 cal. Dilute hydrochloric acid added to excess of sodium thiosulphate also produces a momentary and very slight disengagement of heat ($\text{Na}_2\text{S}_2\text{O}_3 + \frac{1}{2}\text{HCl}$ disengages + 0·01 cal. at 11·5° during the first seconds). This is followed by a progressive absorption of heat and deposition of sulphur. With stronger hydrochloric acid, or a larger proportion, or at a higher temperature, the latter change is more rapid, and is

the only one observed. The author considers the heat of neutralisation to be about + 13.8 cal., that is, very near to hydrochloric and hyposulphuric acids. The total absorption of heat observed in these experiments, viz., - 1.0 to - 1.3 cal., corresponds to the difference between the heat of formation of sulphurous and thiosulphuric acids from their elements, i.e., $38.4 - 39.7 = - 1.3$ cal. The decomposition of the liberated thiosulphuric acid into sulphurous acid and free sulphur takes some hours for completion, and is complicated by the union of some of the thiosulphuric acid with some of the sulphurous acid to form thionic acids. The addition of sulphurous acid to sodium thiosulphate solution causes an evolution of heat, but sulphur is soon deposited, especially when the thiosulphate is in excess. The quantity of iodine decolorised by the mixture decreases progressively for several days. The combination of the two acids is never complete, since the thionic acids formed are all liable to slow decomposition, producing sulphurous acid, sulphur, and other thionic acids.—J. M. H. M.

Action of Air on Manganese Carbonate. A. Gorgen. Compt. Rend. **108**, 1006—1009. (Compare this Journal, 1889, 541.)

At the ordinary temperature carbonate of manganese, whether native, precipitated, or crystallised from solution in carbonic acid water, is oxidised with difficulty whether exposed to air or to aerated water. In the most favourable case—the precipitated carbonate kept for 10 years in aerated water—the proportion of oxygen combined was only that required to form $\text{MnO}_2 \cdot \text{MnO}$. The same compound, produced by directly combining an equivalent of hydrated manganese dioxide with one of hydrated manganese monoxide, does not absorb any additional oxygen, even after five months' exposure to air or water. Manganite, $\text{MnO}_2 \cdot \text{MnO}$, is then the limit of oxidation at the ordinary temperature. At 100° , however, and still more at 200° , the carbonate, the protoxide, and the sesquioxide readily undergo oxidation beyond this point, and may be perhaps completely converted into dioxide. The author concludes, in the absence of any analyses showing the native dioxide of manganese to have been produced from the carbonate, that such has not been the case.—J. M. H. M.

Formation of Nitre Deposits. A. Muntz and V. Marciano. Compt. Rend. **108**, 900—902.

See under XV., page 627.

The Salt Deposits of Cheshire. T. Ward. Transactions of the Surveyors' Institution, **21**, 429.

This paper deals specially with the changes made on the surface of the land, by the getting of the underlying salt, and with the nature of the damage to land and buildings caused by subsidence. The rock salt of Cheshire consists of a varying mixture of marls and salt, commercial rock salt of the best class containing about 95 per cent. of salt and 5 per cent. of marl. The Cheshire beds were formed in triassic times, from the evaporation of a series of salt lakes, and form two very thick deposits and a number of thin ones. The lower bed is worked by mining only, and the rock salt is sold chiefly for agricultural purposes. The upper bed was formerly worked by mining, but now exclusively by pumping the brine, all the mines previously in existence in the upper bed having been destroyed by flooding with water or by collapse of the roof. Brine originates by the natural infiltration of water through the strata until the bed of rock salt is reached, when a process of solution takes place, until the brine contains 26 per cent. of salt, and is saturated. This process is continually going on, for the pumping causes a constant flow of brine along the top of the rock-salt bed, the supply being maintained by water entering at the margin of the bed, and becoming saturated in its course over the rock salt to the pumping centre. The action of the fresh water is thus to dissolve away the upper surface of the rock-salt bed, and the space previously occupied by the dissolved salt is filled up by subsidence of the overlying earth. The effect is seen at the surface in

depressions of the ground, which are continually causing great damage to property. The normal form of a subsidence caused by brine pumping is that of a trough, as shown on Fig. C'. Figs. A and B show the relative positions of the strata in two places near Northwich. White salt is obtained by evaporation of the brine in shallow iron pans, the various grades of salt being produced by variations in the rate of evaporation. Fine-grained salt for domestic use requires rapid boiling, whilst a coarser grained article is obtained by conducting the evaporation at a lower temperature.—G. H. B.

PATENT.

Improvements in the Manufacture of Cement and the Utilisation of the Lime-mud Residue of the Ammonia-Soda Process therefor. J. S. Rigby, Liverpool. Eng. Pat. 3148, March 1, 1888. 4d.

THE inventor washes out the alkaline earthy chlorides as far as possible with hot water, and then adds sodium silicate in sufficient quantity to convert the remaining alkaline earthy chlorides into insoluble alkaline earthy silicates. Finely-divided clay is then added in the required proportion, and the mixture is calcined, ground, and "purged" as usual.

—E. G. C.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

On the Opaque-Etching of Glass. A. Lainer. Dingl. Polyt. J. **272**, 237—239.

THE following two recipes obviate the use of expensive fluorine salts usually employed in the preparation of solutions for the opaque-etching of glass.

(a.) 10 grms. of soda are dissolved in 20 grms. of warm water, and 10 grms. of potassium carbonate in 20 grms. of warm water; the solutions are mixed and 20 grms. of concentrated hydrofluoric acid are added, and 10 grms. of potassium sulphate dissolved in 10 grms. of water also added to the mixture. The addition of a small quantity of hydrochloric acid gives a fine granulation to the etched surface.

(b.) 4 cc. of water, $1\frac{1}{2}$ grms. of pure potassium carbonate, 0.5 cc. of (dilute) hydrofluoric acid, 0.5 cc. of hydrochloric acid, and 0.5 cc. of potassium sulphate are mixed, and the mixture treated with concentrated hydrofluoric acid and potassium carbonate, until the mixture produces the requisite degree of opacity.

Kampmann, of Vienna, uses a simpler method than either of the above two for preparing an opaque-etching fluid. A wooden vessel bound with asphalted metallic hoops is filled up to about one-fifth of its volume with highly concentrated hydrofluoric acid, and this is partially neutralised by the gradual addition of crystallised soda. After the first few quantities the soda should be added in a "polarised" condition, whilst the whole is stirred up with a wooden or a glass rod. When the white frothy mixture is sufficiently thick to remain adhering to the rod, neutralisation should cease and the mixture possess a strongly acid reaction. The process should be carried on in the open air, as large quantities of carbonic and hydrofluoric acids escape. The mixture of sodium fluoride and hydrofluoric acid is transferred to a large tub and diluted with 5—10 volumes of water, according to the concentration of the acid used. The efficiency of the mixture is next tested by etching glass with it for two hours. If it be too strong, the surface of the glass is rough, irregular, and seemingly covered with crystals; if too weak, the etching is uniform, but translucent. To the strong mixture, water is added, to the weak, more concentrated hydrofluoric acid, treated with soda, is added. By the latter means spent solutions may be revived. The following is a convenient method of preparing a small quantity of etching liquid. 240 cc. of commercial hydrofluoric acid

Fig. A
SECTION OF ROCK SALT MINE
AND BRINE PIT,
MARSTON.

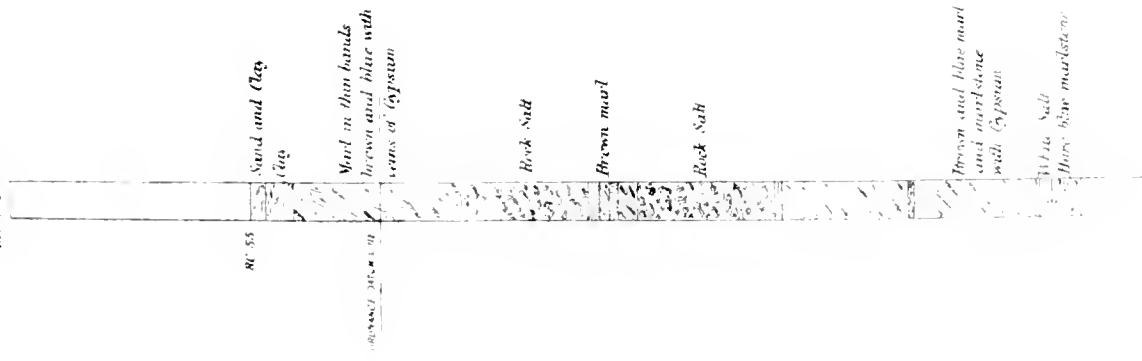


Fig. C

ORDINARY BRINE SUBSIDENCE.

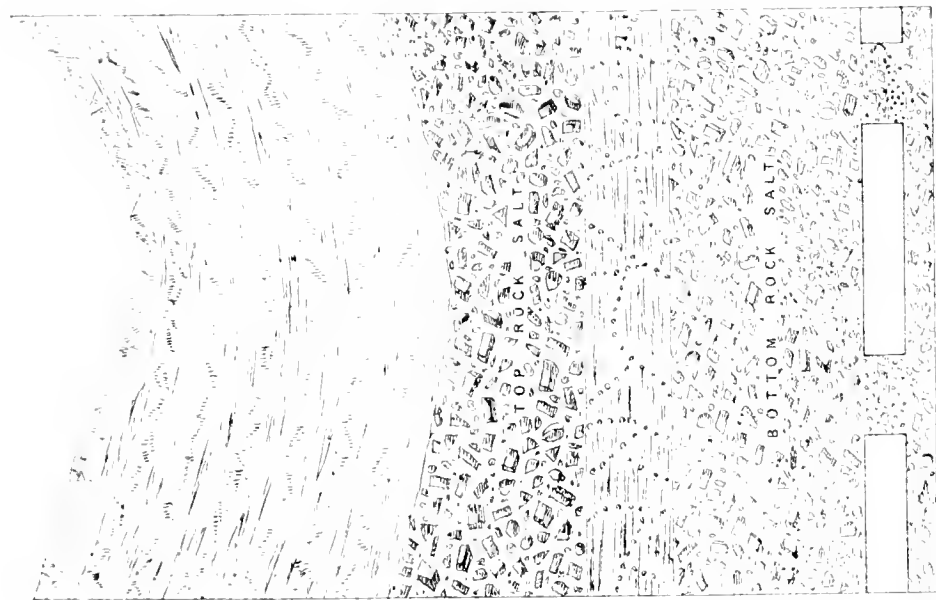
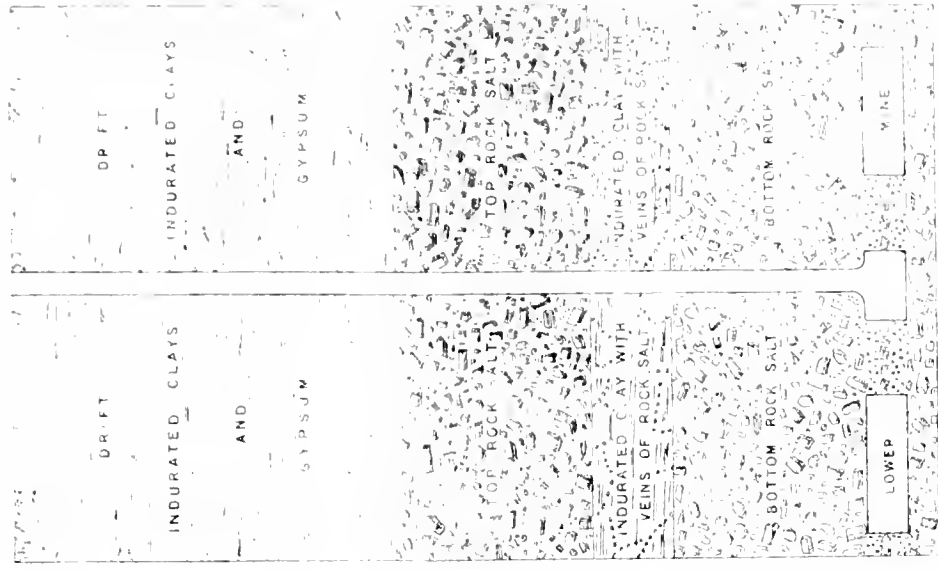


Fig. B

SECTION OF STRATA PASSED THROUGH IN SINKING
A ROCK SALT MINE NORTHWICH



(sp. gr. 1.2583) are treated with 600 grms. of powdered crystallised soda and diluted with 1,000 cc. of water. About 1,600 cc. of the mixture are obtained. (The specific gravity of the acid is determined in a flask which holds about 260 cc., and which is lined with wax.) On standing for some time a sediment settles with a clear supernatant liquid. Before etching, the glass must be thoroughly cleaned and then provided with a rim of wax (yellow wax, tallow, colophony, and asphalt powder, &c. kneaded together) and etched for a few minutes with ordinary hydrofluoric acid (1:10) solution. This is poured off into a separate india-rubber flask and the glass washed with water and wiped almost dry with a soft sponge. The etching liquid is then stirred up and poured on to the glass, $\frac{1}{2}$ to 1 cm. thick. In an hour's time a fine opaque etching is obtained. The liquid is poured off and the plate washed with water, and water is allowed to stand on it till a thin film (silicates) forms on the glass. This is rubbed off with the finger or a brush, and the glass is finally washed with water. By subsequent treatment with hydrofluoric acid the opaque-etching can be brought down to any degree of transparency. If the etching liquid be not stirred up and the supernatant clear liquid used, a good etching is produced in two hours' time, but the solution loses its strength rapidly if used repeatedly. The thick paste alone, without the supernatant liquid, produces a good etching in an hour's time. If the mixture be only allowed to act for half an hour a thin etching is not obtained but one the grain of which is very open.—F. W. T. K.

PATENTS.

Improvements in Muffle Kilns for Bending and Firing Stained Glass, Tiles, Pottery Ware, and for other suitable Purposes. G. Lazenby, Leeds. Eng. Pat. 6980, May 10, 1888. 8d.

THE muffle kiln is constructed in such a manner that it is equally heated on its sides and at its top and bottom, while its interior is free from the products of combustion, which cannot possibly come in contact with the articles being fired or burnt.—E. G. C.

An Improvement in the Manufacture of Glass. J. T. H. Richardson, Hatton. Eng. Pat. 7309, May 17, 1888. 4d.

FLINT or other glass is hardened during the process of manufacture by an induced current or currents of cold air or gas, or by sudden immersion into a refrigerated air or gas chamber.—E. G. C.

Improvements in the Art of Enamelling or Decorating Slate, Marble, and such like Materials. W. J. Temple, F. W. Rogers, C. W. Trotman, and T. F. Hobbs, Bristol. Eng. Pat. 12,596, September 1, 1888. 4d.

THE material to be operated on is coated with any suitable metallic surface upon which the decorations are made.—E. E. B.

An Improved Composition for Manufacturing Crucibles or the like Vessels or Utensils. E. J. T. Digby, London. Eng. Pat. 17,521, December 1, 1888. 4d.

THE improvement consists in using a composition for the manufacture of crucibles at less cost and having greater fire-resisting properties than heretofore. The component parts are Herin Island granite, plumbago and Welsh slate in equal proportions, with German clay equal to one-fourth of the entire mass. These are ground separately into a fine powder, and having been passed through a dressing machine are mixed together into a thick paste with water, and moulded into the desired shape. After drying in a cool chamber for 24 hours they are thoroughly baked in an oven.—E. S.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Solubility of Minerals in Sea Water. J. Thoulet, Compt. Rend. 108, 753—755.

THE solubility of obsidian, pumice, amphibole, orthoclase, marble, sea shells, and coral in sea water is extremely small; very much less than in distilled water.—J. M. H. M.

PATENTS.

Improvements in the Manufacture of Portland or similar Cement. J. Robertson and J. A. Patrick, Glasgow. Eng. Pat. 2632, February 22, 1888. 4d.

THE inventors employ a mixture of crushed limestone and poor shale, or "blaes."—E. G. C.

Improvements in certain Fire-resisting Materials. J. M. and D. D. Spence, Manchester. Eng. Pat. 4617, March 26, 1888. 8d.

THIS invention "consists, firstly, in a method of forming a mixture of alum and a suitable anti-tumefaction material, such as sawdust, into solid compact cakes, which occupy a greatly reduced space; and, secondly, in the use of the cakes so formed for filling the hollow jackets of fire-resisting safes, boxes, chests, and chambers, and the cavities of fire-resisting doors, and also in the interiors of fire-resisting floors."—E. G. C.

An Improved Plastic Composition for Moulding and other Purposes. F. Beer, Paris, France. Eng. Pat. 5253, April 9, 1888. 6d.

THE ingredients used are pulverised marble, pulverised glass, pulverised quicklime, and silicate of soda or potash.—E. G. C.

Improvements in Cement, in "Cooling" or Maturing the same, and in Apparatus therefor. A. M'Ar, Glasgow. Eng. Pat. 5881, April 20, 1888. 8d.

THE cement is "air-slaked" by a blast or current of air, and the addition of 10 per cent. of carbonate of lime is found to be advantageous by the inventor.—E. G. C.

Improvements in and relating to Cement. J. C. Sellars, Birkenhead. Eng. Pat. 6261, April 27, 1888. 6d.

THIS invention relates to the production of a cement which shall be applicable for use in the building of all kinds of erections (such as retort benches, ovens, gas producers, &c.) subject to heat. An alkaline composition of "fluvial, plastic nature" is admixed with Sellars' or other cement as a base.—E. G. C.

Improved Means for Testing or Measuring the Strength of Cement and other Materials. H. Buignet, Havre, France. Eng. Pat. 6690, May 4, 1888. 8d.

THE block of cement or other material is connected by a lever to a buoyant plunger or float, supported by a fluid (preferably mercury) contained in a stationary vessel communicating at its lower part with a vessel charged with the same liquid and capable of vertical adjustment. "By raising the adjustable vessel, the upward pressure of the liquid on the float and the strain exerted by the float on the materials can be gradually increased, the amount of force thus exerted being indicated with great precision by a graduated tube showing the height of the liquid in the stationary vessel."—E. G. C.

An Improvement in Bricks and Building Blocks. H. G. Carew and F. B. Potts, London. Eng. Pat. 7327, May 17, 1888. 4d.

Cavities in the bricks, which may be made of any of the ordinary materials, are filled with charcoal in the form of cubes, squares, &c., to absorb noxious gases, and the charcoal can be readily changed when necessary.—E. G. C.

An Improvement in Fire-Proof Columns. R. Mannesmann, Bleidingshausen, Germany. Eng. Pat. 8485, June 9, 1888. 6d.

Each column consists of two tubes, preferably of steel, one within the other. The annular space between the two tubes is packed with asbestos, or some other incombustible and badly-conducting material.—E. G. C.

Improvements in the Manufacture of Cement from the Calcium Sulphide Waste of Leblanc Soda Manufactures. J. S. Rigby and A. McDonald, Liverpool. Eng. Pat. 9763, July 5, 1888. 6d.

The greater part of the sulphur is first expelled from alkali waste by carbonic acid, and the remaining sulphur and sulphur salts are mixed with clay or its equivalent, the mixture then being calcined, ground, and "purged."—E. G. C.

Improvements in the Continuous and Economical Manufacture of Cement. F. W. S. Stokes, London. Eng. Pat. 9986, July 10, 1888. 1s. 1d.

This specification contains a detailed description of the apparatus adopted by the inventor in the production of finished cement from the raw materials by the "semi-dry" process, and references are made to past patents (7888 of 1886, 9694 of 1887, and 10,764 of 1887).—E. G. C.

Improved Manufacture of Cement suitable as Plaster and for Moulding Purposes. G. H. Sharpe, London, and F. W. Turner, Carnarvon. Eng. Pat. 19,010, December 29, 1888. 4d.

The materials used are slate dust (66 per cent.), quicklime (30 per cent.), and limestone (4 per cent.), dried and burned separately, mixed, and comminuted.—E. G. C.

A New Combination of Materials forming a Cement for Cutlery. W. T. Wheatley, Sheffield. Eng. Pat. 1206, January 23, 1889. 4d.

The ingredients are roll sulphur (80 per cent.), purified anhydrous calcium sulphate (16 per cent.), zinc oxide (3 per cent.), and, sometimes, alumina silicate (1 per cent.).—E. G. C.

Improvements in Artificial Building Materials. J. Sugden, London. Eng. Pat. 2632, February 14, 1889. 4d.

The materials used are sawdust, calcined magnesia, plaster of Paris, chloride of magnesium, and coarse jute.—E. G. C.

Improvements in the Manufacture of Artificial Stone. A. C. Ponton, Parkstone, B. L. Mosely and C. Chambers, Hastings. Eng. Pat. 2844, February 18, 1889. 4d.

These inventors claim (1) "a liquid siliceous cement composed of a siliceous hydrogel and an alkaline silicate made in the manner and in the proportions herein named, for binding together pulverulent, granular, or coarse material; . . . (2) the combination of the cement described with carbonate of lime; (3) combination of the cement with powdered whiting and sand," &c., &c.—E. G. C.

Improvements in the Manufacture of Elastic Tiles. Sir E. J. Harkand, Bart., Belfast. Eng. Pat. 4806, March 19, 1889. 4d.

The tiles are made of vulcanised india-rubber, and are fixed to the floor or other surface to be covered by a cement composed of two parts of gutta-percha, one part of resin, and one part of Stockholm tar.—E. G. C.

Improvements in and relating to the Treatment of Slag for a variety of Important Uses, such as making it Cellular for Pavements, Walls, and the like. St. G. T. C. Bryan, Birmingham, Alabama, U.S.A. Eng. Pat. 5190, March 26, 1889. 6d.

The slag is rotated while molten, to separate impurities, after which carbonic acid and hydrogen gases are forced through the liquid mass. Building blocks of slag, "in part solid and in part cellular," are then produced in a manner described at length in the specification.—E. G. C.

An Improved Plastic Fire- and Weather-Proof Wood Mass. J. G. Wolf, Graz, Austria. Eng. Pat. 6348, April 13, 1889. 4d.

The material, termed "Ossalith," consists of a mixture of sawdust, shavings, wood pulp, and similar substances, with calcined magnesite and chloride of magnesium, and can be made harder or softer by varying the proportion of the materials. The calcined magnesite is made into a thin cream with the chloride of magnesium and the reduced wood stirred into until a stiff pasty mass is produced, which is then dried.—E. E. B.

A New or Improved Continuous Lime and Cement Kiln or Furnace. A. Schlofer, Laegetdorf, Prussia. Eng. Pat. 8012, May 14, 1889. 6d.

The kiln is as usual vertical, and the body of the furnace is dome-shaped and much wider than the vertical shaft which enters the middle of the dome. The furnace is supplied continuously with chalk or cement through an opening in the shaft a short distance above its junction with the body of the furnace, and is kept filled up to the level of the opening. As the shaft is narrower than the furnace, and the top of the body of the latter dome-shaped, the chalk or cement fed through the shaft leaves an empty space round the top of the dome which has to be filled by means of openings communicating with the outside of the furnace. Drawings of the kiln accompany the specification.—E. E. B.

X.—METALLURGY.

Reduction of Silica and Boric Anhydride by Magnesium. N. J. Tram. Chem. Zeit. 13, 680.

The products of the action of magnesium on silica, boric anhydride, and metallic oxides are always alloys of magnesium with the other metal or metalloïd and separation of the two is only effected with great difficulty. Molybdic anhydride is reduced by magnesium with incandescence and violent detonation, the product being an alloy of molybdenum and magnesium.—C. H. B.

Preparation and Properties of Metallic Manganese. C. Ballock. J. Franklin Inst. 98, 62—64.

MANGANESE is generally stated to be so easily oxidised as to require keeping under rock oil; it is said to decompose water, evolving hydrogen.

Cast manganese containing 8 per cent. of iron is said to be unalterable in air.

If instead of the usual method of obtaining it (viz., by the reduction of its oxide by carbon) Brunner's method be employed, the product is found to be no more easily

oxidisable than iron. The process was carried out by mixing pure fused powdered manganous chloride with an equal weight of powdered fluorspar; ounce charges of this mixture were placed in a French clay crucible, heated to redness, 80 grains of sodium in small pieces added, and the crucible covered until the reaction had ceased, when it was ready for a fresh portion. By this means buttons of metal were obtained weighing about 20 per cent. of the chloride used.

A higher temperature than is necessary should be avoided or the crucibles will be badly attacked. Manganese got by this process is very brittle with a steel-white fracture, scarcely touched by a file, not readily oxidisable, quite unattracted by a magnet; sp. gr. 7.072 becoming 7.153 when re-fused under sodium chloride.

On substituting sodium chloride for fluorspar as a flux, the yield was smaller, the metal less brittle, with a different fracture, and having a specific gravity of 7.231. When fluorspar was used the metal was contaminated with calcium, though free from iron. This may account for its higher specific gravity when re-fused under sodium chloride, and also when made without the use of fluorspar, seeing how low the specific gravity (1.57) of calcium is.—B. B.

Sulphurous and Desulphurised Blast-furnace Slag.

A. D. Elbers. Eng. and Min. Jour. 1889, 522 and 569.

BLAST-FURNACE slag usually contains sulphur as calcium sulphide, derived from both fuel and ore; the presence of the sulphide causes the slag to pass through two stages during solidification, the silicates first solidifying, and afterwards the calcium sulphide. In consequence of this irregularity, castings made of it are apt to warp and be unround.

Slag free from sulphur behaves as a homogeneous mixture of silicates, and passes through a viscous stage during cooling, which persists the longer the greater the difference between the solidifying points of its component simple silicates.

For the desulphurisation of the slag sodium nitrate can be used in the manner suggested by Heaton and Hargreaves, 20 years ago, for the purification and partial decarbonisation of pig iron, though less will be needed, as no carbon (with its low atomic weight and high valency) has to be oxidised.

Assuming the reaction $10\text{CaS} + 12\text{NaNO}_3 = 10\text{CaO} + 6\text{Na}_2\text{O} + 10\text{SO}_2 + 6\text{N}_2$ to occur, each single per cent. of CaS will require rather less than 1.5 per cent. of NaNO_3 , so that a charge of 2,000 lb. of slag containing 2 per cent. of calcium sulphide will need to be treated with about 60 lb. of sodium nitrate. The free basic substances, which, according to the above equation, are produced, serve to increase the duration of the fluidity of the slag, provided it be not already too basic, a condition obtaining if its oxygen ratio fall below that characteristic of a mono-silicate constitution. Besides sodium nitrate, the chloride may be used to get rid of iron by volatilisations as chloride. In addition to the direct benefits attained by the desulphurisation of slag, mentioned above, the following advantages accrue: The solidifying point is lowered, and the range of temperature during which the slag remains plastic is increased; moreover, that part of the slag which clings to the walls of the converter after pouring, can be scraped out before it sets, re-heated and moulded into suitable shapes. So marked is the convenience of this greater fluidity that it is recommended to add some cheap form of alkali (e.g. sodium carbonate) to such slags as require but little sodium nitrate for their complete desulphurisation. In this case the substance selected should be run in already fused, so as not to chill the charge, and cause it to solidify before it can all be used. Manufacturers are likely to comply with this condition, because every pound of the product wasted represents to them a fraction of a pound of material they have *bought directly*, and they are more apt to be alive to the need for economy with respect to it than to anything they have paid for *indirectly*, such as the untreated slag itself.—B. B.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improvements in and connected with Secondary Batteries or Electrical Accumulators. L. Bristol, Bromley. Eng. Pat. 9854, July 6, 1888. *Sd.*

To increase the cohesiveness and rigidity of the plates and to do away with the necessity for a metallic support, the active material is mixed with hair or fibrous substances. A conductor of lead or platinum, having lateral branches, is inserted, and the whole subjected to a gentle pressure and dried. These plates are then placed inside bottomless cases having supporting strips of wood, and the necessary number of such cases placed inside a large water-tight case to form one cell. A simple form of gas escape plug is provided.—B. T.

Improved Connection for the Carbon or Agglomerate Plates of Galvanic Batteries. L. I. Dopping-Hepenstal, Granard. Eng. Pat. 10,627, July 23, 1888. *Ad.*

A piece of platinum wire or bar of suitable size is bent back upon itself and wedged into a hole or slit in the plate or block, the wedge action serving to give close contact.—B. T.

Improvements in or relating to Pyrometers. W. H. Grindley, Tunstall, and W. S. Hensley, Cardiff. Eng. Pat. 13,005, September 8, 1888. *11d.*

Coils of platinum or iridium wire are wound upon an insulating material such as porcelain, and introduced into the chamber whose temperature is to be measured; the terminations of these wires are brought to a suitable switch-board in connexion with a Wheatstone bridge of somewhat novel construction, enabling the resistance of the coils inside the chamber to be measured at any time. As the resistance of the wire varies with the temperature, it is possible by measuring its resistance to ascertain its temperature at that particular time.—B. T.

Improvements in Galvanic Batteries and in Electrolytic Baths. J. L. Roberts and H. L. Breyer, Brooklyn, New York, U.S.A. Eng. Pat. 18,194, December 18, 1888. *Sd.*

In order to prevent the diffusion of liquids in a two-fluid battery, a non-porous partition, but with electrolytic properties, is employed, and may be made of starch "boiled in a strong brine of some salt of an alkali, such as chloride of sodium or a salt of zinc," the gelatinous mass so produced being confined between walls of cloth to form the diaphragm of the battery. Other methods of forming similar diaphragms are described. Or, a porous cell may be soaked in an aqueous solution of silicate of soda or potash, and then dipped into muriatic acid or a solution of a salt such as chloride of iron. In this way silica is deposited in a gelatinous mass in the pores of the pot.—B. T.

An Improvement in Materials to be used in Galvanic Batteries. A. Cornwell, Melbourne, Victoria. Eng. Pat. 19,061, December 31, 1888. *6d.*

This is an improved method of preparing the saline matter referred to in Eng. Pat. 12,378 of 1885 (this Journal, 1886, 500), and is carried out thus:—Three fluid ounces of sulphuric acid are boiled with three fluid drachms of mercury until the latter is dissolved and the excess of acid evaporated. This mercuric sulphate is then dissolved in 10 oz. of water, and 2 oz. of common salt are added until a whitish colour at the required density (viz. 1.425) is obtained.—B. T.

A New or Improved Ozone-Producing Apparatus. H. A. B. H. de Vars, Paris, France. Eng. Pat. 5230, March 27, 1889. 6d.

A GLASS bell-jar, having its outer surface coated with tin foil, is inverted and placed over a glass cylinder having its inside coated with tin foil, the whole being covered with a large inverted glass bell. The outside tin foil is connected with the positive pole of an induction coil, and the inside with the negative. The apparatus is so constructed that a current of air can be passed up the centre cylinder and down between the outside of the cylinder and the inside of the coated bell-jar; at the same time the induction coil is set working and the moving air becomes electrified and changed into ozone. A vessel is arranged beneath for collecting the ozone.—B. T.

Improvements in Secondary Batteries. P. A. Newton, London. From W. Main, Brooklyn, New York, U.S.A. Eng. Pat. 6112, April 9, 1889. 8d.

THIS consists chiefly of an improvement upon the Merséle battery (Eng. Pat. 4311 of 1887; this Journal, 1887, 833), in the new battery the plates being placed horizontal, with the hydrogen plate below the oxygen plate. Vertical end plates of insulating material are placed in the cell, and rods of hard rubber or similar material are stretched across from end-plate to end-plate to support the active material, any desired number of layers of this active material being used. The hydrogen plate consists of a perforated copper tray carrying an amalgam of zinc and mercury, the oxygen plate of lead coated with carbon or a carbonised material to add to its conductivity. The electrolyte may consist of a solution containing zinc and mercury, or a dilute acid solution may be employed.—B. T.

Improvements in Thermo-electric Batteries. J. J. Shedlock and R. Mestern, London. Eng. Pat. 6119, April 9, 1889. 8d.

THE battery is so constructed that the electro-positive metal or alloy can be kept in a molten state by means of the combustion of coal or oil, while the metallic strips connecting these alloys are kept cool outside the molten metal by means of a current of air circulating round them. Any suitable number of these elements can be arranged round a circular combustion flue.—B. T.

Improvements in Secondary Batteries. G. E. Heyl, Charlottenberg, Prussia. Eng. Pat. 6865, April 24, 1889. 4d.

IN this battery the plates are made of a lead felt prepared by hanging up vertically thin round wires or threads of lead and allowing compressed air to blow upon them until they are thoroughly entangled. The felt is then compressed into plates of the required size, and molten lead poured round to form a framework. Plates thus formed have great porosity, and are not liable to short circuit.—B. T.

Improvements in Electric Secondary or Storage Batteries. T. H. Hicks, Detroit, U.S.A. Eng. Pat. 7002, April 26, 1889. 6d.

THE lead plates forming the elements are cast with shelves upon each face, the shelves being bent up so as to form retaining troughs to hold the active material. Oxide of lead is used upon one side of the plate and peroxide on the other. The requisite number of these plates are then fitted to serve as division plates between water-tight cells, one side being used as a positive and the other as a negative plate.—B. T.

CORRECTION.

It is requested that in the July issue, page 551, second column, line 5 of first abstract, the sentence, "The anodes and cathodes are of pure zinc," be corrected to read, "The cathodes are of pure zinc."

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Decomposition of the Neutral Fats by Heating under Pressure. C. Engler and S. Seidner. Dingl. Polyt. J. 271, 515—526 and 572—576.

See under H., page 607.

PATENTS.

Improvements in the Purification of Oils and Fats, and the Obtainment of Useful Products therefrom. W. A. Mitchell and O. C. Hagemann, London. Partly from M. Von Schmidt, Vienna, Austria. Eng. Pat. 6949, May 9, 1888. 6d.

IN carrying out this invention the fats or oils are placed in a vessel provided with stirrers and heated to 180° F. Soda crystals are then added and the whole mass well stirred. Instead of soda crystals other forms of carbonate of soda may be employed, but in such cases the amount of water used must not exceed 160 per cent. of the total amount of Na_2CO_3 added, otherwise an emulsion will be formed from which the oil or fat cannot be separated. After standing for some time, the mass separates into two layers of oil or fat and soap. The separated oil or fat is then washed or filtered and heated in a vessel into which carbonic acid or nitrogen is passed, by which means certain volatile impurities are removed. The carbonic acid or nitrogen can be re-used after purification by passing it through charcoal or solution of permanganate.—E. J. B.

An Improvement in the Manufacture of Soap. T. S. Steen, Londonderry. Eng. Pat. 9123, June 22, 1888. 4d.

THE inventor adds from 6 to 10 per cent. of a pure mineral oil of a specific gravity of about 0.875 to a "fitted" soap containing 70 per cent. of rosin. A sufficient excess of alkali must be added to saponify the mineral oil.—E. J. B.

Improvements in the Treatment or Purification of Fatty Acids and in the Apparatus employed therein. M. V. Brisset, Saint Denis, France. Eng. Pat. 10,296, July 16, 1888. 8d.

THE object of the invention is to remove liquid fatty acids from their mixture with solid fatty acids in a more efficient way than by pressure, which is the method at present employed. The process consists in dissolving the mixture in a suitable solvent, such for example as benzene, turpentine, petroleum ether, acetone, alcohol, carbon disulphide, &c. The solution is effected hot and on cooling the solid fatty acids crystallise out. The crystals are freed from the mother-liquor containing the liquid acids by means of a filter-press, centrifugal machine or vacuum apparatus. The whole of the operations are conducted in hermetically closed vessels.—E. J. B.

Improvements relating to the Preparation of Artificial Manures from Fish and other Substances and to the Extraction of Oil therefrom. C. Weigelt, Berlin, Germany. Eng. Pat. 11,505, August 9, 1888. 6d.

See under XV., page 631.

An Improved Composition for Use as Axle Grease or Stuffing Box Packing. G. Hervieux and V. Bédard, Québec, Canada. Eng. Pat. 4190, March 9, 1889. 4d.

THE inventors claim an axle grease consisting of 24 parts of cod-fish oil, 16 parts of beef tallow, 2 parts of soft soap and 1 part of rosin.—E. J. B.

An Improved Soap Powder. H. C. Foulsham, Broudesbury.
Eng. Pat. 4651, March 16, 1889. 6d.

THE improved soap powder consists of 20 lb. of soap, 12 lb. of alkali, 10 lb. of carbonate of soda, 70 lb. of soda crystals, and to each hundredweight of the mixture 3 lb. of paraffin and 2 lb. of turpentine are added.—E. J. B.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

PATENTS.

Improved Apparatus for Vulcanising Caoutchouc and Moulding Celluloid. J. Wirth, Paris, France. Eng. Pat. 9604, July 2, 1888. 8d.

THE inventor claims that by the use of his apparatus an economy both of time and steam may be effected. The specification is accompanied by 13 descriptive drawings.

—E. J. B.

Improvements in Plastic Compounds. P. M. Justice, London. From A. Gravelin, Liège, Belgium. Eng. Pat. 9665, July 3, 1888. 6d.

THIS invention relates to the manufacture of a substance called "Elurite," suitable as a substitute for ebonite, horn, &c. It is prepared in the following manner:—A mixture is made of 100 parts of paper pulp, containing about 50 per cent. of water, with 80 parts of blood. The mass is well kneaded, rapidly dried and powdered. 100 parts of this powder are mixed with 80 parts of blood, one part of powdered rosin, and $\frac{1}{2}$ part of linseed or other oil. If a pale-coloured product be desired, the serum of blood may be employed and to the mass may be added either casein, white of egg, gelatin, glue, starch, dextrin, or suitable gums. To increase the hardness a small percentage of silicate of soda may be added. The material may be moulded into

any desired form. It possesses greater hardness than wood, does not soften under heat, and is not rendered brittle by cold. It can be readily worked in a lathe, and being a non-conducting material can be used as an electrical insulator.

—E. J. B.

A Method of Producing a Useful Material or Materials from Greenstone, Diabase, and other Varieties of Hornblende. E. Murjahn, Hamburg, Germany. Eng. Pat. 4175, March 9, 1889. 4d.

THE minerals are dried, crushed, and treated with hydrochloric or sulphuric acid, the washed residue being applied to various uses, as paper making, manufacture of rubber compositions, &c.—E. G. C.

An Improved Solution for Rendering Cloth, Felt, Paper, and the like Waterproof. M. Gangl and I. Mossner, Vienna, Austria. Eng. Pat. 5763, April 4, 1889. 4d.

THREE solutions are prepared as follows:—(1.) One part of Indian isinglass is dissolved in 20 parts of hot water, and the solution neutralised with caustic soda; (2.) Ten parts of sugar of lead in 20 parts of hot water; (3.) 6·27 parts of alum in 150 parts of hot water. These solutions are mixed together, and the precipitate of lead sulphate is allowed to settle, and may be utilised as a paint. The solution is diluted with water and is then ready for use.

—E. J. B.

An Improved Buoyant Compound and Water-tight Covering or Enclosure therefor. A. M. Wood, Westminster. Eng. Pat. 7137, April 29, 1889. 4d.

THE inventor claims the manufacture of an "improved buoyant compound or material consisting of cork, rosin, and marine glue or bitumen with cocoa-nut husks, cane, bamboo chips, or whalebone, or with wax and shellac or gum kauri, or with woodite, rubber euphorbia or analogous gums." Also as a covering or cementing medium for pieces of buoyant material, "the improved cement consisting of rosin, pitch, and marine glue with kieselsuhr, asbestos, or whalebone powder or shreds."—E. J. B.

XV.—AGRICULTURE, MANURES, Etc.

Progressive Development of the Potato. A. Girard. Compt. Rend. 108, 602—604.

TWO hundred roots were planted at Joinville, and the investigation of their progressive development extended over about four months, the different portions of the plants being weighed, and analyses made, at six different periods. The mean results of the six series of analyses are given in the following table:—

	July 3.	August 4.	August 28.	September 20.	October 10.	October 25.
Water.....	85·22	80·79	78·16	75·94	80·22	77·05
SOLUBLE MATTERS.						
Saccharose.....	1·48	1·12	0·64	0·27	0·10	0·02
Invert sugar.....	0·67	0·00	0·00	0·00	0·00	0·00
Albuminoids.....	1·36	0·91	1·19	2·06	1·99	1·98
Other organic matter.....	0·35	0·72	0·13	0·96	1·19	1·14
Salts.....	0·86	1·11	1·38	1·31	1·39	1·46
	4·72	3·87	3·34	4·60	4·67	4·60
INSOLUBLE MATTERS.						
Starch.....	8·40	13·92	15·67	17·44	13·70	16·38
Cellulose.....	8·40	1·23	1·60	1·60	1·31	1·66
Azotised lignin.....	1·06	0·08	0·19	0·32	0·19	0·19
Mineral matter.....	1·06	0·09	0·09	0·09	0·13	0·06
	10·06	15·22	17·55	19·47	15·33	18·29

(See also this Journal, 1889, 472.)

—E. G. C.

Fixation of Nitrogen by Arable Soil in Absence and in Presence of Vegetation. Berthelot. *Compt. Rend.* **108**, 700—708. (Compare this Journal 1887, 552; and 1888, 382.)

This paper is an abstract, by Berthelot himself, of a much longer one occupying over 200 pages of the *Annales de Chimie et de Physique* for April 1889, and the present abstract refers to both memoirs. In the latter journal the mode of experiment and the analytical processes are discussed in detail, and the figures relating to each separate experiment are set out. The experiments were made in 1888, and comprised 64 separate pots, following the lines of the author's previous experiments of 1883 and subsequent years. They establish, by the most rigorous figures, the increase in combined nitrogen of plain soil, under certain conditions, and next that the gain in nitrogen is much greater when certain leguminous plants are grown in the soil, and that in this case the gain in nitrogen takes place not only in the soil but also in both the underground and aboveground portions of the plant. As an example of the mode of experiment, the quantities dealt with, and the extent of the increase observed, experiment No. 53 may be cited, especially as it is one of those made under conditions which exclude any question as to the interference of atmospheric ammonia, nitrogen in rain water and nitrogen removed by drainage. On May 11th, 1888, a porcelain pot was filled with 2.145 kilos. of soil which had been carefully air-dried, stones, vegetable debris, and all foreign substances removed, rendered thoroughly homogeneous by very moderate crushing and sifting, and finally subjected to complete analysis. The quantity of soil named consisted of 1.950 kilos. of dry soil and 0.195 kilo. of water, and contained per kilo. of dry soil, 1.8998 grms. of combined nitrogen, 0.0122 grm. nitric nitrogen, and 19.8 grms. of organic carbon. As for the quality of the soil (the full analysis of which is given) it was a clay, rather poor in organic matter, and containing 5—6 per cent. of carbonate of lime. The pot was placed on a ground glass plate under a glass shade of about 45 litres capacity, and the joint rendered air-tight with vaselin. At the commencement of the experiment two determinations gave 0.9743 and 0.9743 of N per kilo. of dry soil. On July 3rd, 1888, after remaining undisturbed for seven weeks, two determinations gave 1.0610 and 1.0579, mean 1.0599 grms. of N per kilo. of dry soil. The total gain of combined nitrogen in the 1.950 kilos. dry soil is, therefore, 2.0629—1.8998 = 0.1631 grm., a quantity far exceeding the experimental error, which was carefully defined by trials in blank. This is exclusive of the nitric nitrogen, of which there was 0.0122 grm. present at the beginning, and 0.0391 grm. at the end of the experiment, so that a feeble nitrification had been in progress simultaneously. As a

control, a quantity of this soil was shaken for some time in a large flask kept filled with pure carbon dioxide, then transferred, without contact with air, to a smaller flask also filled with carbon dioxide, until the latter was full of soil. It was then corked, sealed, and laid aside for four months and a half; at the end of that time it gave 0.986 grm. of N per kilo. of dry soil, against 0.974 at the commencement, the difference being not greater than the experimental error. The gain of nitrogen in experiment No. 53 can, therefore, only be attributed to fixation of free atmospheric nitrogen by the soil under the conditions of the experiment, which are:—a porous condition of the soil, not absolutely pulverised, or injured by excessive crushing or rubbing, which may destroy microbes; gentle circulation of oxygen, giving rise to feeble but not very rapid nitrification, as a consequence of this, absence of reducing fermentations; presence of a limited quantity of water; temperature from 10°—40°; existence in the soil of a limited proportion of nitrogen contained in organic matter not undergoing putrefaction or any anaerobic fermentation; and finally, presence of the natural microbes of the soil. Precisely similar experiments made—(1) with the pots of soil under a glass shelter, but exposed to free circulation of air, and (2) with the pots fully exposed to air and rain, the drainage water being collected by a funnel and tube in a bottle placed underneath, and the nitrogen removed in solution determined, gave similar results, the gains being respectively 0.1387 and 0.1671 grm. of nitrogen. The increases in these three cases amount to 8.6, 7.3, and 8.8 per cent. respectively of the total combined nitrogen present at the commencement, and a comparison of the last two with the first shows that the ammonia of the air and the nitrogen carried to the soil by rain are negligible quantities in these experiments. The gain of nitrogen per hectare of soil, for the same depth (18 centimetres) and for the same time (8, 12, and 11 weeks), would amount to 87, 74, and 89 kilos, respectively, and in experiments with other soils much larger increases have been obtained, but the author does not assert that the conditions necessary for these large increases are present over large areas or depths of land under ordinary circumstances.

The influence of leguminous vegetation is best shown in the series of experiments with a glass shelter, or with free exposure to air, since it is impossible to get a healthy development of the plants in the saturated atmosphere under the glass shades, even though carbon dioxide be occasionally introduced and the air renewed. The following table gives the results as regards nitrogen obtained by growing six leguminous species in the same soil as above-mentioned in pots placed under a glass shelter with free circulation of air:—

	Pot 40. Vetches.	Pot 41. Lupins.	Pot 42. Lathyrus.	Pot 43. Medick and Anthyllus.	Pot 44. Crimson Clover.	Pot 45. Lucerne.
Weeks of growth	11	10	14	22	11	19
	Grms.	Grms.	Grms.	Grms.	Grms.	Grms.
Initial nitrogen { Soil	3.4197	3.4197	3.4197	3.4197	3.4197	3.4197
{ Seed	0.1916	0.4832	0.2328	0.0611	0.1181	0.0845
{ Waterings	0.0330	0.0930	0.0051	0.0096	0.0030	0.0036
Total nitrogen	3.6143	3.8059	3.6576	3.5204	3.5408	3.5138
	Grms.	Grms.	Grms.	Grms.	Grms.	Grms.
Final nitrogen { Soil	3.805	3.673	3.679	3.862	3.704	3.756
{ Plant above ground	0.286	0.261	0.218	0.584	0.115	0.144
{ Roots	0.293	0.113	0.492	0.259	0.095	0.508
Total nitrogen	4.384	4.047	4.389	4.705	3.914	4.832
Before	3.614	3.806	3.658	3.520	3.541	3.514
Gain	0.770	0.243	0.731	1.185	0.373	1.318
Gain per cent. of total nitrogen	21.3	6.1	20.0	33.7	10.5	37.5

Experiments made with free exposure to air and rain gave similar results. It will be noticed that in each case the soil shows a gain of nitrogen, in addition to the generally large gain shown by the plants. The latter gain is generally as great in the roots as in the parts above ground. In most cases the soil was exhausted of the small quantities of nitrates originally present, and those formed during the progress of the experiments. A noteworthy feature is the very large quantity of mineral matter taken by the roots from the soil, the ash of the roots amounting in most cases to over 80 per cent. of the dry matter. In most cases tubercles were developed on the roots of the plants. Experiments made on the fixation of nitrogen by soil alone, the soil being watered with an extract of some of these tubercles, showed that at any rate the tubercles alone, without the growth of the plants to which they are naturally attached, have no power to increase the amount of nitrogen fixed.

To sum up these experiments, they were 64 in number, made with prepared samples of three different soils of different degrees of richness in organic matter; these soils were tried alone under the three conditions of closed shades, glass shelter with free access of air, and no shelter; and under the same three conditions, as far as practicable, with the six species of leguminous plants above mentioned. The results were all of the same sense as those already cited, a gain of nitrogen by the soil alone and by the plant and soil, and in the latter case the gain was shared by both above- and underground portions of the plant, and this gain must in all cases be attributed to fixation of free atmospheric nitrogen. The different leguminous plants, however, showed very different degrees of development in the various experiments, the gain being generally greatest with lucerne, which flourished well and afforded two cuttings, whilst the lupins developed the worst of all. The author's results confirm to a great extent those of Hellriegel and Wilfarth.—J. M. H. M.

On Putrefaction and the Formation of Dung Heaps. J. Reiset. Compt. Rend. **108**, 708—712.

In view of some recent experiments of Schlösing, the author directs attention to his own experiments of 1854—1856, showing that free nitrogen gas is always disengaged during the putrefactive decomposition of nitrogenous organic matter.—J. M. H. M.

Richness of Wheat in Gluten. E. Gattelier and L. L'Hôte. Compt. Rend. **108**, 859—862; 1018—1019; and 1064—1066.

The flour from four samples of the same variety of wheat, grown on the same soil, but with different quantities of nitrogenous manure, gave the following percentages of gluten ($N \times 6.25$) calculated on the dry matter; 10.43, 11.37, 12.75, 11.31. The dressings of ammonium sulphate were 100, 200, 300, and 300 kilos. per hectare respectively. The entire wheat of these samples contained the following percentages of gluten, 12.56, 12.68, 13.75, and 12.75; so that the richness in gluten of the flour follows the same order as that of the entire grain. The previous cropping also influences the proportion of gluten, which is higher the more nitrogen is left in the soil.

Twelve varieties of wheat, grown at the same time, on the same soil, with the same manuring and previous cropping, gave percentages of gluten from 9.56 to 14.18 (dry). The winter wheats were poorer than the spring wheats, and varied from 9.56 to 12.00. There was no relation between the yield of wheat and its richness in gluten.

From a number of observations, the authors conclude that the manuring has more influence on the yield of gluten than the variety of wheat has, and that by giving as much nitrogenous manure as can be safely applied without danger of laying the crop, and at the same time selecting a variety which yields a large crop, productiveness can be combined with richness in gluten.—J. M. H. M.

Formation of Nitric Deposits. A. Muntz and V. Marcano. Compt. Rend. **108**, 900—902.

Caves containing deposits of earth with from 4 to 30 per cent. of calcium nitrate, and 5 to 60 per cent. of calcium phosphate, are common in Venezuela, not only in the littoral mountain chains, but also on the flanks of the Cordillera of the Andes. In these deposits are embedded remains of mammalian bones, preserving their form, but so friable as to fall to powder when they are extracted. They consist solely of calcium phosphate; the gelatin has been nitrified and dissolved out, and the calcium carbonate of the bone has been used up in neutralising the nitric acid produced. The nitric ferment is found in abundance throughout the deposits, in a very well developed form. Some of these deposits are 10 metres thick.—J. M. H. M.

Proportion of Nitrates in the Rain of Tropical Regions. A. Muntz and V. Marcano. Compt. Rend. **108**, 1062—1064.

One hundred and twenty-one samples of rain collected at Caracas, 1883—1885, gave as a mean 2.23 mgrms. of nitric acid (N_2O_5 ?) per litre, the maximum being 16.25 mgrms. and the minimum 0.20 mgrm.

Nineteen samples collected at St. Denis, Réunion Island, 1886—1887, gave as a mean 2.67 mgrms., maximum 12.5 mgrms., minimum 0.4 mgrm. These figures are much higher than those found for Alsace by Boussingault, and for England by Lawes and Gilbert, and as the tropical rainfall also is much greater than that in temperate climates, it follows that the nitric acid carried down to the soil by rain is not in the tropics a negligible quantity, as it is here.—J. M. H. M.

Culture, Varieties, and Diseases of Hops practically considered. C. F. Thatcher. Trans. Laboratory Club, **1**, 84—86.

Rice loamy soils are suitable for hops, but apparently no general rules can be laid down for the selection of soils for this crop. The application of high farming, involving the use of large quantities of artificial manures, is deprecated, as they are stated to increase the crops with a very considerable sacrifice of quality. Training on poles is more economical than training on wires, but the latter have the advantage of not offering a harbour for certain insects; string has been used with success for hop training. Washes composed of infusions of elder leaves, soap, tobacco, and quassia, also sulphur and paraffin, are used for destroying pests and preventing disease. The aphids, which migrate from the plum to the hop in the spring and, *vice versa* in the autumn, is the worst parasite, the red spider, which is sometimes green and also brown, coming next, whilst there are about half a dozen insects injurious to hops. Of English hops cultivated in Kent and Sussex, Goldings are the best, then come Grape, Jones', and then the Colegate at once the most hardy, most prolific, and most inferior. The White and Green Bine hops are grown in Surrey, Hants, and Worcestershire. The "Brambling," Bass's, Tuggle's, White's "early" and "early prolific" are inferior varieties of the true Goldings. Jones' hops require picking as soon as ripe, as they then drop their petals and are hence known as "flyers." Hops discoloured during growth by sun after heavy dews, although deficient in colour, appear to retain their flavour and keeping qualities intact, and should not be discarded by brewers. It is always better to use small quantities of good hops than large quantities of an inferior quality. There is, it seems, little or no connexion between the keeping powers of ale and the quantity of hops used. English hops are packed by the growers and can be depended upon as being of the district marked on them, a fact not so certain in Continental hops, which are packed by the merchant.—D. A. L.

Decomposition of Albuminoids in Plants in the Absence of Free Oxygen. W. Palladin. Ber. d. Bot. Gesell. **6**, 205—212; 296—304.

MANY investigators have proved that decomposition of albuminoids in plants takes place in the open air, but owing to their constant reproduction from the carbohydrates which accumulate in plants, this decomposition cannot be readily perceived. If, however, the supply of carbohydrates is cut off by exposing the plant in a dark room, then the decomposition of the albuminoids proceeds vigorously, the chief and almost only product being asparagine, showing that the decomposition is really oxidation.

In the absence of free oxygen green plants do not suffer loss of albuminoids during the first 20 hours, provided they contain sufficient non-nitrogenous matter. If, however, they have been deprived of most of their non-nitrogenous matter by detention in a dark room, then also they lose a considerable proportion of their albuminoids during the first 20 hours' exposure in a place free from oxygen the chief products of this decomposition being leucine and tyrosine, asparagine being formed only in small quantities.—D. A. L.

Acidity of Cell-Juice. Lange. Forschungen auf dem Gebiete d. Agrikulturphysik, **11**, 111—116.

THE author's investigations on the variation of the acidity in the cell-juice of plants have led him to conclude that in the morning an increase of acidity is observed as compared with the preceding day, whilst in the evening the acidity is less than that of the preceding night. The loss of acid during the day proceeds more energetically in the red half of the spectrum than it does in the blue half.—D. A. L.

Cultivation of Sugar-Beet. H. Briem. Oesterr. Ungar. Zeits. f. Zuckerind. u. Landw. **17**, 1888, 571—578.

SUGAR-beet was cultivated from the same seed on a rich garden soil made up of pond mud, and on a poor soil with a very thin layer of mould and a stony subsoil. In the former case large watery roots were obtained; in the latter they were small and ill-developed; whilst in both cases the quality was much inferior to that of the roots usually produced from the seed employed. From this it is inferred

that good seed alone will not ensure a good quality of crops, but that in addition careful cultivation, favourable climate, and suitable soil are required.—D. A. L.

Manurial Value of Different Phosphates. T. Poggi and P. Maissen. Le Stazioni Speriment. Agrar. Ital. **15**, 583—584.

MAIZE was grown on a sandy calcareous clay soil without manure, with bone-meal alone, with bone-meal and ammonium sulphate, with bone-meal ammonium sulphate and potassium chloride; a similar series of plots being arranged with mineral phosphate in place of bone-meal. The experiments were made in duplicate or even triplicate, and the mineral phosphate was found to be nearly as good as the bone-meal when similar proportions of each were used. The best result was obtained with a dressing of 300 kilos. of bone-meal and 160 kilos. of ammonium sulphate per hectare.—D. A. L.

Fertilising Subsoil. G. de Marneffé. Bull. de la stat. agronom. de l'Etat à Gembloux, **42**, 13—18.

TO facilitate the fertilisation of the subsoil recommended by some agriculturalists, the author has constructed a plough which makes a furrow twice the ordinary size and throws the ridge twice the usual distance; the surface of subsoil thus exposed is then ploughed with an ordinary plough, or may first be dressed with manure, then by refilling in the reverse order any admixture of subsoil with surface is avoided. The subsoil is in this way exposed to the air and can be manured, without in any way affecting the surface soil.—D. A. L.

Digestibility of the Nitrogenous Constituents of Sugar-Beet Residues and some other Feeding-Stuffs, when Fresh, Dry, or as Silage. A. Morgan. Jour. f. Landw. **34**, 1888, 309—323.

THE author has made a great many artificial digestive experiments, by digesting various fodders with pepsin and pancreatic juice. Some of the results are given in the following table:—

Fodder.	Percentage of Total Nitrogen.		
	As Albuminoids.	Digestible.	
		Total.	As Albuminoids.
Fresh sugar-beet residues.....	100	76·3	76·3
Fresh sugar-beet residues, dried.....	100	79·7	79·7
Fresh sugar-beet residues, at 125°—130°.....	100	65·8	65·8
Ensiled sugar-beet residues.....	91·7	83·2	74·9
Sugar-beet tops.....	76·9	72·8	49·7
Sugar-beet tops, ensiled.....	41·6	81·0	22·6
Sugar-beet leaves, ensiled.....	35·5	79·9	15·3
Meadow grass.....	80·0	71·6	51·6
Meadow grass, sweet silage, 71 days old.....	80·8	36·9	17·8
Meadow grass, sweet silage, 154 „ „.....	71·5	24·8	..
Crimson clover, sweet silage, 70 „ „.....	56·2	70·1	23·3
Crimson clover, sweet silage, 147 „ „.....	55·5	51·7	7·2
Crimson clover.....	76·8	77·2	54·0
Fresh lupins.....	79·1	91·8	70·9
Lupin silage (sweet).....	..	78·4	..
Maize silage (sour).....	54·1	51·2	8·3
Distillers' wash, dried.....	91·2	82·5	69·3
Brewers' grains, dried.....	92·5	87·1	79·6
Oat grain.....	94·7	94·3	88·9
Wheat bran.....	82·3	86·7	69·0
Meadow hay, spoiled by rain.....	100	62·9	62·9

The author remarks that the nitrogenous matter in sugar-beet residues is not all digestible as is frequently supposed; moreover, the digestibility is not altered by drying at moderate temperatures, but is diminished by temperatures above 125—130°. He also draws attention to the fact that unlike other feeding-stuffs the digestibility of the nitrogenous constituents of sugar-beet residues does not decrease by ensiling. The digestibility of many other fodders has been tested, and the results are tabulated in the paper. The following are a few of the digestibility-coefficients ascertained: Straw of cereals, 29.4; straw of leguminosae, 62.80; chaff, 36.20; meadow hay, 76.60; clover hay, 83.80; lucerne hay, 88.5; barley groats, 72.7; wheat

bran, 76.6; cotton-seed cake, 93.0; earth-nut cake, 94.6; palm-nut cake, 76.9.—D. A. L.

Composition and Digestibility of certain Fodders, and Observations on the Determination of the Digestibility of Albuminoids and Carbohydrates. W. A. Jordan, J. M. Bartlett, and L. H. Merrill. *Agricultural Science*, 1888, 283—302.

The following results were obtained by the usual methods. Nitrogen by the Kjeldahl's method; crude fibre by the Weender method, and so on, from American (Maine) plants:—

TABLE I.

Name of Plant.	Condition of Plant.	In 100 of Dry Substance.				
		Ash.	Albuminoids.	Crude Fibre.	Non-Nitrogenous Solution.	Fat.
Alsike clover.....	Incipient blossom.....	9.86	16.25	30.22	38.51	4.16
" ".....	Full flower.....	8.19	14.51	31.86	40.74	3.90
Red clover.....	Incipient blossom.....	8.38	16.70	29.17	41.10	4.65
White clover.....	Full flower.....	7.72	21.90	22.16	41.87	6.35
" ".....	Some time after full flower.....	8.47	17.20	28.43	41.65	4.19
Blue joint grass.....	Cut middle of July.....	5.88	12.00	39.88	38.54	3.70
" ".....	Cut late in July.....	5.97	19.03	34.22	41.69	3.00
Cock's foot grass.....	After flowering.....	7.02	8.42	37.08	41.08	3.40
Common bent grass.....	In full flower.....	5.06	9.63	39.98	50.64	3.65
Timothy or cat's tail grass.....	" " 1885.....	6.47	7.67	38.50	43.70	3.01
" " ".....	" " 1887.....	4.58	8.18	32.66	50.98	3.60
Wild oat grass.....	Flowering.....	3.81	7.49	34.10	51.74	2.86
Couch grass.....	".....	6.79	9.33	36.88	43.86	3.14
Crow foot (buttercup).....	In full bloom.....	8.71	10.11	33.97	45.47	3.74
White weed.....	" ".....	7.58	9.34	32.09	46.17	4.82

Experiments on the digestibility of these fodders were tried with sheep. The sheep were kept in stalls and fed for twelve days on each of the different materials. After seven days' feeding the faeces were collected for five days,

sampled and analysed. The results are given in detail in the original and are epitomised in the following table, the material in the faeces being regarded as undigested:—

TABLE II.

Name of Plant.	Percentage Digested of—					
	Dry Substance.	Organic Matter.	Albuminoids	Crude Fibre.	Non-Nitrogenous Extract.	Fat.
Alsike clover.....	56.7	57.8	57.6	47.4	66.6	48.6
White clover.....	66.0	66.6	73.2	60.6	69.5	50.6
Blue joint grass.....	39.9	41.8	56.5	36.5	49.2	37.0
Cock's foot grass.....	54.4	55.8	58.5	37.5	54.4	51.2
Oat straw.....	50.3	52.0	"	37.6	53.2	38.3
Common bent grass.....	57.6	59.3	60.1	61.2	59.1	44.2
Timothy grass.....	55.7	56.8	48.8	49.8	62.7	49.0
Wild oat grass.....	59.6	61.2	48.5	65.1	62.1	58.2
Couch grass.....	59.9	61.0	64.2	59.2	62.1	60.0
Crow foot.....	56.1	56.6	57.8	41.1	66.9	60.7
White weed.....	57.8	58.3	58.1	45.5	66.7	62.2

As a control of these results, artificial digestion experiments were tried according to Stutzer's process, by digesting with pepsin (made from dry preparation) and pancreatic juice at 40° C.; the pancreatic juice was prepared by

Chittenden's method and the digestion in it was carried on for 12 hours. In the following table are given the results, in column A, from the feeding experiments, in column B, from the artificial digestion.

TABLE III.

	—	A.	B.	C.	D.
Percentage of Total Nitrogen.					
	Present as Albuminoids.	Digested by Sheep and calculated in the ordinary Manner.	Digested artificially by Pepsin-pancreas.	As under A., but corrected for Nitrogen of Faeces soluble in Ether, Alcohol, Hot Water, and Cold Lime Water. Gastric Juice.	
Alsike clover (full bloom).....	87.2	64.0	80.3	72.1	77.9
White clover	83.9	73.3	81.8	81.5	84.5
Blue joint grass	88.4	56.4	67.3	69.0	73.9
Cock's foot grass.....	95.8	58.2	70.8	73.3	75.7
Oat straw .....	..	15.2	15.6	20.5	28.7
Oat straw and raw potatoes.....	..	27.9	78.5	91.0	64.8
Common bent grass.....	..	60.4	64.1	68.4	72.6
Timothy (1887) grass	89.2	60.4	74.2	63.8	71.8
Wild oat grass	90.0	48.5	65.1	63.4	68.0
Couch grass	91.2	61.2	78.7	73.9	80.5
Crow foot.....	91.5	57.8	75.8	67.5	72.6
White weed	91.1	58.4	73.3	65.7	72.8

The differences in the results are attributed to the inclusion of nitrogen derived from digestive fluids and wear and tear of tissue in the numbers for undigested nitrogen in the analysis of the faeces, and experiments were made to confirm this view. To remove the nitrogen derived from wear of tissue, &c. without attacking the undigested nitrogenous matter, the faeces were treated with various solvents in succession—ether, alcohol, hot water, and cold lime water. The feeding results, when corrected on this basis, are given in column C. of the above table. In other experiments digestion for 24 hours with gastric juice was applied to the faeces for the

removal of tissue, &c. nitrogen, but nitrogen continues to be dissolved by this method throughout the 24 hours, and the quantities are probably too high. The results from the feeding experiments corrected on this basis are given in column D. of the above table. If six instead of 24 hours digestion with gastric be taken, the results are almost exactly the same as under B. These results are valuable as indicating sources of error in digestion experiments. The following table shows the relation the nitrogen in the faeces derived from the animal juices, tissues, &c. bears to the albuminoids consumed and to the organic matter digested.

TABLE IV.

Name of Plant.	Daily Consumption of Albuminoids.	Organic Matter digested Daily.	Nitrogen dissolved from the Faeces, &c. by the Treatment with Solvents.—Per Cent. of the Albuminoids Consumed.
	Grams.	Grams.	
Alsike clover (full bloom).....	88.8	349.5	1.30
White clover	105.8	374.0	1.32
Blue joint grass	64.3	251.5	1.97
Cock's foot grass.....	52.5	323.7	2.32
Oat straw.....	12.5	158.6	4.80
Oat straw and raw potatoes.....	38.9	312.6	3.42
Common bent grass.....	59.8	347.6	1.27
Timothy (1887) grass	52.5	408.9	1.50
Wild oat grass	48.0	378.9	2.27
Couch grass	59.5	360.1	1.59
Crow foot.....	63.4	331.3	1.45
White weed	59.1	350.7	1.22

These data demonstrate that the quantity of nitrogen in the faeces arising from juices, &c. depends on the extent of work imposed on the digestive system, and not on the proportion of nitrogen in the food; in fact, as a rule, it seems that the lower the proportion of nitrogen in the food the larger will be the quantity of this nitrogen in the faeces. This accounts for the great discrepancies between some of

the numbers in columns A, B, C, and D, in Table III.; those for oat straw, for example.

In estimating carbohydrates, cognisance has been taken of the fact that some are readily digestible, and others are not. Therefore determinations of cane-sugar, of grape-sugar, and of starch were made in the fodders, and of starch in the faeces. Some of the results are given in the following table:—

TABLE V.

	In 100 parts of Dry Substance.						Mean Percentage of Non- nitrogenous Extract Digested.
	Non-nitrogenous Extract		Cane Sugar.	Glucose.	Starch.		
	In Fodder.	In Faeces.			In Fodder.	In Faeces.	
Alsike clover.....	40.74	27.05	1.49	3.09	10.61	6.14	71.12
White clover	41.65	35.24	0.39	2.73	15.77	13.71	69.54
Blue joint grass.....	44.66	42.22	2.23	3.53	14.43	10.73	43.21
Cock's foot grass.....	44.08	41.15	1.54	4.05	1.53	10.50	54.34
Common bent grass.....	50.64	48.81	3.14	4.25	16.58	12.44	50.12
Timothy grass	51.30	43.55	3.25	6.18	14.92	11.67	61.05
Wild oat grass	51.74	48.66	1.78	3.76	17.46	12.85	62.10
Couch grass	43.21	40.84	2.57	5.09	16.06	11.94	62.10
Crow foot	45.47	34.32	0.60	4.65	9.15	5.98	66.93
White weed	46.17	36.40	0.79	4.39	10.77	5.64	66.72

—D. A. L.

Formation of Organic Acids, Nitrogenous Organic Matter, and Potassium Nitrate in different Parts of the Beet-Plant. H. Leplat. *La sucrerie indigène*, 1888, 415.

INVESTIGATIONS on this subject have led the author to conclude that neither potash, lime, nor ammonia are present in the plant either in a free state or as carbonates; but that more probably the bases taken by the roots from the soil in the form of acid carbonates reappear in the leaves and roots as organic nitrogenous compounds, as nitrates and as salts of organic acids. The author does not state how the nitric acid gets into the plant.—D. A. L.

PATENT.

Improvements relating to the Preparation of Artificial Manures from Fish and other Substances, and to the Extraction of Oil therefrom. C. Weigelt, Berlin, Germany. Eng. Pat. 11,505, August 9, 1888. *Id.*

THE animal substances are treated with a solution containing potassium chloride or sulphate or magnesium sulphate. The "juice" is separated by pressure and the residue left to dry in the air. It is then ground. If much fat be present it will be expressed with the juice from which it may be recovered; or the dried material may be treated in an extraction apparatus.—E. J. B.

XVI.—SUGAR, STARCH, GUM, Etc.

Record of Experiments conducted by the Commissioner of Agriculture in the Manufacture of Sugar from Sorghum in 1888. H. W. Wiley, U. S. Department of Agriculture. Bulletin, 20.

THIS pamphlet contains very full details of all the work done in connexion with this industry at the five sugar factories, Rio Grande, N.J.; Kenner, La.; Conway Springs,

Douglas and Sterling, Kans., along with general conclusions, which have been derived from a study of the results obtained, and suggestions for the better working of the industry in the future.

The reports from the superintendents and chemists of each station are given in full, and will be found of great interest and value to persons who have any connexion with this industry.

Many of the reports indicate comparative failure, but all the writers unite in prophesying a good future for the sorghum sugar manufacture, and can point to many difficulties already overcome, and are confident of ultimate success.

The application of the principle of diffusion has been the first step towards making this a possible industry, and excellent results are now obtained so far as the extraction of the sugar is concerned.

One great trouble is the vagaries of the sorghum plant, which requires the constant supervision of the chemist, and great stress is laid on the necessity of improving the quality of the cane to be used, by careful seed selection and cultivation, so as to ensure a high and uniform yield of sucrose; and, in the light of the success that has attended the cultivation of the sugar-beet, it is not too much to expect that the sorghum may be similarly improved.

So far as experience goes, a soil and climate similar to those of Southern and Western Kansas appear to be best suited to the culture of sorghum for sugar-making purposes.

The juice as it comes from the diffusion cells has to be filtered to remove the particles of suspended matter, and after many experiments it was found that a shallow filter of coarse sawdust answered the purpose best, one bushel being sufficient to filter the juice from 15 tons of cane.

By dusting finely-powdered air-slaked lime in the chips as they left the shredder, in the proportion of one quart to 1,100 lb. of chips, inversion during diffusion was entirely prevented.

At the Conway Springs factory the average amount of sugar per ton of cane was 249 lb. One analysis of cane showed 13.85 per cent. of sucrose and 1.01 per cent. of glucose, and this is considered the highest yet produced.

Another difficulty that has yet to be overcome is the separation of the sugar from the juice. This is prevented to a large extent by the gum, starch, &c., which it contains, as well as the glucose, so that in the before-mentioned factory only 100 lb. of sugar were obtained out of a possible 249 lb.

The last report of the work done at the Sterling experimental station is specially devoted to the consideration of the faults of the sorghum plant and the best means of improving it, together with much interesting analytical data and results of experiments with the known varieties; and it is pointed out that sorghum has advantages over both the sugar-cane and the sugar-beet in selecting seed from the best individuals. Sugar-beet is a biennial plant requiring two years to produce its seed, whereas sorghum is an annual, requiring but one year to mature its seed, consequently progress in its improvement should be twice as rapid. Further, "the sorghum is unique among sugar-producing plants, in that its seed may be separated entirely from the cane, and the latter analysed, giving exactly the worth of the individual which produced the seed without injury to the seed itself," and the authors think "it would be criminal folly on our part if we failed to avail ourselves in the sorghum industry of the advantages naturally possessed by the plant, and of the lessons taught us by the experience of others with the beet and cane."—W. M.

New Processes and Apparatus for Sugar Manufactories. Stammer. *Dingl. Polyt. J.* 272, 128—141.

Investigation of Sugar in Aqueous Solution.—In connexion with his previous investigations on the influence of dilution in the testing of aqueous sugar solutions (see this Journal, 1888, 591), Pareus points out that the following method of procedure is necessary:—10 grms. of sugar are dissolved in water, made up to 50 cc. and filtered. 25 cc. of the filtrate are run into 50 cc. of boiling Soddani solution, heated for five minutes and filtered. Should clarification with lead acetate be found necessary, 20 grms. of the substance are dissolved in water, lead acetate added, the solution made up to 50 cc. and filtered, 25 cc. being transferred to a 50 cc. flask, the lead precipitated with sodium carbonate, the liquid made up to 50 cc. and filtered again, 25 cc. of the filtrate being used as above for the purposes of testing. Pareus points out that (in contradistinction to what takes place with Fehling solution) alkaline sugars almost always, under these circumstances, cause a turbidity on being boiled; this turbidity being due to the lime which is not completely precipitated by the sodium salts. It is therefore necessary to filter the solution after boiling, before any conclusion as to the precipitation of cuprous oxide can be arrived at.

Investigations on the Structure and Development of the Beet-root Nematoids (Heterodera Schachtii).—A. Strubell has observed that the eggs of the nematoids are killed in a short time in a mixture of glycerol and water, in a 3 per cent. salt solution, and in a weak picric acid and chromic acid solution. The nematoids themselves were able to exist in a 3 per cent. solution, but died off after two days in a 5 per cent. solution. Willot has also made the latter observation, and believes that it might be employed for the destruction of these parasites. The use of such a strong salt solution will probably be found objectionable from an agricultural point of view, and Strubell's observations on the destruction of the eggs may be found to possess more practical importance.

Lixivation of Mud in Beet-root Sugar Works.—Since Lippmann has shown that the polarising substance contained in the last washings from the mud of the beet-root sugar manufacture consisted of the more highly polarising substance galactose and not of sugar, the question has arisen whether after all it is right to lixiviate the mud as completely as possible. For this purpose A. Herzfeld has examined two samples of mud from a Silesian factory, one lixiviated the other not, and it appears that as the quantities of active non-sugars present in muds of this character are not worth mentioning, lixiviation should be carried out as far as possible.

Influence of the Alcohol Method in the selection of Beet-roots.—The wide distribution of raffinose in the products of sugar manufacture is now well known, and as the detection of raffinose in presence of sugar is impossible by means of the alcohol method, the question has very naturally arisen whether the selection of beet-roots for seed by this alcohol method, giving high polarisation results, has not unintentionally led to the excessive accumulation of raffinose in the descendants. A. Herzfeld has carried out experiments on the subject, and in the cases he has investigated he has found that the selection of beet-roots for seed purposes by the alcohol polarisation method did not tend towards the accumulation of raffinose. This is not, however, intended to indicate that raffinose, or at any rate polarising non-sugars, were totally absent.

Raffinose a Natural Constituent of Beet-roots.—It has been variously asserted that the presence of raffinose in sugar is due, in certain methods of sugar manufacture, to the employment of a large excess of alkaline earths, which are said to cause its production from other compounds. In connexion with this subject, v. Lippmann has been continuing his investigations on raffinose, and has succeeded in obtaining raffinose in appreciable quantity from beet-sugar prepared by the osmosis method, a method therefore in which neither lime nor strontia are employed. It consequently seems to be no longer doubtful that raffinose is a natural constituent of beet-roots, though of course it cannot be asserted that it occurs in all beet-roots or that the amount in them is invariably the same.

Sugar Candy Manufacture. J. Bock.—The crude sugar employed should be as good as possible. This is melted, filtered through large quantities of bone-black, and then subjected to a preliminary concentration in vacuo. Since the specific gravity cannot be determined in the vacuum pans, either directly or by means of the boiling point, as the latter is subject to considerable fluctuations, the last portions of water are usually driven off in open pans with double bottoms and provided with direct steam coils. By this means the right degree of concentration, which is very important in candy manufacture, can be accurately determined. The boiling point lies between 112°—115° C. The solution is then run into the candy pots by means of a receiver. These pots are usually conical copper vessels. The threads on which the candy is to crystallise are either attached to copper or iron frames, or else they traverse the pots and are threaded through holes in the pots which are separately closed with clay, or the whole of the outside of the pots is pasted over with paper.

The pots are placed in stoves, and should be filled up as quickly as possible to prevent their cooling before the stoves are closed. The solution in the pots is sufficiently hot to raise the temperature of the stove to the proper point. After 8—10 days the stoves have cooled down to 35°—30° C. They are then opened, the pots removed, the thin crystalline crust on the top broken through, and the mother-liquor poured off the crystals through sieves.

Some pots are made large enough to hold one brew, in which case they are fixed in the stove and the mother-liquor is let off through a valve at the bottom. To prevent crystallisation on the sides as far as possible, the pots are washed thoroughly clean, but are not scoured bright, as the radiation from the bright parts is too rapid. The candy crystals are next washed with luke-warm water, dried, sorted and packed; 48—52 per cent. of the sugar is thus obtained as candy. The mother-liquor is usually worked up into other forms of refined sugar. It can, however, be employed again for candy manufacture three or four times, according to the quality of the crude sugar used. Of course the impurities of the sugar accumulate in it. The chief impurity of colonial sugar is invert sugar; the chief impurities of beetroot sugars are the salts contained in them. Sugars containing difficultly soluble salts (the principal one is potassium sulphate) should be avoided, as they go down with the candy and give it a salty taste; the more soluble salts do not matter. As much crude sugar as dissolved in the mother-liquor as has crystallised out as candy, a little water being added. The solution is then concentrated and treated as described above. However, even when almost pure sugar is used, there is a limit to the re-employment of

the mother-liquor, as a portion of the sugar always loses its power of crystallisation through heating. This influence is very clearly marked by the crystals becoming smaller and insignificant.—F. W. T. K.

Diffusion Experiments. Herzfeld. Zeit. f. Zucker. Ind. **39**, 304.

In the extraction of beet by diffusion a considerable quantity of salts passes into the syrup along with the sugar. Solid organic and inorganic constituents of the marc also dissolve in quantity which increases with the duration of heating, the number of vessels heated, and the slower circulation of the syrup. With thick sections the battery must be longer and the number of heated vessels must be increased in order to effect complete extraction. It follows that the resulting syrup will be richer in ash. An increase of temperature to 65°–85° in the middle of the battery is not so injurious as might be expected. Feebly ammoniacal water may be used with advantage.—C. H. B.

PATENTS.

Improvements in the Acid Saccharification of Amylaceous Substances. A. H. J. Bergé, Brussels, Belgium. Eng. Pat. 9320, June 26, 1888. 8d.

THE author finds that for a given temperature, duration of process and quantity of acid, the saccharifying action of acids on starch bodies becomes more rapid and complete in proportion as the pressure is increased. This principle is practically applied in the saccharification of starch by sulphurous acid. The operation is conducted in closed vessels, and the requisite pressure is obtained by forcing in carbonic acid, nitrogen, or some other non-oxidising gas.

—A. J. K.

Process for Manufacturing Colourless Maltose Syrup. O. Leuz, Berlin, Germany. Eng. Pat. 76, January 2, 1889. 4d.

THE saccharification of pure potato-starch or rice-starch is effected by a malt extract at a temperature of about 50° C. and under a pressure of three to four atmospheres. The temperature is then raised to 70° C. for the purpose of eliminating most of the vegetable albumen. After some time the solution of maltose, which is now of a brown colour, is filtered from the precipitated albumen and boiled to precipitate the remainder of the albumen. The juice is filtered again, first through fine cloth, then through bone-black. A clear limpid juice is obtained, which is evaporated to 25° B., filtered again through bone-black, and finally through fine cloth. The final syrup has a pure sweet taste and is colourless and odourless.—A. J. K.

A Novel Method or Process for the Manufacture of Gluten and Starch. H. Barker, Somerville, Mass., U.S.A. Eng. Pat. 4741, March 19, 1889. 8d.

THE cereal, preferably wheat, is pulverised to the form of a flour, and the flour is mixed with water to a semi-fluid or pasty mass. The paste is then forced through a perforated plate and the depending bars or threads are cut by a special appliance into short lengths and dropped into a vessel containing water. After agitation for some time the gluten settles to the bottom of this vessel, and the starch remaining in suspension is drawn off from the top of the tank with the water, into large settling vessels, in which the starch is separated by subsidence.—A. J. K.

XVII.—BREWING, WINES, SPIRITS, Etc.

Effect of Carbon Dioxide on the Growth and Activity of Yeast. G. Foth. Woch. f. Brauerei. **6**, 263.

THE presence of carbon dioxide in wort, whether under ordinary or increased pressure, retards fermentation to a considerable extent. This effect increases with the quantity of gas dissolved in the liquid, and consequently with a reduction of temperature or an increase of pressure. Different species of yeast are affected in different degrees; *Saccharomyces pastorianus*, for example, will grow in presence of a quantity of carbon dioxide sufficient to prevent the action of other species.

These facts have considerable bearing on the preservation of beer. Saturation with carbon dioxide causes more complete settling of the yeast, and a further development of it, and hence the beer can be obtained quite clear. The quantity of gas necessary varies with the strength of the wort and the species of the yeast. It must be borne in mind that the presence of carbon dioxide may affect the taste of the beer, especially in the case of full-flavoured varieties.

—C. H. B.

Combination of Malt with Water. W. Schulze. Chem. Zeit. Rep. **13**, 126–127.

WHEN malt is moistened with water, it combines with part of the latter, and this combination is the cause of the well-known development of heat. When the moistened malt is mashed there is a further development of heat. The combined water partly passes into solution in the wort and partly remains behind in the grains. The usual assumption that the specific gravity of malt is 1.333, and its specific volume 0.75, is inaccurate; the specific volume of the malt used by the author was 0.6877. The proportion method commonly used for the estimation of extractive matter gives results which are always more than one per cent. too high, but if a correction be made for the water which enters into combination, the results are more accurate. An approximate correction may be made by subtracting 1.2 from the percentage of extractive matter as usually determined in this way. The sum of the true volumes of the wort and grains is equal to the sum of the true volumes of the malt and water before mashing.

—C. H. B.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A)—CHEMISTRY OF FOOD.

Alcoholic Fermentation of Milk. Martinand. Compt. Rend. **108**, 1067–1069.

THE author finds that coagulation of the casein takes place under certain conditions when the alcoholic fermentation is excited in milk or milk and water by any of the following ferments: — *Saccharomyces cerevisiae*, *S. ellipsoideus*, *S. pastorianus*, *S. apiculatus*, and Duclaux yeast, and this whether the added sugar be glucose or sucrose; with the exception of *S. apiculatus* in a solution of sucrose the coagulation is not due to acid products of fermentation, for the fermented liquids, passed through a Chamberland filter, are incapable of coagulating the smallest quantity of fresh milk. To produce the coagulation there must be a sufficient proportion of fermentable sugar present.—J. M. H. M.

PATENT.

Improvements in the Manufacture of Seed Cake or Cattle-Food from Cotton Seed. R. S. Baxter and G. D. MacDougall, Dundee. Eng. Pat. 15,813, November 2, 1888. 6d.

THE cotton fibres with which many varieties of cotton seeds are ordinarily covered, render cake made from such seeds unsuitable for cattle food, if the fibres be present therein in their natural condition. The improved process consists in first moistening the cotton seeds with dilute sulphuric acid, heating or drying and finally removing soluble matters by washing. By this means the cotton fibres are rendered innocuous.—A. J. K.

(C)—DISINFECTANTS.

Antiseptic Properties of Hydroxylamine. G. Marpmann. Pharm. Centr. N.F. 10, 245.

HYDROXYLAMINE is a very powerful antiseptic. One part in 5,000 prevents fermentation even in a liquid rich in organic matter and containing readily fermentable substances. One part in 30,000 prevents the development of germs in cultivation-gelatin.—C. H. B.

XIX.—PAPER, PASTEBOARD, Etc.

PATENTS.

Improvements in the Manufacture or Treatment of Paper. C. Morfit, London. Eng. Pat. 8148, June 19, 1886 (Amended Specification.) 6d.

THESE have already been described in this Journal, 1887, 558. The inventor now restricts himself to the use of Irish Moss or Agar-Agar, while the description of the improvements is modified.—O. H.

Improvements in Machinery or Apparatus for Treating, Washing, Cleansing, Discharging, Bleaching, Drying, and Softening Fibrous and Textile Materials. E. Brasier, New Cross. Eng. Pat. 6570, May 2, 1888. 8d.

THE improvement consists in causing a carriage furnished with rollers to travel to and fro along a vessel, at the bottom of which the material to be treated is placed. When intended for drying the rollers may be heated. Suitable arrangements are supplied for filling the tank with water or other liquid.—E. J. B.

Improvements Connected with the Carbonising of Woollen, Silk, and other Rays and Fibrous Materials. G. Solson, Dewsbury. Eng. Pat. 8931, June 19, 1888. 8d.

THE inventor introduces improvements upon his original invention of a carbonising machine (Eng. Pat. 6254 of 1887). They consist chiefly in the addition of a fan for drying the material before carbonisation in order to prevent the condensation of moisture upon the material to be treated.—E. J. B.

Improvements in Preparing Pulp for Paper-Making Machines and in Apparatus therefor. J. H. Annandale, Polton. Eng. Pat. 9106, June 22, 1888. 11d.

ESPARTO or other fibrous material boiled in the usual way is conveyed to an improved breaking engine where it is made into half-stuff. It then passes through a box to the save-all, from thence to a vessel where it meets with a stream of hot water, and into one or other of a set of improved bleaching vessels. The bleached material passes through a box on to a coarse strainer, sand tables, a fine strainer, and then through another box into the save-all. From this it falls into trucks. The bleached half-stuff is conveyed by the

trucks to a vessel similar in construction to the bleaching vessel. Here it is mixed with rosin size. It then passes through a beater similar to the breaking engine, thence to the chest, where the starch, clay and alum are added. The pulp is now ready to be made into paper in the usual way.

—E. J. B.

Improved Papers and Methods of Manufacturing the same. L. G. Danielson, Nygvarn, Sweden. Eng. Pat. 9321, June 26, 1888. 6d.

THE improved paper consists of two sheets, one sized and the other unsized, joined together. One vat contains sized pulp and another vat contains the unsized pulp. The two sheets are made on cylinders, and are united together in the usual way on a press blanket, as they pass under a roller. The sheet is then carried forward to the drying cylinders in the usual way.—E. J. B.

Improvements in Paper-Making Machines. J. H. Annandale, Polton. Eng. Pat. 9942, July 9, 1888. 8d.

THE object of this invention is to produce a jogging or slight but rapid up-and-down motion of the wire cloth, in addition to the horizontal motion usually imparted to it. For details the original specification must be consulted.

—E. J. B.

Improved Apparatus for the Treatment of Rhea or China Grass and other Vegetable Fibrous Matters. W. Hitchcock-Spencer, Hitchin. Eng. Pat. 10,633, July 23, 1888. 8d.

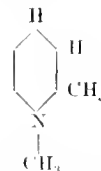
THE apparatus consists of a keir made of boiler plate and capable of withstanding steam pressure. The material to be treated is packed in cages covered with wire cloth, and so arranged that after treatment their sides can be forced inwards so as to exert a pressure on the material and express the liquor contained in it. These cages are rotated on a shaft which is connected by means of a clutch with a driving shaft. The keir is provided with suitable means for heating and for the supply of the necessary liquids for treating the material.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Conversion of Anhydro-ecgonine into Pyridine.

A. Einhorn. Ber. 22, 1362—1368.

REFERRING to his previous investigations, the author proves the relationship which exists between anhydro-ecgonine and pyridine. By heating anhydro-ecgonine and hydrochloric acid in a closed tube to 270°—280° C., he obtains a number of different products. The contents of 12 tubes were first distilled over with steam in order to separate the neutral bodies, mostly hydrocarbons. By making the solution alkaline, the smell of ammonia, methylamine, and pyridine bases were at once noticeable. By means of nitroso compounds he is able to separate a secondary and tertiary base. The secondary base forms a gold double salt which yields pyridine on distillation with zinc-dust. The tertiary compound, probably a tetrahydrated- α -picoline with a methyl radical linked to the nitrogen atom, expressed by the formula:—



By distilling larger quantities of anhydro-ecgonine with zinc-dust hydrocarbons and also pyridine are obtained, besides

an oily base. Pyridine is identified by means of gold double salt. The author concludes that the conversion of anhydrococcine into pyridine shows clearly that cocaine is a pyridine derivative. His researches enable him to place the different atoms in the cocaine molecule and therefore the task of finding the constitution of cocaine can be considered as solved.—O. J. S.

The Conversion of Coumarin Derivatives into Quinoline Derivatives. W. v. Muller and Fr. Kinklein. Ber. **22**, 1716—1718.

In a brief communication the authors describe the conversion of nitromethoxybenzylidene aldehyde into α -nitroquinoline by means of alcoholic ammonia. In order to determine whether the original product employed was a derivative of coumaric acid or coumarin it was oxidised with freshly prepared oxide of silver in alcoholic solution and yielded the monomethylether of nitro- α -coumaric acid, which was found to be identical with a compound prepared by "Perkins' reaction."

—O. J. S.

The Manufacture of Lemon Essences in Sicily.

"The Times," August 20, 1889, 7.

THE United States Consul at Messina, in a report on the cultivation of oranges and lemons in Sicily, describes the mode of manufacturing lemon essences. With three strokes of a sharp knife the cutter peels the lemon lengthwise and lets the peel fall into a tub under the chopping block. He then cuts the lemon in two and throws it from his knife into a bucket. He works with wonderful rapidity, and fills from 10 to 12 tubs with peel a day, and is paid 2½d. a tub, weighing 77 lb. His left hand and right index finger are protected with bands of leather. The fresh peel is soaked in water 15 minutes before the essence is extracted. Peel that has stood a day or two remains soaking from 30 to 40 minutes that it may swell and offer a greater resistance to the sponge. The workman holds a small sponge in his left hand, against which he presses each piece of peel two or three times—simple pressure, followed by rotary pressure. The women employed in this work run a piece of cane through their sponges to enable them to hold them more firmly. The outside of the peel is pressed against the sponge, as the oil glands are in the epicarp. The crushing of the oil cells liberates the essence therein contained. The sponge, when saturated with the essence, is squeezed into an earthen vessel held in the lap. The peel is so thoroughly pressed that not a single cell escapes. This is ascertained by holding the pressed peel to the flame of a candle; should it neither crackle nor diminish the brilliancy of the flame the cells are empty. This process yields, besides the essence, a small quantity of juice and fecia (dregs). The separation of the essence juice and fecia soon takes place if the vessels are not disturbed; the oil floats on the juice and the dregs fall to the bottom. These three products derived from the peel have no affinity with each other. As the essence rises to the surface it is skimmed off, bottled, and left to settle for a few days. It is then drawn off with a glass siphon into copper cans, which are hermetically sealed. After the essence has been expressed, a small quantity of juice is pressed from the peels, which are then given to oxen or goats, or thrown on the manure heap and well rotted, or they would make too heating a fertiliser. The yield of essence is variable. The industry is carried on five months in the year. Immature fruit contains the most oil. From November to April, in the province of Messina, 1,000 lemons yield about 14 oz. of essence and 17 gallons of juice. The essence is so valuable that the workmen are closely watched, for they are most ingenious in secreting it about their persons. Six men work up 8,000 lemons a day; two cut off the peel, while four extract the essence and obtain 136 gallons of lemon juice and 7 lb. of essence. Dealers sometimes adulterate their essences with fixed oils, alcohol, or turpentine, but these mixtures may be easily detected. The essence of sour orange mixed with the essence of lemon produces an aroma similar to that of the essences of bergamot.

Terpenes and Etheral Oils. O. Wallach. Ann. **252**, 91—105.

LAURENE and menthene, hydrocarbons occurring in oil of laurel and oil of peppermint, have been investigated by Brühl (Ber. **21**, 115) who, from a study of their physical properties, came to the conclusion that these compounds differed from all other known terpenes, but whether they were identical or not could not at the time be ascertained. They both boil at 173°—175°, and in this respect closely resemble citrene, dipentene, and isoprene, which are terpenes having the saturation formula $C_{10}H_{16}E_2$. As, however, they contain only one double link they do not belong to this class of compounds, and they also differ from the pinenes having the saturation formula $C_{10}H_{16}E_1$.

The author's investigations prove that laurene, and probably also menthene, have no existence, as is shown by the following experiments. Oil of laurel, obtained from the leaves, was carefully fractionated and separated into a portion boiling above, and a portion boiling below 180°. The latter was again repeatedly refractionated and separated into a small portion, boiling at 158°—168°, and three much larger fractions boiling between 170° and 178°, the lowest of which was found to contain oxygen. The fraction 158°—168° was treated with amylnitrite and hydrochloric acid and the resulting nitrosochloride, which melted at 101°—102°, decomposed with piperidine. A nitrosoamine melting at 118° was obtained, a result which proves that oil of laurel contains small quantities of pinene. The three fractions boiling at 170°—178° were mixed together, diluted with light petroleum, and hydrogen bromide passed into the solution, whereon a large quantity of a colourless compound was precipitated. The precipitate was separated by filtration, pressed, decomposed with alkali and the resulting oil fractionated. The portion boiling at 176° solidified when cooled in a freezing mixture and was proved to be cineol. Pure cineol can be easily isolated from oil of laurel by this method.

Oil of laurel, obtained from the berries, was investigated in a similar manner. It yielded a small quantity of a compound boiling at 161°—166°, which was proved to be pinene, and a larger quantity boiling at 171°—177°, which was proved to be cineol.

These results show that even the lower boiling fractions of oil of laurel consist principally of a mixture of pinene and cineol, the latter being present in by far the larger quantity. Laurene has, therefore, no existence, and the peculiar properties which were assigned to it by Brühl were due to the presence of cineol in the substance investigated.

Oil of Olibanum.—Stenhouse (Ann. **35**, 306) and Kurbatov (Ann. **173**, 1) investigated oil of olibanum and have described a terpene, olibene, which they obtained therefrom. This terpene is identical with levo-pinene. A sample of crude oil of olibanum was separated by fractional distillation into two principal portions boiling at 157°—160° and 160°—165° respectively. Both fractions were feebly levo-rotatory and were proved to contain levo-pinene. Another fraction boiling at 177°—179° was found to contain small quantities of dipentene.

Oil of Elemi, as the author has previously shown (Ann. **246**, 233), contains a considerable quantity of dextro-phellandrene which occurs in the fraction boiling below 176°. This hydrocarbon is identical with that obtained from fennel oil and from *Phellandrium aquaticum*. The fraction 175°—180° contains such a large quantity of dipentene that oil of elemi can be very conveniently employed for the preparation of dipentene compounds. Deville (Ann. **71**, 353) investigated a sample of oil of elemi which he found to be strongly levo-rotatory; this oil probably contained, besides dipentene, a levo-phellandrene identical with that recently found by the author in the so-called Australian eucalyptus-oil. (Compare Ann. **246**, 232.) Besides phellandrene and dipentene, oil of elemi contains large quantities of higher-boiling products, consisting of polyterpenes and probably also of compounds containing oxygen. In fractionating the oil the presence of a crystalline compound was repeatedly observed; this substance is probably closely related to the amyrin investigated by Vesterberg (Ber. **20**, 1212). A sample of Brazilian resin which the author

examined contained such a large quantity of amyrin that crystals of this compound could be obtained by recrystallising once from ethyl acetate.

Oil of Sage.—The investigations of Tilden (Ber. **11**, 1264, and **13**, 2088) and the author (Ann. **227**, 289) have already proved that the lower boiling portions of oil of sage contain a hydrocarbon similar to pinene. A sample of the oil was submitted to fractional distillation, the portion boiling at 158° — 168° , which formed only a small quantity of the whole, was almost optically inactive and contained large quantities of pinene. The fraction 174° — 178° consisted principally of cineol. The lower boiling constituents of oil of sage are, therefore, principally pinene and cineol, but the principal portion of the oil consists of oil of salvi, boiling at 201° — 204° , which will be further investigated.

Oil of Mace.—A sample of crude oil of mace which was strongly dextro-rotatory was submitted to fractional distillation. The lower boiling (up to 165°) fractions, which form a considerable portion of the whole, were almost optically inactive, and contained considerable quantities of pinene. As the higher boiling portions were strongly dextro-rotatory it is probable that both dextro- and levo-pinene are present in the lower boiling fractions, as will be shown in a future paper. The fraction boiling at 175° — 180° contained dipentene.—F. S. K.

Analysis of Cinchonas and Solubility of their Active Principles in Water, Alcohol and Dilute Hydrochloric Acid. E. Landrin. Compt. Rend. **108**, 750—753.

See under XXIII., page 641.

Ammonium Bromide. K. Thümmel. Arch. Pharm. 1889, **27**, 270. (Compare this Journal, 1889, 210.)

THE yellow colouration developed by acidifying ammonia to which bromine has been added is not due to the presence of an ammonium salt of an oxyacid of bromine, but to the formation of a bromide of ammonium bromide, $\text{NH}_4\text{Br} \cdot x\text{Br}$. If care is taken to keep the ammonia in excess the solution remains colourless when acidified, and the yellow colouration is only obtained when the ammonia has been almost completely neutralised with bromine. When a solution of this kind is allowed to stand, evolution of nitrogen takes place, and when this has ceased the liquid no longer gives a colouration with acids.

In order to obtain ammonium bromide which remains colourless when acidified, an excess of ammonia must be used, and the solution should be allowed to remain for some time before crystallisation.—C. H. B.

Camphor-Phenols. M. Desèsquelle. Rep. de Pharm. **45**, 202.

Fifty grms. of β -naphthol or 150 grms. of salol, as the case may be, and 100 grms. of camphor are finely powdered, mixed together, heated until completely fused, filtered, and preserved in well-closed vessels. The products thus obtained are insoluble in water, but are readily miscible with fats, essential oils, ether, and alcohol. They attack neither wood nor metal, and hence are especially suitable for preserving surgical instruments.

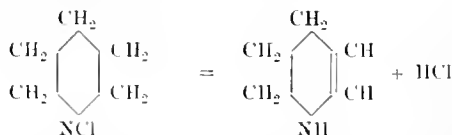
The camphor-phenols readily take up iodine in the cold, a common formula being "camphor-phenol" 90 parts, iodine 10 parts. They also readily dissolve cocaine hydrochloride and the cinchona alkaloids.—C. H. B.

Terpin Hydrate. G. Vulpius. Pharm. Centr. N. F. **10**, 289.

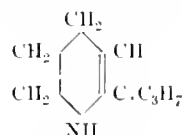
TERPIN hydrate, $\text{C}_{10}\text{H}_{16} \cdot 3\text{H}_2\text{O}$ melts at 116° , whilst terpin, $\text{C}_{10}\text{H}_{16} \cdot 2\text{H}_2\text{O}$ melts at 102° . Terpin hydrate dissolves at 15° in 250 parts of water, 10 parts of 90 per cent. alcohol, 100 parts of ether, or 200 parts of chloroform. A completely odourless product is difficult to obtain, and is best prepared by exposing the dried and powdered substance to the air until it has lost all odour, and then recrystallising it from hot alcohol.—C. H. B.

Coniceine. E. Lellmann. Ber. **22**, 1,000—1,004.

PIPERIDINE, as the author has shown, yields with hypochlorite of lime a chlorinated piperidine. With potash it decomposes, yielding a new base, and hydrochloric acid is split off as follows:—

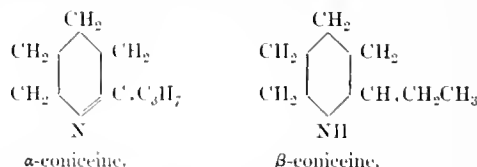


This new base exists only in the form of vapour. At the ordinary temperature it polymerises, forming a dipiperidine, which crystallises readily. The author has experimented in the same direction upon α -methylpiperidine and coneine. Both compounds, on boiling with a solution of bleaching powder, yield colourless oils and give compounds analogous to piperidine. Potash splits off hydrochloric acid, and forms, in the case of coneine, a base *coniceine*, boiling at 171° , and having the formula $\text{C}_8\text{H}_{15}\text{N}$. It is a secondary amine, and as it does not polymerise, it has probably the formula—



The compound appears to be identical with Hofmann's α -coniceine, obtained by the action of bromine and potash on conine.

From these considerations, and from the fact that neither α - or β -coniceine have double molecules, it follows that they will probably have the following constitution—



in which case they contain an asymmetric carbon atom, and should possess active properties.—J. B. C.

On β -Ethyl- α -Stilbazol and some of its Derivatives. G. Plath. Ber. **22**, 1057—1063.

REFERRING to his investigations on the subject (Ber. **21**, 3086) on the action of benzaldehyde on aldehyde collidine, he obtains by reduction of this body, thus produced, by means of hydriodic acid or by Ladenburg's method (sodium and absolute alcohol) the compound $\text{C}_{13}\text{H}_{15}\text{N}$, or β -ethyl- α -stilbazoline.

The salts of this base do not crystallise well. The hydrochloride, platino-chloride, and gold chloride salts were prepared. The physiological properties of base are similar to those of the ethyl compound. Experiments made by Professor Falk gave the following results. The effects of α -ethylstilbazoline hydrochloride are very much the same as those of stilbazoline, for which latter 96.14 mgr. (taking 1,000 grms. of white mouse as a unit) are the deadly dose, whereas 100.4 of ethyl compound produce the same effect. It also causes violent cramps if injected even in not deadly doses. He further forms additional substitution products, dissolving the double linkage by addition of bromine, and also forming the diacetyl compound. On oxidation, the body yields isocinchomeronic and benzoic acids (Ber. **21**, 294).—O. J. S.

On Morphine. L. Knorr. Ber. **22**, 1113—1119.

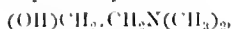
CONTINUING his researches on the subject (Ber. **22**, 181, this Journal, 1889, 305; see also 1889, 475—476) he investigates the action of acetic anhydride on methylmorphimethine,

which seems to explain the position of two still doubtful carbon atoms and the indifferent oxygen atom in morphine. Besides yielding dimethylamine, the treatment of methylmorphimethine yields—

(1.) Acetyl-methylhydroxyphenanthrene (m.p. 131 described by O. Fischer and A. Gerichten).

(2.) An oily base which could be analysed by means of methyl iodide compound, and was found to be methylmorphimethine, which had not been attacked by the acetic anhydride.

(3.) β -hydroxyethyl-dimethylamine—



the link between methylamine and choline (Ladenburg's) dimethylethylamine (Ber. 14, 2108).

The author draws the following conclusions from these facts, which are of importance for the formula of morphine:

(1.) Morphine is a tertiary base.

(2.) It has a methyl group united with nitrogen.

(3.) In methylmorphimethine two methyl groups are united with nitrogen and the conversion of codeine into methylmorphimethine can only be explained by the splitting up of one nucleus, containing the morphine nitrogen as a link.

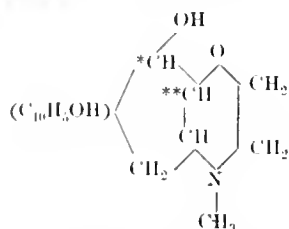
(4.) This seems to be confirmed by the fact that methylmorphimethine can combine with five more bromine atoms than codeine.

(5.) Morphine contains one phenanthrene nucleus, which must be partly reduced considering the high percentage of hydrogen in morphine.

(6.) Methylmorphimethine splits up into β -hydroxyethyl-dimethylamine and a phenanthrene derivative.

(7.) Morphine contains one phenol-hydroxyl, one alcohol hydroxyl, and one indifferent oxygen atom, probably in connexion with an ethereal compound.

(8.) The alcohol hydroxyl reserves its character in methylmorphimethine and only appears as a phenol-hydroxyl after the decomposition into the acetyl compound. He therefore proposes this formula:—



It remains undecided whether the alcohol-hydroxyl is connected with carbon atom * or **.—O. J. S.

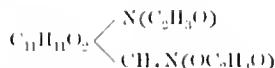
On the Constitution of Ecgonine. C. Stöck. Ber. 22, 1126—1129.

THE author points out the importance of investigations on cocaine since it has become a valuable local anæsthetic. Most of recent researches were made on the relation which exists between cocaine and its decomposition product ecgonine. He continues the work commenced by Merck (Ber. 19, 3002, this Journal, 1887, 225), and confirms the idea that ecgonine, like most alkaloids, belongs to the derivatives of pyridine, and stands in near connexion to tropine, the decomposition product of atropine. By means of distillation with zinc dust and lime, he obtains α -ethyl pyridine, the same pyridine base which, according to Ladenburg (Ber. 20, 1647, this Journal, 1887, 487), bears a close relation to tropine. The distillation also yields hydrogen, water, methylamine, and carbonate of ammonia, which were identified as the platinum double salts. The distillate which separates into an oily and aqueous layer, yields, on further purification of the oil by means of KMnO_4 and redistillation, α -ethyl pyridine. The platinum-chloride crystallises in large prismatic tablets, which melt at 160° — 161° C.

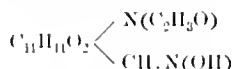
—O. J. S.

Hydrastine. M. Freund. Ber. 22, 1156—1160. (This Journal 1889, 412; and 1887, 381, 449 and 611.)

DIACETYLHYDRASTINE-OXIME is formed by the action of acetic anhydride on hydrastine-oxime; much heat is evolved during the reaction. It separates in beautiful crystalline plates melting at 121 — 122° C., and soluble in hydrochloric acid, reprecipitated by caustic soda. Its constitutional formula is—



By saponification with caustic soda, one of the acetyl groups is removed. The new body crystallises with two molecules of water and melts at 90° C. The water is driven off at 100° C. The dry compound melts at 139 — 140° C. Its formula is—



By the continued oxidation of hydrastine in alkaline solution with potassium permanganate, hydrastinic acid is obtained. The acid is difficultly soluble in cold water, easily in hot water, from which it crystallises in splendid white broad needles, melting at 164° C. It is also soluble in alcohol and ether, scarcely soluble in chloroform. It is formed from hydrastine without the separation of carbon. It is mono-basic and its formula is $\text{C}_{11}\text{H}_{11}\text{NO}_5$. Its aqueous solution neutralised with ammonia gives no precipitate with solutions of silver or lead. Hydrastinic acid melts with evolution of carbonic acid. The melted residue dissolves almost completely in boiling alcohol, a small quantity being left which melts at 260° C. The solution deposits crystals melting at 215° C. The crystals are insoluble in sodium carbonate, but dissolve in sodium hydrate solution from which they are reprecipitated by hydrochloric acid. Hydrastinic acid, boiled with very dilute nitric acid, yields a beautifully crystalline substance melting at 230° C.—H. T. P.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Yellow Stains in Gelatin Negatives. A. Lainer. Phot. Corr. 26, 171—175.

THE yellow stain frequently observed in gelatin negatives which have been developed with alkaline pyrogallol may be due to one of three causes:—(1) Decomposition of the insoluble sodium silver thiosulphate, $\text{Ag}_2\text{S}_2\text{O}_3 \cdot \text{Na}_2\text{S}_2\text{O}_3$, left in the film, owing to imperfect fixing; (2) the action of the carbon dioxide of the air on the soluble sodium silver thiosulphate, $\text{Ag}_2\text{S}_2\text{O}_3 \cdot 2\text{Na}_2\text{S}_2\text{O}_3$, left in the film owing to imperfect washing; and (3) the combination of the gelatin with brown products of the oxidation of the pyrogallol. In the first two cases silver sulphide is formed and cannot be readily removed, but its formation is prevented by using a sufficient quantity of thiosulphate to ensure formation of the soluble double salt, and then taking care that all the latter is removed from the film by thorough washing. The brown stain due to the products of oxidation of pyrogallol may be removed in the usual way by treatment with an acidified solution of alum, or, more conveniently, by using an acid fixing bath prepared by adding to the solution of sodium thiosulphate a quantity of a solution of sodium sulphite previously acidified with citric or tartaric acid. The fixing bath then contains free sulphurous acid. The proportion of acid to sulphite must be carefully regulated, otherwise the thiosulphate will be partly decomposed and

sulphur will separate. One litre of thiosulphate solution may be mixed with 70 cc. of a solution of normal sodium sulphite in 4 parts of water, previously acidified with 30 cc. of a solution of tartaric acid in 2 parts of water, or 40 cc. of a similar solution of citric acid. It is advisable to use the fixing bath as fresh as possible.—C. H. B.

Prints on Boxwood. Phot. Archiv. 30, 102.

THE surface of the wood is rubbed with a filtered solution of 8 grms. of white soap and 8 grms. of gelatin in 500 cc. of water to which some zinc oxide has been added. After drying, the surface is brushed over with a mixture of clarified albumen 30 grms., water 24 cc., ammonium chloride 1.2 grms., and citric acid 0.2 grms. It is then dried, flooded with a solution of 3.2 grms. of silver nitrate in 31 cc. of distilled water, the excess poured off, and the surface again dried. After printing under a negative in the usual way, the surface of the wood is immersed in a solution of sodium chloride and then in a solution of sodium thiosulphate, in order to remove unaltered silver salts.—C. H. B.

Application of Photography to the Measurement of Expansion. Le Chatelier. La Nature, 1888, 35.

THE substance is employed in the form of rods, and the temperature is measured by means of a thermo-electric couple of platinum and platinum alloyed with rhodium. The rod is photographed in its actual size by means of two objectives, each of which is opposite an end of the rod, the distance between them being exactly the length of the rod. The method is very sensitive, since the negatives can be measured to 0.01 mm., and it has the advantage of being applicable at high temperatures.

The coefficient of expansion of Bayeux porcelain was found to be constant between 0° and 1000°, its value being 0.0000096.—C. H. B.

XXIII.—ANALYTICAL CHEMISTRY.

Notes on Lead in Water. C. Rawson. J. Soc. Dyers and Colourists, 5, 58—61.

THESE experiments were made to clear up some points connected with the presence of lead in the Bradford water supply. Contrary to the often-quoted statement of Fresenius, it is found that carbonate of lead is practically insoluble in pure distilled water, but if free carbonic acid be present, it will dissolve to the extent of 5 grains of lead per gallon. The test used for the presence of lead was sulphuretted hydrogen water acidified with acetic acid, which gives a colouration with less than one-twentieth of a grain of lead per gallon. Phosphate of lead is insoluble in water, but sulphate of lead, again, in contradiction to the statement of Fresenius, dissolves in distilled water to the extent of 1.75 grains of lead per gallon. Numerous experiments were made, by enclosing samples of water in old and new lead pipes for 24 hours, which pointed decisively to the conclusion that it is the free carbonic acid in waters which enable them to take up lead in transit through pipes, and this is especially the case with waters containing any considerable quantity of carbonic acid above that required to form bicarbonates of the bases present. The presence of neutral nitrates or of humic acid was without appreciable

effect. The results of adding reagents to a water containing much free carbonic acid showed that its solvent action on lead could be stopped by the addition of sodium carbonate, calcium hydrate, sodium phosphate, or calcium phosphate. On taking the practical aspects of a treatment of the water on the large scale, the author gives the preference to a treatment with phosphates, such as would be given by filtration through a bed of broken coprolites or bone-ash, which would remove any tendency of the water to dissolve lead. To remove traces of lead from solution in water, treatment with carbonates or phosphates will suffice, a very convenient and efficient means being filtration through a medium containing calcium phosphate, such as animal charcoal.

A series of dyeing experiments were made on wool with a few of the brighter coal-tar colours, with a view of ascertaining the effect of small quantities of lead in the water used. The colouring matters taken were the following:—Naphthol yellow, Tartrazin, Manchester yellow, Brilliant green, Safranin, Magenta, Rhodamine, and Night blue. The only natural colouring matter experimented upon was indigo, which was dyed in the form of indigo sulphonic acid. Some of these colouring matters were dyed in a neutral bath, and others with addition of sulphuric acid. The experiments were made in series of four. In the first place, the water used was free from lead; in the second, $\frac{1}{2}$ grain of lead per gallon was added; in the third, $\frac{2}{3}$ grain; and in the fourth, 1 grain per gallon. It was observed that wherever sulphuric acid was used in dyeing, the colour was not affected by lead, but shades dyed in a neutral bath were rendered duller in proportion to the amount of lead present in solution. Wool treated neutral and with acid, without addition of colouring matter, behaved in a similar manner. In a neutral bath containing lead, the wool was dyed a drab shade, but with addition of a small quantity of sulphuric acid ($2\frac{1}{2}$ per cent. on the weight of the wool), it remained white. In the case of Rhodamine, one of the brightest of all colouring matters, 5 per cent. of alum was used in the dye-bath, and the shade was almost, but not entirely, unaffected by the presence of lead. In the case of Night blue, the colour was dissolved in acetic acid, but the shade was affected in a similar manner to those dyed neutral. It is true that the amount of acetic acid present in the dye-bath would be exceedingly small, and the effect of a larger amount was not tried. The saddening effect is apparently caused by the sulphur naturally present in the wool combining with the lead, and forming sulphide of lead. But the formation of sulphide of lead on the fibre does not take place in the presence of sulphuric acid.—G. H. B.

Bradford Water: its Hardness and Action on Lead. T. Whitaker. J. Soc. Dyers and Colourists, 5, 61—69.

THIS paper contains an extended series of observations on the small variations in the character of the Bradford water supply, both high and low level, with especial reference to its action on lead. The hardness is usually about 3 grains per gallon, a small part of which is temporary, and the total solids amount to about 7 grains. The analytical results are set forth in numerous tables from which certain conclusions may be drawn. The tendency of the water to act on lead becomes greater as the amount of hardness present (especially temporary hardness) becomes less. The action of the water on lead seems to depend on the quantity of acid in the water, and this may be derived from peat or may be carbonic acid, but its action is diminished when the hardness is increased. Pipes corroded by the action of one water will give up lead to a water which does not by itself act upon lead. So-called composition lead piping was found to greatly increase the tendency of the water to act on lead, and is therefore unsuitable for water supply. The influence of pressure was to slightly retard the action on lead, whilst heating the water to boiling immensely increased the rapidity of the action. Exposure to air and carbonic acid during contact with lead increases the action of the water. Numerous experiments showed that the lead in water is

partially or wholly removable by simple filtration through inactive media, such as filter-paper, asbestos, cotton wool, or crushed flints. As a measure to be taken up in the case of a water having a tendency to act on lead, the author recommends admixture with a harder water and a filtration through a bed of flints and limestone or sand.—G. H. B.

On the Peroxides of Cobalt and Nickel, and the Volumetric Determination of those Metals. A. Carnot. *Compt. Rend.* **108**, 610–612.

THE results of the author's experiments show that the brown oxide obtained when cobalt is precipitated by hydrogen peroxide and boiling potash, has exactly the composition of a sesquioxide, Co_2O_3 , and that the black oxide of nickel, precipitated by an alkaline hypochlorite, or bromine and potash, corresponds exactly to the formula of the sesquioxide of nickel, Ni_2O_3 . On the other hand, the almost black oxide of cobalt, obtained when a hypochlorite, bromine, or iodine, is used, always contains a notably larger proportion of oxygen than corresponds to the sesquioxide. Instead of Co_2O_3 , for example, the trials gave at least $\text{Co}_2\text{O}_{3.25}$ with hypochlorite, $\text{Co}_2\text{O}_{3.25}$ with bromine, and $\text{Co}_2\text{O}_{3.25}$ with iodine. The composition of the precipitate given by hypochlorite corresponds to the formula $2\text{Co}_2\text{O}_3 \cdot 4\text{Co}_2\text{O}_3$; and that given by bromine or iodine to $2\text{Co}_2\text{O}_3 \cdot 3\text{Co}_2\text{O}_3$. The bearing of these results upon analytical estimations of cobalt is obvious.—E. G. C.

Separation of Nickel and Cobalt after Oxidation in Ammoniacal Solution. A. Carnot. *Compt. Rend.* **108**, 741–744.

HYDROGEN peroxide, added before or after saturation with ammonia, gives at first a brown colour, passing into purple-red, rose, or violet, according to the relative quantities of cobalt and nickel present. Excess of caustic potash precipitates from this solution oxide of nickel, contaminated with a little cobalt; by repeating the treatment the oxide of nickel may be obtained pure; the alkaline filtrate containing the rosecobaltic salt, deposits on boiling the cobalt in the form of sesquioxide. The formation of the rose-coloured solution is a sure index to the presence of cobalt.

—J. M. H. M.

On the Limits of Error in Assays of Fine Gold. P. Charpentier. *Compt. Rend.* **108**, 612–613.

THE accuracy of determinations of gold, by either the fire or humid assay, can generally be guaranteed to about $\frac{3}{10,000}$ if the precautions usually insisted on are followed by the assayer. The author has made 300 experimental assays of chemically pure gold (0.5 grm. being taken in each case), with the object of finding how the results are affected by neglect or observance of any one, several, or all of these precautions. The conclusions arrived at are appended. The silver employed contained $\frac{24}{1,000}$ of copper.

1. The heat of the muffle should have a special intensity, but, if the assay be conducted at much too high a temperature, there is a *loss* of gold varying from $\frac{15}{10,000}$ to $\frac{35}{10,000}$; average $\frac{24}{10,000}$. 2. If the assay be conducted at too low a temperature there is an *excess* varying from $\frac{5}{10,000}$ to $\frac{8}{10,000}$; average, $\frac{6}{10,000}$. 3. Employing the maximum proportion of lead, viz., 17 grms., there is a *loss* of $0 - \frac{3}{10,000}$; average, $\frac{2}{10,000}$. 4. Using a minimum of lead, 0.5 grm., the *excess* is $\frac{4}{10,000}$ to $\frac{8}{10,000}$; average, $\frac{6}{10,000}$. 5. With a great excess of silver, 5 grms. instead of 1.5 grms., the assay falls to powder. *Excess* of $\frac{6}{10,000} - \frac{15}{10,000}$; average, $\frac{10}{10,000}$. 6. With only 0.5 grm. of silver, the *excess* can equal the weight of gold assayed. 7. The button, on its return to the furnace, should be carefully annealed. If all annealing and flattening

be omitted the assay falls to powder. There is a *loss* of gold varying from 0 to $\frac{25}{10,000}$; average, $\frac{8}{10,000}$. 8. If the first annealing be effected, on the contrary, at a maximum temperature of about 1,200°, there is a *loss* of gold of from 0 to $\frac{10}{10,000}$; average, $\frac{3}{10,000}$. 9. If flattening be omitted the errors vary between $\frac{10}{10,000}$ *excess*, and $\frac{7}{10,000}$ *loss*. 10. When the assays are beaten as flat as possible "parting" is difficult and violent; *excess*, varying from 0 to $\frac{10}{10,000}$; average, $\frac{6}{10,000}$. 11. If the second annealing (after flattening) be omitted, the plates are very lustrous, and there is an *excess* varying from $\frac{12}{10,000}$ to $\frac{37}{10,000}$; average, $\frac{25}{10,000}$. 12. The assay, having been flattened and annealed, is bent in the fingers into a coiled cornet; and the author recommends that the cornet should not be too closely coiled. If, on the contrary, the plate is bent into a very tight coil there will be an *excess*, ranging from 0 to $\frac{10}{10,000}$; average, $\frac{1}{10,000}$. 13. The cornet is treated first of all with nitric acid at 22° B. and then with acid at 32°. If acid at 22° be used for the three digestions, there is an *excess*, ranging from $\frac{10}{10,000}$ to $\frac{20}{10,000}$; average, $\frac{13}{10,000}$. 14. If, on the other hand, 32° acid is employed for all three digestions, the *excess* of gold varies from 0 to $\frac{5}{10,000}$; average, $\frac{2}{10,000}$.—E. G. C.

The Electrolytic Separation of Cadmium from Zinc. E. F. Smith and L. K. Frankel. *J. Franklin Inst.* **98**, 154–155.

THIS separation has been effected by Yoer, who used the acetates, and confirmed by Smith and Knerr, who found that the current must be carefully regulated to obtain good results. The separation can also be effected from the tartrates. In the new method, solutions of the double cyanides were employed, it having been ascertained that a feeble current would suffice for the complete deposition of each metal, when alone in a cyanide solution in presence of excess of an alkaline cyanide. The cadmium separates more readily and with a weaker current than is necessary for the zinc, the latter not being deposited until the excess of cyanide has been completely decomposed. The excess of cyanide is such that, with the strength of current employed, the decomposition of the alkaline cyanide does not take place in less than 48 hours; and as all the cadmium is deposited in 23 hours, the complete separation of cadmium from zinc is effected. The strength of the current used was such that it would deposit 3 cc. oxy-hydrogen gas per minute.—E. T.

Estimation of Silicon in Ferro-Silicon. A. Ziegler. *Chem. Zeit.* **13**, 562.

THE pulverised ferro-silicon is evaporated to dryness with aqua regia (1 vol. of nitric acid, 3 vols. of hydrochloric acid, and 4 vols. of water) on a water-bath, the residue evaporated to dryness with dilute sulphuric acid (1 to 3), and heated on sand-bath until sulphuric fumes are evolved. It is then treated with water on the water-bath, filtered, washed with water containing 1 per cent. of hydrochloric acid and ignited in a platinum crucible. If the silica retains any iron it is treated with aqueous hydrofluoric acid and by deducting the residue the amount of pure silica is found.

—D. A. L.

Arsenic in Glycerin. G. Vulpius. *Apoth. Zeit.* **4**, 389.

JANUS (*Chem. Zeit. Rep.* **12**, 293) showed that arsenic is contained in commercial glycerin. This has been more recently amply confirmed. The author states that the manager of a glycerin works informed him that to produce an article free from arsenic would necessitate an addition of 10 per cent. to current prices. To detect arsenic, 2 cc. of glycerin are mixed with 3 cc. of moderately strong hydrochloric

acid and a few pieces of metallic zinc are added. The gas which is evolved is allowed to act on filter-paper moistened with a 50 per cent. solution of silver nitrate. After 15 minutes the paper should show no yellow stains becoming black when moistened with water.—C. H. B.

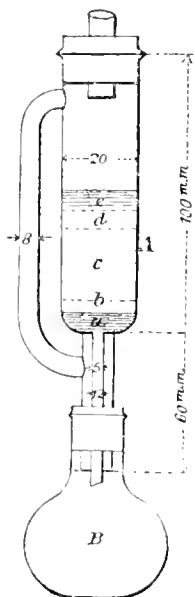
Action of Phenols on Cinnamic Aldehyde. Probable Presence of the Latter in Woody Matter. A. Ihl. Chem. Zeit. 13, 560.

THE author has shown that cinnamon oil gives characteristic red colourations with phloroglucinol and resorcinol (this Journal 1889, 421) which he now finds is due to the cinnamic aldehyde in the oil, and, moreover, has obtained the following reactions with both cinnamic aldehyde and genuine cinnamon oil.

With cold alcoholic solutions in the presence of acid; deep dark red colouration with phloroglucinol; cinnabar red with resorcinol; full light red with oreinol; strong fleshy red with pyrogallol; and dirty red, on heating, with phenol, α -naphthol, and thymol. Dilute cinnamic aldehyde or the oil is coloured yellow by alcoholic aniline sulphate; and concentrated sulphuric acid colours them deep black. The phloroglucinol reaction is sufficiently delicate to serve as an indicator for the presence of traces of free acid. Phloroglucinol, resorcinol, oreinol, aniline sulphate, and sulphuric acid give similar reactions with lignin; cinnamic aldehyde is never suggested as a probable constituent of woody matter. Neither clove oil nor pimento oil are acted on in the cold by resorcinol or oreinol.—D. A. L.

Determination of Indigotin in Commercial Indigo. M. Hönig. Zeits. f. angew. Chem. 1889, 280—283.

THIS method is based on the fact that aniline and nitrobenzene in a boiling state are moderate solvents for indigotin. Under certain conditions it is possible to dissolve the indigotin completely, and it can be obtained in crystals from the solution. Other organic matters accompanying the indigotin in commercial indigo also go in solution, but they do not crystallise along with the indigotin. The process is carried out as follows:—0.5 to 0.8 gram. of the very finely powdered indigo is mixed with three times its volume of calcined sand, which has been deprived of fine dust, and the size of grain of which is 1 mm. The mixture is then treated in the modified Soxhlet apparatus, shown in the diagram. The extraction tube A contains a loose cotton



plug *a*, then a small layer of sand at *b*, then a mixture of sand and indigo at *c*, then again some sand, and finally a plug of cotton wool at *e*. The apparatus is then connected with a reversed condenser. The flask B is charged with about 50 cc. of aniline or nitrobenzene, perfectly free from water. The contents of the flask are gradually brought to a boil and a brisk ebullition is maintained, the vapours given off extracting the indigotin from the mixture. After 1½ to 2 hours the extraction will have proceeded so far that the liquor running from the extraction tube has only a pale blue colour. The extraction is now interrupted, and, after cooling the apparatus, the distilling flask is disconnected and the contents of the extraction tube washed two or three times with 95 per cent. alcohol. These washings are kept for further use. The extraction tube is emptied into a small dish, the mass spread with a spatula and dried in an air-bath at 105° to 110° C. for about half an hour or so. The mass is again filled into the extraction tube without loss, and, after putting the apparatus together, the extraction is continued for about 20 minutes, when it should be found that the liquor filtering through the extraction tube has no longer a bluish tint. The extraction is then complete: proof of this is found in the fact that the sand dried and calcined does not give off red-violet vapours. The solution in the distilling flask, usually coloured dark blue, is concentrated as much as possible. As a rule this can be done up to 15 or 10 cc. After cooling this residue, its volume is measured. It is then mixed with five or six times its volume of 95 per cent. alcohol—the previous alcoholic washings may be taken—filtered through a dried (at 110° C.) and weighed filter, and the crystals on the filter washed with 95 per cent. alcohol, until the washings have only a very pale blue colour. The filter is dried at 110° C. and weighed, thus obtaining the weight of the crystals of indigotin. To this weight is added that quantity which remained in solution in the mother-liquor, viz., for every 10 cc. of aniline, .013 gram. of indigotin; or for every 10 cc. of nitrobenzene, .021 gram. of indigotin. It makes no difference as regards the final result whether aniline or nitrobenzene be used as a solvent. In using the latter the crystals assume a better shape, and the corks are less attacked. It may be mentioned that it is desirable to estimate the ash in a portion of the indigotin obtained, in order to make sure that it is not adulterated with sand. The results of analyses given by the author show that the method gives very concordant results. The process is, of course, also applicable for the quick and convenient preparation of pure indigotin.—S. H.

Analysis of Cinchonas and Solubility of their Active Principles in Water, Alcohol, and Dilute Hydrochloric Acid. E. Landrin. Compt. Rend. 108, 750—753.

THE experiments were made on a sample of *C. succirubra* from the Dutch Government grounds at Java. The method of extraction followed by the author for some years is as follows: 300 grms. of the bark are powdered and passed through a No. 40 sieve, then mixed thoroughly with 1 litre of milk of soda-lime containing 75 grms. of quicklime and 75 grms. of solution of sodium hydrate at 40° B. To this mixture, thinned, if necessary, by a little water, 2 litres of petroleum spirit are added, heated to 100° for 20 minutes, with constant agitation; the oil is then decanted, and the extraction repeated with a second 2 litres. The first extraction yielded 11.45 grms. crystalline salts; the second, 1.71 grms. The 4 litres of extract are washed twice with 75 cc. of 10 per cent. sulphuric acid added to 150 cc. water; and a third time with one-third of these quantities. The acid extracts are boiled and neutralised with ammonia, and filtered, the last serving to wash the filter. On cooling, about nine-tenths of the alkaloidal sulphates crystallise out, are filtered off, and the mother-liquor precipitated by caustic soda, the alkaloids washed, dried, pressed, and transformed into sulphates by cautious addition of sulphuric acid, then added to the rest, and weighed; the sulphate of quinine is separated by known processes. Operating thus, the sample yielded per kilo.: total alkaloids, 75.92 grms.; crystallisable salts, 51.83 grms.; quinine sulphate, 21.27 grms.

The same sample, extracted respectively with boiling water, 90 per cent. alcohol, and dilute hydrochloric acid, as recommended by de Vrij, yielded the following results:—

One kilo. contained	Moisture.	Soluble. Insoluble		Total Alkaloids.		Crystallisable Salts.		Quinine Sulphate.	
				Soluble.	Insoluble.	Soluble.	Insoluble.	Soluble	Insoluble.
Treated with boiling water.....	100	340	160	61.42	11.50	43.49	8.34	15.85	5.42
" " 90 per cent. alcohol.....	100	325	575	65.97	9.95	45.71	6.12	18.27	3.00
" " dilute hydrochloric acid	100	260	640	58.68	17.24	39.61	12.22	13.88	7.39

The author prefers the extraction with hydrochloric acid. —J. M. H. M.

Examination of Commercial Olein for Linoleic Acid.

K. HAZURA. *Zeits. f. angew. Chem.* 1889, 283—284.

GRANVAL and VALSER lately drew attention to the fact, that olein of commerce is sometimes adulterated with linoleic acid (this Journal, 1889, 425). They also stated some tests for the presence of the latter. The author has found an analytical method, which is based on the following facts: (1.) Olein chiefly contains oleic acid, $C_{18}H_{34}O_2$, and small quantities of linoleic acid, $C_{18}H_{32}O_2$. On oxidising its alkaline solution with permanganate it gives solid products of oxidation, viz., the dihydroxystearic acid, $C_{18}H_{34}O_2(OH)_2$, which melts at $137^\circ C.$ and is nearly insoluble in water and ether; the tetrahydroxystearic acid, $C_{18}H_{32}O_2(OH)_4$, which melts at $174^\circ C.$ and is slightly soluble in water and insoluble in ether; and the azelaic acid, $C_9H_{16}O_4$, which is easily soluble in both water and ether. (2.) The linoleic acid contains small quantities of oleic acid, $C_{18}H_{34}O_2$, of linoleic acid, $C_{18}H_{32}O_2$, and isolinoleic acid, $C_{18}H_{30}O_2(OH)_2$. On oxidising an alkaline solution with permanganate solid products of oxidation are formed, viz., dihydroxystearic acid, tetrahydroxystearic acid, two hexahydroxystearic acids and azelaic acid.

The analytical process is as follows:—50 grms. of the olein to be tested are saponified on the water-bath with dilute alcoholic potassium hydrate. The potash soap is freed from alcohol and dissolved in 1,000 cc. of water. This strong alkaline solution is gradually mixed with 1,000 cc. of a 5 per cent. solution of potassium permanganate. After $\frac{1}{2}$ —1 hour the manganese peroxide is filtered off, the filtrate acidified with sulphuric acid and again filtered. The filtrate thus obtained is neutralised with potassium hydrate, concentrated to about 300 cc., and again acidified with sulphuric acid, which produces a precipitate. The acid liquid and the precipitate are shaken with ether. If the precipitate dissolves in ether, it consisted of pure azelaic acid and the original olein is free from linoleic acid. If the precipitate does not dissolve in ether, it is probably owing to the presence of linoleic acid. To be quite certain, the precipitate is filtered several times, recrystallised from water or alcohol with the addition of animal charcoal, and after air-drying its melting point is determined. If the latter be above $160^\circ C.$, linoleic acid is undoubtedly present.—S. H.

Lard and Lard Adulterations. H. W. WILEY. U.S. Dept. of Agriculture Bulletin, 13, Part 4.

A. The pamphlet first describes the different kinds of lard and the various materials used in adulterating it.

1. LARD.—The followings kinds are recognised. (a.) *Neutral lard* made from the leaf of the freshly slaughtered hog, chilled, ground, and kettle-rendered. It contains at most 0.25 per cent. of free fatty acid, and is used almost wholly for making butter substitutes. (b.) *Leaf lard* obtained from the residue from neutral lard by rendering it by means of steam under pressure. (c.) *Choice kettle-rendered lard* obtained from such portion of the leaf not needed for margarin together with the fat from the back, by rendering in steam-jacketed open kettles. (d.) *Prime steam lard* from the whole of the head (after removal of the jaw), the fat attached to the intestines and heart, and fat from the back, and leaf when not otherwise required.

(e.) *Butchers' lard* from the accumulated scraps of these tradesmen. It is usually kettle-rendered.

2. STEARINS. By this term is meant the more solid part of any fat from which the more fluid portion has been removed by pressure. Such are: (a.) *Lard stearin* made from "prime steam lard" by treatment in screw presses at 50° — $60^\circ F.$ The expressed *lard oil* is used for burning and lubricating; it contains less free fatty acid than the solid residue, the quantity in which amounts to 0.5 per cent. The stearin is worth more than the lard. (b.) *Oleo-stearin* obtained from the caul fat of hives rendered in open kettles at a low temperature. The resulting tallow is kept at 80° — $90^\circ F.$ for 36—48 hours, and pressed at $90^\circ F.$; the *aleo-oil* is used in margarin manufacture.

3. COTTON-SEED OIL.—Cotton seed is screened and then freed from any remaining lint by being put through a gin; about 20 lb. per ton are obtained. The clean seed is cut up, and the hulls removed by sieving; it is then ground to meal, heated to 210° — $215^\circ F.$, made into cakes weighing about 16 lb. each, and subjected to a pressure of 3,000—4,000 lb. per square inch. (For the yield, see this Journal, 1889, 431.) The expressed cakes contain about 10 per cent. of oil, and are used for cattle food or as a fertiliser. The crude oil contains about 1.5 per cent. of free fatty acid. The manufacture is chiefly conducted in winter, the seed not keeping well in summer. The crude oil is shipped in bulk. It is refined by means of caustic soda (compare this Journal, 1888, 756); the oil thus obtained after being heated and clarified is termed *summer yellow oil*, and if cooled, and the stearin removed, *winter yellow oil*. The cotton-oil stearin is used for making butterine and soap. The yellow oil agitated with fuller's earth and filtered, becomes colourless, and is known as *white oil*.

B. Properties of lard and its adulterants.

1. PURE LARD. (a.) *Specific gravity* is about 0.890 at $40^\circ C.$ and 0.860 at $100^\circ C.$ referred to water at $4^\circ C.$ (b.) *Melting point* varies from $35.1^\circ C.$ (from the foot) to $44^\circ C.$ (intestinal fat). Average value $37^\circ C.$ (c.) *Solidifying point of fatty acids* determined by Dalcian's method varies from 32.1° to $42.7^\circ C.$ (Compare this Journal, 1889, 423—424.) (d.) *Melting point of fatty acids* ranges from 36.9° and $46.6^\circ C.$ (e.) *Refractive index* corrected to $25^\circ C.$, averages 1.4620. (f.) *Colour reactions* with litmus and sulphuric acids are usually slight, and though not serving as an absolute criterion, are of value in discriminating between pure and sophisticated samples. The variations observed in the case of pure lards are probably due to the different quantities of gelatinous and similar matter entangled in different samples. (g.) *Rise of temperature with sulphuric acid*. The extreme values obtained were 37.1° and $46.2^\circ C.$ The author is engaged in endeavouring to measure the heat evolved in this reaction instead of the temperature. (h.) *Volatile fatty acids*. The quantity from 5 grms. of the fat neutralised 0.2 to 0.4 cc. of decinormal alkali. (i.) *Insoluble fatty acids* ranged from 93 to 95 per cent. (l.) *Free fatty acids* rarely exceeded 0.5 per cent. (m.) *Saponification equivalent* varied between 272 and 294, and averaged 280. (n.) *Iodine number* varied according to the part of the animal from which the lard had been obtained. Thus it was 57.34 for intestinal lard, 52.55 for leaf lard, 77.28

for foot lard, 85.03 from head lard. The average value for pure lard with miscellaneous origin was 62.48. (a.) *Reaction with silver nitrate.* Using either Beechi's or Milliau's prescription, the reduction or colouration was extremely small or nil. (p.) *Microscopic appearances.* A definite crystalline structure is perceptible, but the character of the crystals is not distinguishable; if slowly crystallised from ether, rhombic crystals of stearin are obtained, differing from the fan-shaped crystals yielded by beef or mutton fat under like conditions. (q.) *Moisture* varies from a trace up to 0.7 per cent.

2. COTTON-SEED OIL. — (a.) *Specific Gravity.* The following table shows the specific gravity of normal oil at various temperatures referred to water at 15° C. as unity:—

Temperature. °C.	Specific Gravity.	Temperature. °C.	Specific Gravity.
10	*9249	26	*9149
11	*9243	27	*9143
12	*9237	28	*9136
13	*9231	29	*9129
14	*9224	30	*9123
15	*9218	31	*9117
16	*9212	32	*9110
17	*9206	33	*9105
18	*9199	34	*9098
19	*9193	35	*9092
20	*9187	36	*9086
21	*9181	37	*9079
22	*9174	38	*9073
23	*9168	39	*9067
24	*9161	40	*9060
25	*9155	50	*8997

(b.) *Melting point.* Near or below 0° C. (c.) *Solidifying point of fatty acids* by Dalcian's method ranged from 30.5° to 35.6° C., mean, 33.5° C. (d.) *Melting point of fatty acids.* Maximum, 44.4° C.; minimum, 34.6° C.; mean, 39.1° C. (e.) *Refractive index* averaged 1.4674 at 25° C.; its mean rate of variation for each degree centigrade was .000288—sensibly the same as that of lard. (f.) *Colour reactions* with nitric and sulphuric acids are marked and fairly characteristic. (g.) *Rise of temperature with sulphuric acid.* Maximum, 90.2° C.; minimum, 80.1° C.; mean, 85.1° C. (h.) *Volatile fatty acids.* The quantity from 5 grms. of the oil neutralised at most 0.5 cc. deci-normal alkali. (k.) *Saponification equivalent* was not very constant; the mean was 283.8. (l.) *Iodine number* ranged between 100 and 116.97; the mean value was 109.02. (m.) *Reaction with silver nitrate.* The reducing action of cotton-seed oil on silver nitrate, when tested according to Beechi or Milliau, is well marked and of great analytical importance.

3. STEARINS. — (a.) *Specific gravity* differed little from that of lard. (b.) *Melting point* varied according to the origin of the stearin; thus a lard stearin from a dead (as opposed to slaughtered) hog melted at 38.2° C., a prime lard stearin at 44.3° C., and two oleo-stearins at 51.9° and 53.8° C. respectively. (c.) *Refractive index* appears to be slightly higher than that of the glycerides from which any given sample is derived. (d.) *Colour reactions* are similar to those of the parent glycerides. (e.) *Rise of temperature with sulphuric acid* is difficult to determine in a manner strictly comparable with that applicable to the original glycerides on account of the high initial temperature required. The values, however, appear to be similar to those given by the latter. (f.) *Volatile fatty acids* occur in negligibly small quantity. (g.) *Saponification equivalent* is practically the same as that given by the original glycerides. (h.) *Iodine number* is lower than that of the original glycerides; e.g., two oleo-stearins gave the numbers 17.38 and 26.81; three lard stearins, 44.24, 44.24, and 49.78; various cotton-seed stearins gave results varying between 85.28 and 99.39. (i.) *Reaction with silver nitrate.* This takes place in a manner quite comparable with that of the original glycerides; it is somewhat less marked, however, with cotton-seed stearin than with cotton-seed oil. (l.) *Microscopic appearances.* Lard stearins give crystals like those mentioned under "lard;" oleo-stearin gives characteristic fan-shaped crystals. (m.) *Moisture* is generally only present in traces.

4. ADULTERATED LARD. — (a.) *Specific gravity* does not necessarily differ from that of pure lard, though cotton-seed oil, if present in greater quantity than 15 per cent., raises it above normal limits. It generally ranges from 0.906 to 0.910 at 35° C., compared with water at the same temperature. (b.) *Melting point* is no certain guide. Of factitious lard from Fairbank and Co. the highest was 41.9° C., the lowest 31.3° C., the mean 38.1° C., while the samples from Armour and Co. gave 43.3°, 38.9°, and 40.6° C. for corresponding figures. (c.) *Solidifying point of fatty acids.* Fairbank's, mean, 37.4° C.; Armour's, mean, 39.8° C. (d.) *Melting point of fatty acids.* Fairbank's, mean, 40.6° C.; Armour's, mean, 42.8° C. (e.) *Refractive index.* Fairbank's, mean, 1.4651; Armour's, mean, 1.4634. (f.) *Colour reactions* are usually strongly indicative of cotton-seed oil. A pinkish tint is sometimes yielded by lards containing much beef-fat stearin, though it cannot with certainty be said to be due to that substance. (g.) *Rise of temperature with sulphuric acid*—

Fairbank's, maximum, 68.8° C., minimum, 51.3° C.
Armour's, " 58.9° C., " 42.1° C.

(h.) *Volatile fatty acids* negligibly small. (k.) *Saponification equivalent.* Fairbank's, mean, 279.4; Armour's, mean, 275. (l.) *Iodine number*—

Fairbank's, maximum, 94.78, minimum, 78.24.
Armour's, " 71.19, " 54.11.

(m.) *Reaction with silver nitrate.* Unless the proportion of cotton-seed oil in a lard be very small, reduction of silver sufficient for its detection always occurs. (n.) *Microscopic appearances.* Tufted crystals of the stearins used as adulterants are perceptible, as well as normal lard crystals. (o.) *Moisture* is generally present only in traces, but 30 per cent. was found on one occasion; it is not a common adulterant.

The following table shows the mean results of the analytical data obtained during this investigation:—

Kind of Samples.	Specific Gravity.	Sapon. Equiv.	M. P.	M. P. of Fatty Acids.	S. P. of Fatty Acids.	Maumene's Test.	I. Number.	Refractory Index.
Pure lard.....	*9053	280.3	40.7	43.3	39.6	41.5	62.48	1.4620
Lard of various origin.....	*9067	274.4	41.7	42.9	39.6	45.7	64.34	1.4633
Prime steam lard.....	*9055	283.5	37.0	42.1	38.6	39.9	62.86	1.4623
Fairbank's "lards".....	*9095	279.4	38.1	40.6	37.4	57.9	85.31	1.4651
Armour's "lards".....	*9060	275.0	48.6	42.8	39.8	46.5	63.58	1.4634

Methods of Analysis Employed.

1. Specific Gravity.—The specific gravity bottle and the Westphal balance were used for oils and fats in the liquid condition, and a platinum crucible, of known displacement, weighed, together with the fat, in air and water, for fats in the solid state.

In the following tables, which are compiled from the data obtained by C. A. Crampton, the specific gravity is always referred to that of water at 4° C., except where otherwise stated.

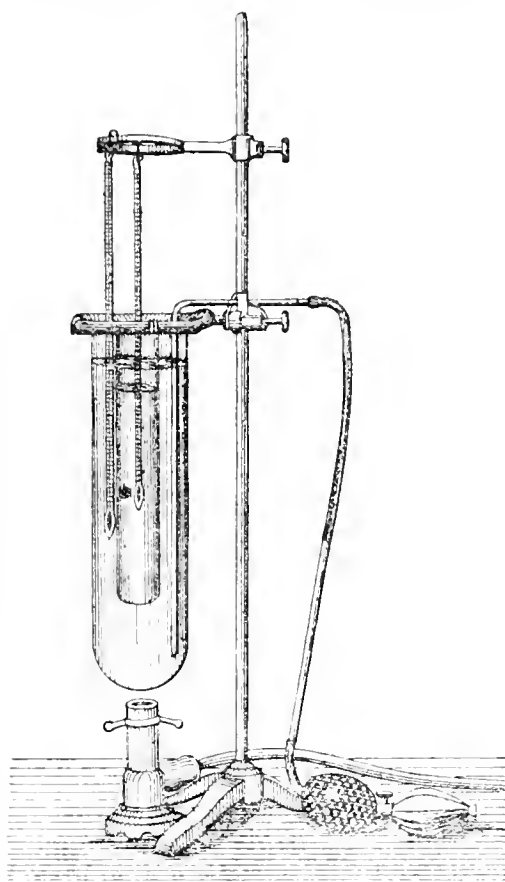
Description.	Apparent Sp. Gr. in Glass Vessels at	
	15°52°.	166°.
Leaf lard rendered in laboratory	'91181	'85997
Intestinal lard " "	'91157	'85907
Head lard " "	'91336	'86094
" Pure lard " (J. P. Squires and Co.)	'91206	'86002
" Pure lard " (Cassard and Co.)	'91341	'86191
" Compound lard " (Armour and Co.)	'91458	'86222
" Compound lard " " "	'91378	'86121
" Compound lard " (Fairbank and Co.)	'91515	'86289
Lard stearin (used by Armour and Co.)	'90965	'85750
Lard stearin (used by Fairbank and Co.)	'90659	'85792
Beef fat from testis (obtained from Prof. Sharpless)	'91144	'85888
Oleo-stearin (used by Armour and Co.)	'90714	'85572
Oleo-stearin (used by Fairbank and Co.)	'90647	'85444
Cotton-seed stearin (from Prof. Wesson)	'91884	'86163
Crude cotton-seed oil (from Prof. Wesson) ...	'92046	'86739
" " " (from Southern Cotton Oil Trust)	'92209	'87054
Summer yellow " " "	'92063	'86716
" white " " "	'92055	'86681
Winter yellow " " "	'92191	'86512
" white " " "	'92179	'86774
Refined " (Armour and Co.)	'92150	'86714
" Pure olive oil " (Z. D. Gilman)	'91557	'86168
" Pure olive oil " (from Prof. Sharpless)	'91595	'86194

Comparison of results with plummet and with specific gravity bottle taken at 35° C., compared with water at the same temperature:—

Description.	With Plummet.	With Sp. Gr. Bottle.
Lard	'9058	'90508
"	'9047	'90484
"	'9066	'90652
"	'9044	'90523
"	'9067	'90671
"	'9069	'90797
"	'9068	'90667
"	'9080	'90816
Cotton-seed oil	'9151	'91391
"	'9164	'91510
"	'9134	'91377
"	'9132	'91357

Description.	With Plummet.	With Sp. Gr. Bottle.
Cotton seed oil	'9154	'91112
"	'9138	'91675
"	'9133	'91152
Olive oil	'9076	'90848
"	'9080	'90811

2. Melting Point.—It is not easy to fix the precise melting point of a fat, but the best way to do so is to observe the temperature at which a thin disc floating in a medium of its own density assumes the form of a sphere. The apparatus shown in the figure achieves this object.



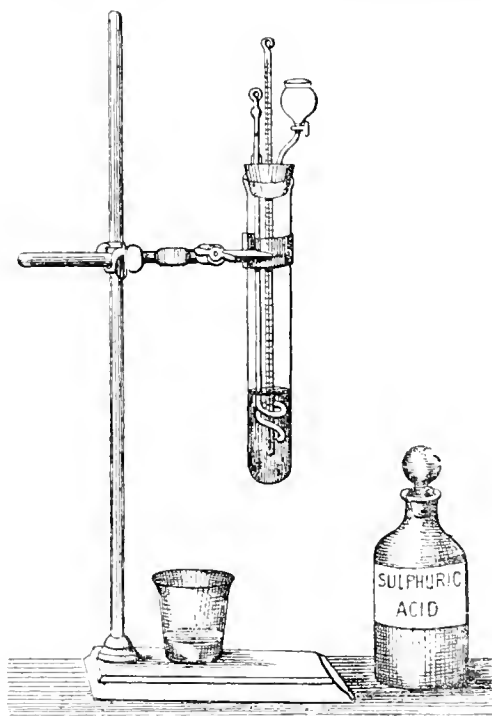
The inner test tube is 30 cm. long and 3·5 cm. in diameter; the outer beaker 35 × 10 cm. The tube is about half filled with boiling distilled water; on this, while still hot, is poured alcohol which has also been boiled. The beaker contains water, which can be agitated by any suitable means, such as a stream of air from the little hand-blower shown in the figure. An ordinary thermometer gives the temperature of the liquid in the beaker, while an accurate one, reading to 0·1° C., is suspended in the test tube. The whole apparatus having been cooled to about 10° C., discs of the fat to be examined are prepared by allowing it to fall from a dropping tube from a height of 15—20 cm. on to a smooth piece of ice floating in water, and are transferred to the inner tube by means of a spatula. They sink through the alcohol until they come to a stratum of alcohol and water of their own specific gravity, and remain floating there. The temperature of the bath is now slowly raised until the discs become sensibly spherical, when the temperature indicated by the inner thermometer, placed as close as possible to the

fat globule and gently rotated during the last stages of fusion, is read off. The inner tube can then be removed and another substituted for a fresh determination. After cooling, the fat globules can be picked out with a small spoon at the end of a wire, without disturbing the layers of water and alcohol, and the tube used again. It is necessary to renew its contents after three or four days, as it absorbs air, and this escaping in bubbles on heating, buoys up the disc of fat and brings it to the top, thus spoiling the determination.

3. Refractive Index.—This was determined by an apparatus described by Abbe in his brochure "Neue Apparate zur Bestimmung des Brechungs- und Zerstreuungsvermögens fester und flüssiger Körper." For the higher temperatures the hot room of a Turkish bath proved useful. The following table shows some results corrected to the uniform temperature of 25° C.:

Description.	Refractive Index.
Prime lard stearin.....	1.4614
Neutral lard.....	1.4614
Kettle-rendered lard.....	1.4600
"Golden cotolene" (a mixture of cotton-seed oil and oleo-stearin).....	1.4619
Oleo oil.....	1.4604
Oleo-stearin.....	1.4584
"....."	1.4579
White cotton-seed oil stearin.....	1.4659
Yellow " " ".....	1.4664
Fatty acids from lard.....	1.4554
" " ".....	1.4564
" from oleo-stearin.....	1.4585
" " cotton-seed oil stearin.....	1.4624
" " "compound lard".....	1.4564
Cotton-seed oil stearin.....	1.4587

4. Rise of Temperature with Sulphuric Acid.—The apparatus used is based on that employed by W. Ramsay for the determination of the molecular weights of nitrogen trioxide and tetroxide by Raoult's method (J. Chem. Soc. Trans., 1888, 622). The functions of its parts are obvious from the figure; when in use its lower portion is covered by



a non-conducting case. The quantities of fat or oil and sulphuric acid taken are those generally adopted, viz., 50 cc. and 10 cc. respectively. It was found that a difference of 10° in the starting temperature made one of 2°—3° in the rise observed.

5. Solidifying Point of Fatty Acids.—A tube 15 cm. by 2.5—3 cm. is filled with the fused fatty acids, a thermometer graduated to 0.1° C. inserted in it, and the whole protected from draughts by being placed in an empty bottle, the bottom of which has been warmed so as to avoid chilling the fatty acids prematurely. When crystallisation commences the temperature begins to rise, at which point the thermometer should be stirred round the tube in both directions three or four times; this hastens the crystallisation, and the temperature continues to rise and finally remains stationary for one or two minutes. This is taken as the true solidifying point.

6. Melting Point of Fatty Acids.—The capillary method or the plan of heating a film of the fatty acids on the bulb of a thermometer, held in the centre of an empty flask until it is collected into a single drop, was used with success.

7. Colour Reactions (with sulphuric and nitric acids).—These call for no comment.

8. Microscopic Examination.—The method adopted was to dissolve 2—5 grms. of the fat in 10—20 cc. of ether in a test tube and allow it to stand loosely plugged with cotton-wool all night. The crystals deposited at the bottom of the tube were then examined under $\frac{1}{2}$ or $\frac{1}{4}$ in. obj. The different forms observed are shown in a series of 20 photomicrographs, for which the original pamphlet must be consulted. The method proved of value for the detection of beef fat, 20 per cent. of which could be readily discerned, though with 10 per cent. the indications were somewhat doubtful.

9. Soluble and Volatile and Insoluble Fatty Acids, and Saponification Equivalent.—The determination of these calls for no remark, save that it was found convenient in weighing out quantities of fats that were required to approximately equal some round number of grams (e.g. 5 grms.), to use a pipette of such capacity that it held that weight of fat at a temperature somewhat above its melting point.

10. Iodine Number.—This was determined in the usual manner. The author comments on the large fluctuations in the strength of the iodine solution observed. A solution allowed to stand from April 23rd, 1888, to November 10th, 1888, consumed, for 10 cc., 17.9 cc. on the first date and only 7.3 cc. on the second.

11. Reaction with Silver Nitrate.—Two forms of the Beech prescription were employed. (i.) 10 cc. of a solution containing $\frac{1}{10}$ — $\frac{1}{100}$ gm. of AgNO_3 in 200 cc. of 95 per cent. alcohol and 20 cc. of ether, together with 10 cc. of a mixture of 15 parts of rape oil and 85 parts of amyl alcohol. (ii.) 1 cc. of a solution containing 1 gm. of AgNO_3 in 200 cc. of a mixture of equal parts of alcohol and ether, together with 10 cc. of the amyl alcohol mixture mentioned under (i.).

The second solution acts more promptly than the first, which is nevertheless otherwise more satisfactory. The method of applying the test is the same in both cases, and consists in mixing the requisite quantities of the reagents with 10 cc. of the oil in a test tube, shaking well, and pouring into a porcelain dish on a steam-bath. Heating and occasional stirring are continued for 20 minutes. Results:—(a.) With pure cotton-seed oil. In from two to three minutes the mixture turns red; in five to ten minutes it becomes so brown as to appear black in thick layers; at the end of the test metallic silver is deposited on the sides of the dish, varying in colour from bluish black to reddish purple. In the liquid float particles of silver, giving it a greenish tint. (b.) With lard containing more than 20 per cent. of cotton-seed oil. The same phenomena occur but less promptly. (c.) With quite small percentages of cotton-seed oil. The reaction eventually appears. (d.) Animal fats, rape, olive, peanut and linseed oils, give either no colour or at most a faint pink.

Some Peculiar Reactions.—Crude cotton-seed oil gives a less sharp reaction than the refined oil. Linseed oil gives a reddish colour but no reduction. Head and gut lard give a slightly greater colouration than leaf lard. It remains to be seen whether lard made from swine fattened on beech-mast or cotton-meal would give the reaction. A trace of alkali in the oil to be tested (such as might come from an imperfectly washed cotton-seed oil) might precipitate silver oxide and obscure the reaction; to avoid this it is well to make the solution of silver nitrate distinctly acid with nitric acid. It has been suggested that the substance present in cotton-seed oil causing the reaction is an aldehyde; in any case it appears to resist saponification, for Millian's modification of the Beechi's test is founded on the use of the fatty acids instead of the original oil. There is little doubt that no commercially profitable adulteration with cotton-seed oil could fail to be detected by this test.

Millian's Process.—This was modified by the author by the use of a round bottomed porcelain dish holding about 50 cc. in place of the tube generally employed, and by the acidification of the silver nitrate solution with 0.5 to 1.0 cc. of pure nitric acid.

It was found that the reaction when it *did* occur was remarkably sharp, but in certain cases it failed to appear altogether; it also appeared that the fatty acids, if kept, lost their reducing power.

12. Sulphur Chloride Test.—This seemed likely to be of use, but time for its full investigation failed.

Quantitative Determination of Adulterants in Lard.

From the results got by the processes mentioned above some idea may be obtained of the percentage of adulterants present. It by no means follows that calculations based on

different data yielded by the sample under examination will yield identical results. Aid may be had by remembering that cotton-seed oil and stearin are usually present in "compound lards" in the proportion of 1:5:1. The following table is based on this assumption.

Observed Sp. Gr. at 35° C.	Pure Lard.	Adulterant.	Of which there is —	
			Cotton Oil.	Stearin.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
0950	10.0	0.0	0.0	0.0
0955	87.5	12.5	7.5	5.0
0960	75.0	25.0	15.0	10.0
0965	62.5	37.5	22.5	15.0
0970	50.0	50.0	30.0	20.0
0980	25.0	75.0	45.0	30.0
0985	12.5	87.5	52.5	35.0
0990	0.0	100.0	60.0	40.0

The index of refraction is perhaps as good a single gauge of the percentage of adulterant as any.

From the methods already worked out as applied to the two classes of "compound lards" examined, the following general results are deducible:—

Method of Examination.	Sample from—	Per Cent. of Adulteration.
Specific gravity	Armour and Co.	18.42
Refractive index	"	70.00
Mannine's test	"	23.30
Specific gravity	Fairbank and Co.	100.00
Refractive index	"	100.00
Mannine's test	"	76.30

Description.	Specific Gravity at 35° C.	Melting Point, C. °.	M. P. of Fatty Acids, C. °.	S. P. of Fatty Acids, C. °.	Colour Reactions with		Refractive Index at 25° C.	Mannine's Test, C. °.	Saponification Equivalent.	Reaction with Silver Nitrate.		Water, per Cent.	Microscopic Indications.	Iodine Number.
					H ₂ SO ₄ .	HNO ₃ .				Beechi.	Millian.			
"Pure leaf lard" (J. P. Squire and Co.)	0945	45.1	46.6	41.5	Faint pink	Trace	1.4626	40.9	..	Trace of colour.	Trace of reduction.	..	..	56.93
Pigs' feet lard (D. Wesson)	0988	35.1	36.9	32.4	..	..	1.4639	..	..	No colour	"	..	..	77.28
Pure lard (mean of 19 samples)	0963	40.7	43.3	39.6	..	..	1.4620	41.5	280.33	..	..	0.077	..	62.18
Stearin lard (mean of 11 samples)	0955	37.0	42.1	38.00	..	..	1.4623	39.9	284.45	..	..	0.109	..	62.86
Cotton-seed oil (mean of 17 samples)	0912	..	38.8	33.5	..	..	1.4678	86.7	283.80	..	..	0.061	..	169.06
Oleo-stearin (Armour and Co.)	0906	51.9	..	..	Note	Trace of yellow.	..	..	..	No colour	..	0.580	Tallow stearin.	17.38
Lard stearin (Armour and Co.)	0931	44.3	..	..	Trace	Trace	1.4594	..	..	Faint blue	..	0.050	Lard stearin.	44.24
Yellow cotton-seed oil stearin (Southern Cotton Oil Trust) .....	..	..	..	..	..	..	1.4659	64.0	235.11	Very black	Heavy reduction; very black.	..	..	91.90
"Compound lard" (mean of 13 samples) (Armour and Co.)	0960	40.6	42.8	39.8	..	..	1.4634	46.5	275.23	..	..	0.068	..	63.58
"Compound lard" (mean of 17 samples) (Fairbank and Co.)	0995	38.4	40.6	37.4	..	..	1.4651	57.0	279.40	..	..	0.133	..	85.31
"Choice family lard" (Fowler and Co.)	0972	42.7	42.2	39.6	Brown	Red-brown	1.4635	39.5	275.53	Dark red-brown.	No reduction.	0.621	Tallow stearin.	66.34
"Choice family lard" (P. F. Tietjen)	0969	42.8	43.0	39.5	Light brown.	Dirty light brown.	1.4628	51.1	271.82	Brown-black; green tint.	Slight reduction.	35.66	Lard and tallow stearin.	59.62
Crude cotton oil (Southern Oil Trust)	0914	..	40.2	34.9	..	..	1.4670	79.0	281.81	Very black	..	..	..	109.45

The foregoing table is compiled from the very voluminous tables embodied in the pamphlet. The samples recorded have been selected either because they display some peculiarity or else fairly represent the average of a large number of analyses.

The rest of the pamphlet is occupied with abstracts from recent numbers of the *Analyst* of the methods used by various chemists for the detection of adulterants in lard, and by the reports of sundry legal cases turning upon the alleged adulteration of samples of lard.

In conclusion, the author clearly points out the gross fraud practised by selling the so-called "refined lard" as genuine lard, and records with satisfaction the fact that the largest American manufacturers of factitious lard have abandoned the use of the word "refined" and are selling the product as "compound lard."

Scattered through the pamphlet are several statements of interest which do not fall into the divisions under which the rest of it has been abstracted for this Journal. Such are:

(1.) *Definition of the "guts" of a hog.*—As used by the hog-packers, this term means the whole abdominal viscera. Of these, everything except the liver and the intestines

proper (which are used for sausage casings) goes into the rendering tank. It is stated that the grease thus obtained is used for the manufacture of lard oil, and soap, and does not enter into the lard of commerce. (2.) *White grease* is chiefly made from hogs which die in transit, and until lately from hogs dead from disease. (3.) *Brown grease* is made from the intestines of the animals mentioned under (2). (4.) *Yellow grease* is made by the packers from any refuse they may have, as well as from any hogs that may die on their hands. (5.) *Pig's-foot grease* is chiefly obtained from the glue factories. All these varieties are chiefly used for making lard oil and soap. (6.) Now-a-days all beef fat is not termed *tallow*, but is divided into several sorts, such as "butter-stock" rendered from the caul fat at a low temperature (and from which is manufactured by pressure oleo-oil and oleo-stearin), kidney-fat (suet), marrow-stock, and tallow, the last being made from the trimmings and portions of the viscera. (7.) *Other adulterants of lard* are said to be dead-hog grease and stearin, pea-nut and other vegetable oils. Such practices seem never to have been in use on a scale of commercial importance. (8.) The appended table gives the analytical results of some miscellaneous oils examined in the course of this investigation:—

Description.	Specific Gravity at 35° C.	M. P. of Fatty Acids.	S. P. of Fatty Acids.	Colour Reactions with		Refractive Index at 25° C.	Mauern's Test.	Reaction with Silver Nitrate.		Water, per Cent.	Iodine Number.
				H ₂ SO ₄ .	HNO ₃ .			Bechi.	Millian.		
"Olive oil sublime"	·9076	26·6	19·55	Brown-black	Yellow-green	1·4642	50·9	Dirty red-yellow	No reduction	..	85·37
Rape oil	·9039	21·6	..	"	Light red	1·4672	68·0	Light dirty brown.	"	0·035	98·72
Lard oil	·8049	42·6	..	Deep brown	Deep dirty red	1·4632	54·2	Light brown	"	1·365	66·36
Pea-nut oil	·9124	32·6	30·87	..	..	1·4658	60·1	..	"	0·125	96·61
Olive oil.....	·9076	..	..	Green, changing to brown.	Light green	1·4643	..	Light green-brown.	..	..	83·38
"	·9080	24·2	17·27	"	"	1·4638	49·0	Light green-yellow.	No reduction	..	81·90
"	·9039	27·0	..	Deep blk.-brown	Light yellow	1·4639	53·0	Light red-brown	Mere trace	0·100	82·76
Dead-hog grease	·9081	41·4	38·90	Black-brown	Dirty brown	1·4615	44·0	Light red	..	0·235	61·70
"	·9086	42·0	37·10	Light-pink brown	Decided pink	1·4618	42·4	No colour	Jelly*	0·155	60·52
" .....	..	..	39·60	..	Marked pink	..	..	"	..	0·045	56·13
4 to per cent. oleo-stearin.	..	..	..	..	..	..	..	..	..	..	..
Dead-hog grease	·9058	40·4	38·50	..	..	1·4664	43·7	..	Mere trace	0·245	65·49
Dead-animal grease.....	·9027	42·6	40·45	..	..	1·4585	37·5	Faint yellow	No reduction	3·780	53·42
Lard oil	·9151	..	..	..	..	1·4650	..	No colour	..	..	85·63

* Gelatinous precipitate formed consisting apparently of the silver salt of an organic acid.

(9.) *Statistics of the lard industry.*—The annual production of lard in the United States is about 600,000,000 lb., of which about half is pure and half "compound" lard. The exports amount to 320,000,000 lb., and of this about 40 per cent. is "compound" lard. The total quantity of cotton-seed oil accounted for in this way is 120,000,000 lb.

In 1882 it was estimated that the oil industry was represented by the following data:—

" 110,000 tons of seed yielding 35 galls. of crude oil to the ton, amounting to 14,350,000 galls. worth 30 cents per gall.	Dols.	4,305,000
" 110,000 tons of seed yielding 22 lb. cotton lint to the ton, amounting to 9,029,000 lb. cotton, worth 8 cents per lb.		721,600
" 110,000 tons of seed yielding 750 lb. of oil cake to the ton, amounting to 137,277 tons, at 20 dols. per ton.		2,745,549
		7,772,149
Deduct the price of the seed, reckoning it to be 10 dols. per ton.....		4,100,000
Gross profit		3,672,149

—(Brant. *Vegetable and Animal Oils.*)

The crude oil is said to have a specific gravity of ·9306 at 59° F., and the refined oil one of ·9264 at the same temperature. (Compare this Journal 1889, 431.) By cooling the refined oil, palmitin is removed, its specific gravity lowered, and it becomes more suited for the adulteration of olive oil."—B. B.

Dyewoods and Extracts; their Use and Abuse. L. Bruehl. Textile Colourist, 1889, No. 114 et seq.

See under VI., pp. 612—618.

Estimation of Raffinose in Raw Sugar. T. Breyer. Chem. Zeit. 13, 559—560.

The inversion is conducted in the following manner:—50 cc. of the polarisation solution (26·048 grms. per 100 cc.) are poured into a "50—55 cc. flask" and acidified with 5 cc. of hydrochloric acid (sp. gr. 1·182). The flask is then placed in a water-bath, and heated to about 70°, simultaneously with

a similar flask filled with water and with a thermometer in it. The heat is regulated so that this thermometer registers 68—69° for five minutes, five minutes being allowed for it to reach this temperature. When the inversion is complete, the solution is quickly cooled, and allowed to stand for some hours in the room where it is to be polarised. After accurately filling to the mark, and if necessary decolourising with dry washed animal charcoal, the solution is filtered into a covered cylinder and polarised in a glass tube with wide tube attached for the thermometer. From the polarisation before and after inversion, and the thermometer reading, the apparent amount of cane-sugar can be calculated by Clerget's formula. A difference of 0.5 or over from the direct polarisation may be regarded as indicating the presence of other optically active substances, and in the absence of substances capable of reducing Fehling's solution, the true amount of cane-sugar may be calculated by the following formula, which is a combination of Clerget's and Creydt's formulae. The difference between the number so found and the direct polarisation may be assumed to be due to a definite quantity of raffinose, which may be calculated:—

	Saccharose.	Raffinose.
A. Direct polarisation.....	+ 100	+ 100
B. Polarisation after inversion, at t	$-(11 - \frac{t}{2})$	+ 5.7; or corrected for temperature:— $+ (16.7 + \frac{t}{5})$.
C. Difference for 1 original polarisation.....	$100 + 11 - \frac{t}{2}$ 100	0.194; or corrected for temperature:— $+ (109 - 16.7 - \frac{t}{5})$. 100

S. Percentage of sugar.

R. Percentage of raffinose.

1. $A = S + 1.85 R$.

2. $C = \frac{100 + 11 - \frac{t}{2}}{100} S + 1.85 R \times 0.493$.

3. $0.493 A = 0.493 S + 1.85 R \times 0.493$.

By subtracting 3 from 2

$S = C - 0.493 A$

$$\frac{111 - \frac{t}{2}}{100}$$

$$R = \frac{A - S}{1.85}$$

It is shown that neither differences in concentration nor in temperature, within certain limits, will affect Creydt's constants for the inversion of raffinose solutions; in fact the concentration is neglected in Creydt's formula, and as regards temperature, the variations in rotary power of the products of the inversion of raffinose (levulose and dextro-rotary galactose and perhaps dextrose) are found to practically neutralise one another, and therefore the above formula may be depended on under ordinary circumstances; but if a correction be required it is simply necessary to substitute the expression—

$$\left(\frac{100 - 16.7 - \frac{t}{5}}{100} \right) = \frac{53.3 - \frac{t}{5}}{100}$$

for the number 0.493 used in the above equations, and then—

$$S = \frac{100 C - \left(\frac{53.3 - \frac{t}{5}}{100} \right) A}{100.7 - 0.493 t}$$

—D. A. L.

PATENTS.

Improvements in or relating to Oil-Testing Machines.
W. S. Boulton, Birkenhead. Eng. Pat. 10,883, July 27, 1888. *Ed.*

The apparatus consists of an expanding journal B fixed on the shaft D, and made in two halves kept separate by the

spring C, but adjustable towards each other by the screws M. The journal works in a metal bush A provided with a flange and surrounded by a jacket E. The jacket is furnished with a thermometer G.

Fig. 1.

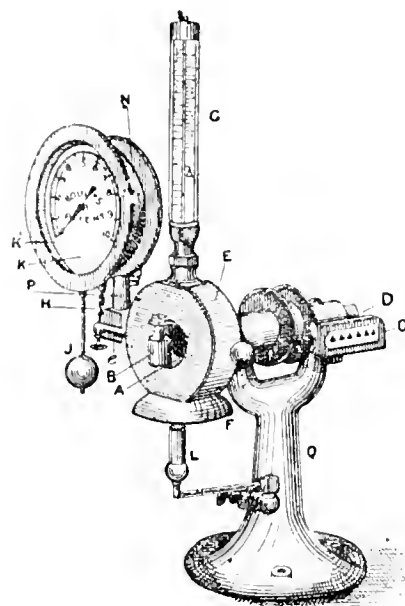
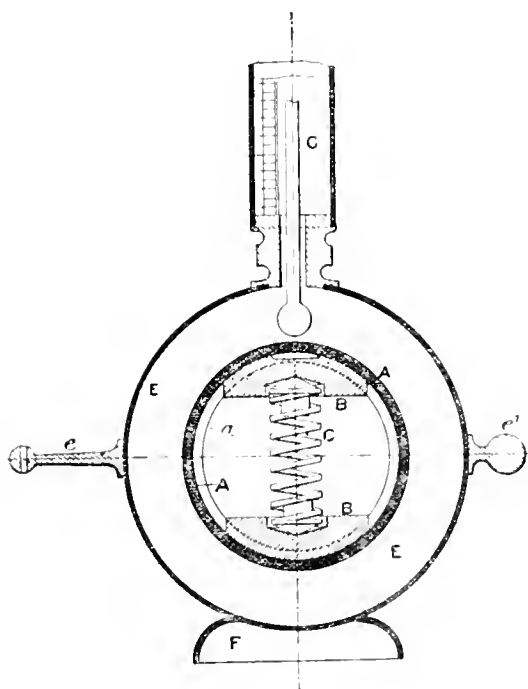


Fig. 2.



J is a burner for heating the jacket E. The amount of oil to be applied to the journal is measured by the narrow bore tube R, from which the oil is delivered by the plunger S (Fig. 4). The amount of friction between the journal B and the bush A corresponds to the deflection of the

Fig. 3.

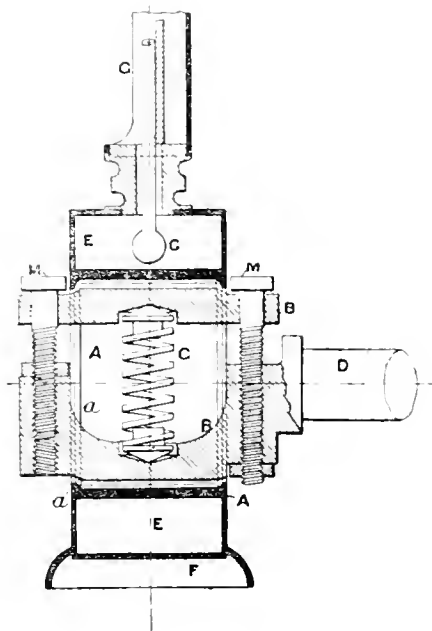
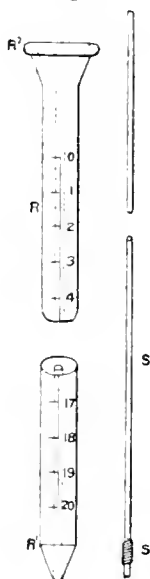


Fig. 4.



pendulum J, which is connected by means of a chain with the arm *c* fixed to the jacket E. The amount of deflection of the pendulum is shown by the pointer K' on the dial K.

—E. J. B.

Improvements in or relating to Pyrometers. W. H. Grindley, Tunstall, and W. S. Hensley, Cardiff. Eng. Pat. 13,003, September 8, 1888. 11d.

See under XI., page 623.

An Improved Funnel for Facilitating the Introduction of Liquids into Bottles, Jars, and other Vessels. T. C. Howlercroft, Uttoxeter. Eng. Pat. 7789, May 9, 1889. 6d.

A FUNNEL of the ordinary form is caused to fit air-tight into the neck of a bottle by means of a conical-shaped

collar or band of some elastic material round the lower portion of the stem. Above the collar is a tap to control the flow of the liquid. An air-tube is fixed on the outside of the funnel, and carried down to the top of the elastic collar, and through the stem to the end, that portion of it and the stem below the collar being perforated for the passage of air from the bottle. The advantages are:—(1.) The prevention of the sudden overflow of the liquid from the bottle, owing to the air having a means of escape. (2.) The exact amount of liquid required can be introduced. (3.) When the bottle is quite filled, if the tap be turned, the pressure of the external air will prevent the escape of the fluid from the stem on withdrawing the funnel. A drawing is attached to the specification.—E. S.

New Books.

DIE TECHNIK DER ROSANILINFARBSTOFFE. ENTWICKELUNGSGESCHICHTLICH DARGESTELLT UND FÜR PRAXIS UND WISSENSCHAFT BEARBEITET. DR. OTTO VON MÜHLHAÜSER. Stuttgart, 1889: Verlag der J. G. Cotta'schen Buchhandlung Nachfolger. London: H. Grevel & Co., 33, Covent Garden.

LARGE 8vo volume, strongly bound in cloth, price 1*l.* 4*s.* The work contains Preface, Table of Contents, 283 pages of subject-matter, copious alphabetical index, glossary of abbreviated titles of literary works of reference, 10 sheets of admirably executed engravings illustrative of descriptions in the text, and 5 pages of classified descriptions of the parts lettered in the sheets of engravings. The text is divided into a GENERAL PART and a SPECIAL PART. The former is subdivided as follows:—

PRODUCTION OF THE ROSANILINES.—Construction of the Rosanilines from 1 mol. of a non-phenylated C_1 -compound and 3 mols. of an aromatic base. Construction of the Rosanilines from $\frac{1}{2}$ mol. of a mono-phenylated C_1 -compound and 2 mols. of an aromatic base. Construction of the Rosanilines from 1 mol. of a C_1 substituted aniline substituted at the nitrogen, and 2 mols. of an aromatic base. Construction of the Rosanilines from 1 mol. of an *N*-benzylated amine and 1 mol. of an aromatic base. Construction of the Rosanilines from 1 mol. of a diphenylated C_1 -compound and 1 mol. of an aromatic base. Preparation of Rosanilines from triphenylmethane derivatives by alterations in the substituted groups.

FURTHER PREPARATIONS FROM THE ROSANILINES.

CONVERSION OF THE COLOURING MATTERS INTO LEUCO BASES.—Production of Leuco bases. Further preparations from the Leuco bases. Conversion of poly-amidized triphenylmethanes into colouring matters.

SPECIAL PART.—Diamidotriphenyl carbinols. Derivatives of diamidotriphenyl carbinol. Triamidotriphenyl carbinols. Triamidotolylidiphenyl carbinols. Triamidoditolylphenyl carbinols.

HIGHER HOMOLOGUES.—Diamido-naphthylidiphenyl carbinols. Triamido-naphthylidiphenyl carbinols.

THE DYEING OF TEXTILE FABRICS. By J. J. HUMMELL, F.C.S., Professor and Director of the Dyeing Department of the Yorkshire College, Leeds. Third edition. Cassell & Co., Limited, London, Paris, New York, and Melbourne. 1888.

THIS important work now appears as a third edition, and in a slightly enlarged form. The text, illustrated with 97 diagrams, covers 527 pages, exclusive of preface, table of contents, and list of illustrations. The price is 5*s.* It has been sufficiently esteemed in Germany to render it advisable to issue a German edition, which is greatly appreciated. The form of the work is, apart from the enlargement, precisely like that of preceding editions.

Trade Report.

(From Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

RUSSIA.

Change in Excise Duty on Matches.

A despatch, dated the 4th July last, has been received at the Foreign Office from Mr. Audley C. Gosling, Her Majesty's Chargé d'Affaires at St. Petersburg, transmitting an extract from the *Journal de St. Pétersbourg*, notifying a change in the Russian excise duty on matches of home and foreign manufacture, which was imposed in May 1888. The change is as follows:—

The excise on matches of home manufacture is one-half copeck per box of from 75 to 150 matches, and of three-fourths of a copeck per box of from 150 to 225 matches.

The excise on matches of foreign manufacture is one copeck (credit) per box of from 75 to 150 matches, and one copeck and a half (credit) per box of from 150 to 225 matches.

Matches exported to the Asiatic markets are not free from payment of excise.

Imposition of Transit Duty on Goods passing through Batoum.

A despatch, dated the 26th July last, has been received at the Foreign Office from Mr. A. Gosling, Her Majesty's Chargé d'Affaires at St. Petersburg, enclosing an extract from the *Journal de St. Pétersbourg* for the same date, according to which the Imperial Council, with the approval of the Emperor, has decided that for 10 years a transit duty will be levied on all goods passing through the port of Batoum. This duty will be:—

1. One-half copeck per pound on wood for building purposes (with the exception of cachou, walnut, carob, and palm), on firewood, salt, cement, common stones, mineral coal, and raw naphtha; and

2. One copeck per pound on all other articles.

This duty will be levied without examining the goods in detail and according to the quantity indicated on the documents accompanying the goods.

PORTUGAL.

Abolition of Export Duties on Wine.

A despatch, dated the 16th July last, has been received from Mr. G. G. Petre, Her Majesty's Minister at Lisbon, enclosing copies and translation of a law passed by the Cortes at the close of the last session, abolishing the export duties on wines levied in Portugal. The following is a copy of the translation in question:—

Art. 1. The exportation of common wines, whether white or red, is free from duty, but nevertheless red wines will be liable to a statistical duty of 2 reis (0.106*d.*) per decalitre, and white wines to that of 1 real (0.053*d.*) per decalitre.

Art. 2. The duties levied in the Portuguese colonies on the importation of wine or vinegar produced in and sent from the continental part of the kingdom and from the islands are abolished.

Art. 3. The octroi duty in Lisbon on charcoal is reduced to 8 per cent. *ad valorem*, and coke must pay the same rate of duty.

Art. 4. The duties imposed in virtue of the law of July 13, 1888, on brandy and alcohol, shall be raised as follows in the respective articles of the General Customs' Tariff. "Article 217," brandy and alcohol in casks or demijohns, per decalitre of pure alcohol, reis 1,800 (8*s.*) "Article 218," brandy and alcohol in bottles or flasks or the like, and alcoholic beverages not otherwise specified, per decalitre of liquid, reis 2,200 (9*s.* 9.33*d.*).

§. In order to aid the several bodies and individuals referred to in this article in the making of these wines, the Government will engage abroad the duly qualified technical "personnel" that may be required, with a view to their carrying out in the private wine-lodges in the most important wine-growing regions and at the proper seasons the various wine-making operations that may be called for.

Art. 6. Any distilleries set up for the purpose of making fine brandies, like French cognac, or any fine brandies, exclusively out of Portuguese wines, will be exempted during five years from the payment of any direct taxes.

§. The fixed price of 33.3 reis (1.77*d.*) per kilogramme of sulphuret of carbon as at present paid by the wine-growers is guaranteed to them, irrespective of the price at which the Government may be able to buy it.

UNITED STATES.

Customs Decision.

Certain so-called calcined magnesite, having all the characteristic properties of a cement, and destined for use as a mortar in cementing magnesite bricks, is dutiable as cement at the rate of 20 per cent. *ad valorem*.

URUGUAY.

Changes in Customs Tariff.

Note.—Kilog. = 2.204 lb. avoird. Peso Fuerte = 4*s.* 2*d.*

The Uruguayan Government has recently passed a law altering the rates of Customs duty leviable on various goods imported into Uruguay, as follows:—

Designation of Articles.	Rates of Duty now leviable.
Prussian blue, common, for washing	Pes. Cts. Kilog. (gross wt.) 0'01
Soap, common	" " 0'08
Candles of stearin, including case	" " 0'16

CANADA.

Customs Decision.

The *Canada Gazette* for the 6th July last contains the following Order of the Governor-General of Canada in Council:—

Whereas a difference of opinion has arisen as to the Customs duty payable under the tariff on ferro-manganese, ferro-silicon, spiegel, steel bloom ends, and cross ends of steel rails when not for the manufacture of steel—

His Excellency, under the authority conferred upon him by section 5 of the Customs Amendment Act (51 Viet. c. 14.), and by and with the advice of the Queen's Privy Council for Canada, is pleased to direct that such articles when imported for other purposes than for the manufacture of steel shall be rated for duty under item 41 of Act 50 & 51 Viet. c. 39, at the rate of 4 dols. per ton, and that the Order in Council of 4th June 1889 be cancelled.

CAPE OF GOOD HOPE.

Tariff of Rebate Rates.

The Cape of Good Hope *Government Gazette* for the 25th June says that, under section 5 of the Customs Union Tariff Act of 1889, his Excellency the Officer Administering the Government of the Cape has directed it to be notified that from and after the 1st July 1889, rebate to the extent shown in the following tables was to be granted in respect to such articles as are specified, whenever any such articles are removed overland to British Bechnanaland and the South African Republic:—

Articles.		Rebate to be granted.	Duty less Rebate to be paid.
Candles.....	Lb.	£ s. d. 0 0 1½	£ s. d. 0 0 1
Copper in sheets		12 % <i>ad val.</i>	Nil.
Dynamite.....	Lb.	0 0 2	0 0 1
Guns of all description		12 % <i>ad val.</i>	Nil.
India-rubber (unmanufactured)		"	"
Oils of all descriptions, other than chemical, essential, and perfumed	Imp. gall.	0 0 6	0 0 6
Do. chemical, essential, and perfumed		10 % <i>ad val.</i>	5 % <i>ad val.</i>
Ores and minerals, crude		12 % <i>ad val.</i>	Nil.
Rosin		5 % <i>ad val.</i>	5 % <i>ad val.</i>
Soap, common	100 lb.	0 3 5	0 0 9
Soda, caustic		5 % <i>ad val.</i>	5 % <i>ad val.</i>
Tallow	100 lb.	0 2 7½	0 1 6½
Turmeric	"	1 4 3½	0 0 8½
Turpentine	Gall.	0 0 10½	0 0 1½
Varnish	"	0 0 6	0 0 6
Vinegar.....	"	0 0 5½	0 0 0½

REPORT FOR THE YEAR 1888 ON THE TRADE OF FRANKFORT-ON-MAIN.

(*Diplomatic and Consular Reports*, 1889, No. 573.)

The report of the Frankfort Chamber of Commerce for the year 1888 contains the following remarks with reference to Great Britain:—

"The commercial relations between Great Britain and Germany have maintained last year the same steady and even course which trade generally pursues if not disturbed by tariff difficulties or other obstacles thrown in its way.

"Exports and imports have risen; we rejoice at this improvement of British trade, and do not complain of our position. The deficiency in the export of our productions in iron of every description, quoted specially as a proof of our failing capacity to compete, gives us no uneasiness whatever, the more so as our works are in full activity for the much more remunerative home market.

"Our statistics show no material decrease in exports to the United Kingdom, the deficiency in one article being counterbalanced by the increase in another.

"Sugar shows a falling off of 1,200,000 double cwt. as against 1887. Export of wine in bottles has decreased, whilst in casks it has increased.

"Our imports from the United Kingdom have increased in bleaching powder, the manufacture of which has diminished in Germany in consequence of the introduction of the Solvay process.

"The following articles likewise showed an increase, viz., bone-black, saltpetre, pig iron, iron ores (reaching us from England by way of transit only), machines, coal, bitumen, and linseed oil in casks."

"SUMMARY OF VALUES" OF IMPORTS AND EXPORTS FOR THREE YEARS.

	IMPORTS.		
	1886.	1887.	1888.
Drugs unenumerated	£ 104,410	£ 101,846	£ 111,471
Chemicals, ditto	219,838	280,032	292,927
Dyeing and tanning goods, ditto...	31,150	26,727	29,989

	EXPORTS.		
	1886.	1887.	1888.
Drugs unenumerated	£ 38,194	£ 58,204	£ 107,852
Chemicals, ditto	276,821	326,006	314,093
Dyeing and tanning goods, ditto ..	..	..	..

I.—TABLE OF THE PRINCIPAL ARTICLES IMPORTED FROM GREAT BRITAIN INTO GERMANY (CUSTOMS UNION) IN THE YEARS 1886, 1887, AND 1888.

Articles.	Quantities in 100 Kilos.		
	1886.	1887.	1888.
Guano	17,311	33,069	13,366
Lead, pig lead	2,490	5,439	2,561
Caustic soda	16,454	12,090	9,363
Alum	1,706	1,270	526
Chloride of lime.....	50,081	29,787	40,819
Dyewood extract	5,926	2,295	2,766
Double carbonate of soda...	3,327	3,637	4,884
Calcined soda	10,789	9,434	4,004
Soda, raw, crystals.....	8,944	3,297	1,056
Soda ash.....	13,945	12,677	4,828
Ammonia, carbonated, sal-ammoniac, &c.....	3,145	3,062	5,327
Sulphate of ammonia	282,696	245,519	246,004
Aniline dyes	962	1,274	1,934
Cachou, brown and yellow ..	20,613	19,735	16,976
Cinchona	31,699	25,147	22,894
Chlorate of potash	4,401	5,060	4,062
Chromate of potash	8,530	5,954	8,416
Dyewoods	26,788	30,340	24,324
Glycerin, refined and crude ..	6,453	10,034	15,221
Indigo	5,466	5,238	6,132
Bone-black	22,280	14,607	29,499
Bone dust	1,803	522	1,177
Sulphate of soda	3,156	3,243	824
Saltpetre (Chili)	16,927	17,466	46,234
Sulphur, also pulverised	1,031	2,369	6,298
Superphosphate	18,180	32,184	131,425
Turpentine and other resinous oils	7,148	5,622	6,497
Vitriols of every description.	1,746	926	734
Iron in lump and waste iron	2,357	7,339	5,440

I.—TABLE OF THE PRINCIPAL ARTICLES IMPORTED FROM GREAT BRITAIN INTO GERMANY (CUSTOMS UNION) IN THE YEARS 1886, 1887, AND 1888—*continued*.

Articles.	Quantities in 100 Kilos.		
	1886.	1887.	1888.
Pig iron of every description	1,516,527	1,349,919	1,976,163
Malleable iron, in bars	27,065	30,715	31,589
Plates and sheets of malleable iron.....	12,908	13,088	13,872
Tin plates	21,032	20,056	25,793
Cement	12,241	13,010	36,658
Iron ore	2,764	66,863	235,189
Hemp	1,807	2,811	4,060
Jute	273,624	328,994	286,263
Rape and rape seed	95,873	11,556	28,803
Linseed.....	16,517	11,238	9,884
Palm, kernel, and copra	213,128	226,997	264,496
Raw hides, wet	4,214	4,739	4,361
„ dry	36,338	30,680	38,972
Horse hides	2,817	3,905	3,105
Sheep, kid, and goat skins ..	3,606	2,977	3,080
Horns, horn tips	7,634	8,963	7,765
India-rubber (raw and cleaned)	11,728	13,167	17,877
Copper, in pigs.....	56,125	61,773	24,792
Mercury	1,116	1,263	1,078
Leather (except kid and sole)	7,770	10,364	11,234
Kid and morocco	1,066	1,067	1,103
Sole leather	2,644	2,753	4,880
Salt	241,498	241,327	259,874
Sugar.....	13,335	15,967	18,852
Cotton oil.....	..	37,987	31,828
Linseed oil.....	168,938	170,058	199,739
Olive oil	2,923	1,204	1,018
Palm and cocoa-nut oil	67,946	67,083	65,762
Lard and grease	14,910	5,708	6,773
Stearic and palmitic acids and paraffin	3,654	1,464	500
Train and fish oil	9,703	12,223	10,038
Tallow	28,988	25,100	20,187
Petroleum	3,220	3,070	2,612
Mineral lubricating oil	36,764	40,870	43,901
Raw silk	1,007	603	547
Coke	412,540	312,170	310,163
Slates.....	234,376	331,655	351,445
Coal	16,399,135	15,556,063	19,133,959
Bitumen	15,095	3,809	15,856
Turpentine and resins	11,731	11,530	21,698
Tar of every description	68,748	79,713	77,839
Fire bricks.....	116,433	100,046	168,000
Crucibles, muffles	5,117	3,663	1,252
Pottery (not porcelain)	2,671	2,604	3,281
Raw zinc	5,532	7,534	17,579
Tin	28,252	29,858	38,745

II.—TABLE OF THE PRINCIPAL ARTICLES EXPORTED FROM GERMANY (CUSTOMS UNION) TO GREAT BRITAIN IN THE YEARS 1886, 1887, AND 1888.

Articles.	Quantities in 100 Kilos.		
	1886.	1887.	1888.
Lead, pig lead, &c.	113,060	104,785	74,192
Ultramarine	12,267	12,352	10,322
Alum, alamine	22,940	19,568	18,896
Soda, calcined	1,216	4,098	2,576
„ raw, crystals	3,175	3,793	334
Potash	11,528	16,647	16,237
Alizarin	21,653	24,305	29,050
Anilin and its products	1,208	1,563	1,729
Anilin dyes and tar colours..	10,804	11,385	11,848
White lead and zinc white ..	54,178	71,130	79,150
Chloride of potassium.....	81,339	254,999	153,215
Glycerin, refined and crude .	3,542	2,338	4,644
Potash sulphate	26,751	36,912	44,979
Mineral waters	23,331	25,956	25,832
Soda and sulphate of soda...	1,105	8,022	4,472
Nitrate of soda.....	2,540	4,311	5,255
„ of potash	20,363	14,001	16,657
Gunpowder and rock powder	10,162	816	2,682
Superphosphate and calcined bones	2,900	5,551	11,598
Vitriol of every description..	327	506	1,257
Tartaric acid.....	5,018	6,983	8,019
Iron in lumps and scraps ...	30,830	14,190	3,710
Pig iron	6,783	25,921	8,705
Cement	22,588	4,188	7,403
Hollow glass, natural	64,976	61,811	65,905
„ plain, white...	7,319	5,966	9,611
Plate glass, polished	7,227	4,520	6,600
„ silvered.....	1,637	1,736	2,000
Bristles.....	1,103	1,494	1,501
Calf skins, fresh and salted .	285	60	1,664
Hides, fresh and salted.....	292	1,165	3,334
Sheepskins, raw-haired	1,449	816	1,358
Copper, pigs and lumps	107	50	2,229
„ articles.....	3,157	3,412	3,529
Aluminium and nickelware ..	3,354	2,610	1,827
Leather of every description	3,703	4,055	4,823
Kid leather, Morocco	5,608	4,366	4,033
Fancy leather goods	6,571	6,711	8,514
Cords and ropes	2,410	3,935	3,980
Beer of every description ...	11,506	13,370	11,290
Spirits and alcohol.....	13,972	10,604	15,124
Wine and must in casks.....	4,622	5,482	7,151
Sparkling wines in bottles ..	7,687	8,089	7,321
Other wines in bottles	13,208	13,496	9,883
Butter; also artificial	2,977	9,253	12,847
Starch and arrowroot	48,337	71,207	91,208
Salt .....	..	741	21,346

II.—TABLE OF THE PRINCIPAL ARTICLES EXPORTED FROM GERMANY (CUSTOMS UNION) TO GREAT BRITAIN IN THE YEARS 1886, 1887, AND 1888—*continued*.

Articles.	Quantities in 100 Kilos.		
	1886.	1887.	1888.
Pasteboard	83,689	118,249	104,345
Tobacco leaves.....	3,013	3,865	4,573
Sugar.....	3,112,373	3,843,805	2,629,581
Palm and coconut oil	24,374	30,657	34,825
Rape-seed oil	36,562	60,231	54,239
Celluloid, &c. for paper manu- facture	74,832	62,119	66,798
Grey blotting and packing paper.....	25,788	27,380	28,243
Coal.....	21,127	27,050	29,176
Bitumen.....	18,754	13,482	23,794
Bricks	4,603	4,676	4,095
Firebricks	1,591	124	741
Other pottery.....	2,532	2,366	2,799
China and porcelain	21,219	25,548	26,573
Raw zinc	251,527	254,734	225,975
Zinc in sheets.....	60,561	61,943	51,708

In brandy matters were quite exceptional in the first half of the year owing to the fact that it being a period of transition the excise officers were without instructions, and the distillers and dealers did not yet understand the workings of the new law. Goods on which the new duty was paid could hardly be sold, whilst others were kept in store awaiting the new arrangements. Matters improved only with the increased facilities for permits, and the introduction of special licenses enabling the working of material on which duty was unpaid. From this period dates also a more active sale in raw materials. From this same period dates also the scheme of forming a spirit syndicate, which prospect, however, proved a failure; as also another, conceived by the Frankfort dealers, to establish a spirit factory independent of the northern establishments. In the liquor trade the high tariff caused quite a stagnation, the sales were trifling, and a profit was out of the question; there was a tendency to bring inferior brands into the market.

The total import and export of spirits was as follows:—

	Meter-cwts.
In 1888 imported.....	21,654
1887 ".....	28,609
1888 exported	11,100
1887 ".....	8,252

SOME RIO TINTO STATISTICS CALCULATED FROM THOSE PUBLISHED.

(*Eng. and Min. Jour.* 1889. 2, 25.)

1.	2.	3.	4.	5.	6.	7.
Year.	Mineral Exported.	Copper Content.	Copper in Mineral Exported.	Mineral Exported for Sulphur only.	Mineral Locally Treated.	Copper Content.
	Long Tons.	Per Cent.	Long Tons.	Dividends paid. Per Cent.	Long Tons.	Per Cent.
1876	189,362	..	..	..	159,116	..
1877	251,360	..	..	..	520,391	..
1878	218,818	..	..	..	652,289	..
1879	243,241	..	..	5	663,359	..
1880	277,590	2*758	7,656	8	637,567	2*558
1881	249,098	2*890	7,200	14	743,949	2*703
1882	250,924	2*942	7,649	14	688,307	2*752
1883	313,291	2*610	8,177	14	786,682	3*093
1884	312,028	2*851	8,806	8	1,057,890	3*347
1885	406,772	2*186	8,891	5½	954,694	3*496
1886	336,548	2*626	8,837	8	1,041,833	3*182
1887	362,796	2*183	7,920	10	819,642	3*429
1888	393,149	1*992	7,830	17	969,317	3*337
Totals and Averages	3,814,577	2*509	73,056		9,685,316	3*144
	Total since 1880, 2,911,196	Average.	Partial Total.	..	Total since 1880, 7,690,181	Average.

SOME RIO TINTO STATISTICS CALCULATED FROM THOSE PUBLISHED—*continued*.

8.	9.	10.	11.	12.	13.	14.
Copper in Mineral Locally Treated.	Total Copper Handled.	Average Copper Content of Total Mineral.	Copper Produced Locally.	Total Copper Recovered for the Market.	Copper sent to Waste Heaps each Years.	Percentage of the Copper Treated Locally, that is sent to Waste Heaps.
					Or otherwise Lost.	
Long Tons.	Long Tons.	Per Cent.	Long Tons. 946	Long Tons.	Long Tons.	
..	..	..	2,495	..	..	..
..	..	..	4,188	..	..	..
..	..	..	7,179	..	..	..
16,311	23,967	2'619	8,539	16,215	7,752	47'5
20,109	27,369	2'750	9,466	16,666	10,643	52'9
18,949	26,598	2'805	9,740	17,589	9,209	48'6
24,338	32,515	2'956	12,295	20,472	12,043	49'5
35,407	44,303	3'234	12,668	21,564	22,739	64'2
33,031	41,922	3'102	14,593	23,484	18,438	55'8
33,148	41,985	3'046	15,863	24,700	17,285	52'1
28,169	36,029	3'047	17,813	25,733	10,296	36'6
52,349	40,179	2'949	18,522	26,352	13,827	42'7
241,751	314,807	2'970	131,323	192,575	122,232	50'5
Partial Total.	Partial Total.	Average.	Total.	Partial Total.	Partial Total.	Average.

Columns Nos. 1, 2, 4, 6, 10, 11, 12 contain published figures; Nos. 3, 7, 8, 9, 13, 14 are calculated figures.

EXTRACTS FROM BRITISH AND FOREIGN CONSULAR REPORTS.

PHOSPHATE MINES AT REDONDA.

(*American Consular Reports, Feb. 1889, p. 206.*)

The island of Redonda, where the phosphate mines in question are found, is situated about 25 miles south-west of Antigua in latitude 26° 6' and longitude 61° 35', and is under the jurisdiction of the British Government. It is estimated to be 1 mile in length, $\frac{1}{2}$ of a mile in width, and 1,000 ft. in height. Its shores are rock-bound and the only landing place is on the south-west side, near the foot of a ravine in a cliff which is nearly 1,000 ft. high in the highest part. The mines are situated on both the north and south ends of the island.

Phosphate of alumina was discovered at Redonda about 1865, and a license to mine the phosphate for 21 years at the rate of 20*l.* per annum was obtained. About 10,000 tons were mined, but the speculation proved a ruinous one, and in December 1882 the license was surrendered. A new one was granted to the Redonda Phosphate Company in January 1883 for 21 years, on condition that a royalty of 6*d.* a ton be paid on all phosphates exported and not less than 100*l.* be paid for each half year. The shipments of phosphate by the present company began in the latter part of 1885, and have amounted in all to about 21,000 tons, valued at 24,544*l.* f. o. b. Of this quantity 4,850 tons have been shipped to the United States and were invoiced at the rate of about 24*s.* a ton; the remainder was shipped to the United Kingdom. There were 2,000 tons of the rock ready for export in December 1888.

The mining is confined to the surface and the good rock is found in veins. The drilling is done entirely by hand drills with the aid of "rack-a-rock." Some of the rock contains 35 per cent. of phosphoric acid, and that sold is guaranteed to contain not less than 30 per cent. It contains

a large proportion of iron. The supply is stated by experts to be inexhaustible.—C. G. C.

OPPORTUNITIES FOR TRADE IN MALTA.

(*American Consular Reports, April 1889, p. 583.*)

The American Consul at Malta points out that some of our manufacturers are losing grip of the trade of Malta and other of our colonies owing to the fact that they make articles more for sale than for use, and he emphasises the fact that integrity in manufacturing is as essential to success as honesty in dealing. He recommends the sending of commercial travellers carrying nothing for sale, only samples, who should take a room and invite dealers to come and inspect. These travellers should be of good address and speak the language of the country. Soliciting trade by circulars was throwing money away. Patent medicines are already widely sold, but the trade could be increased. Petroleum stoves ought to be sold in greater numbers—they are just the thing to use in hot weather. The writing paper there is poor stuff, all sent from England—of the well-known colonial grade—that is cheap and nasty. There are 19 newspapers published in the island.—C. G. C.

CHINA.

Increase of Opium Culture.

The British Consul at New Chang, in Northern China, reports that the importation of Indian opium into his district is falling off to such an extent that another year or two might see it out of the market altogether, were it not that a few well-to-do natives, mostly southerners, will always be found who prefer to give a higher price for their old favourite. The cultivation of the native poppy is making enormous strides, and the great danger of famine which the

authorities have to face in any exceptional year will be largely increased, owing to so much of the land being devoted to the poppy instead of to food staples. Some idea of the local consumption of opium may be arrived at from the following figures, which are obtained from reliable Chinese sources. There are in the port of Yingtzü alone some 2,000 opium shops. An average sale of opium in a day is 5 oz. This gives 2,244 piculs a year for the public opium shops alone. To this must be added what is smoked in private houses, which is estimated at about 1,500 piculs, and this, it must be remembered, is for Yingtzü only, and those few villages round about which are most easily supplied from here. Twenty years ago 2,685 piculs of Indian drug were imported to supply not Yingtzü, but almost the whole of Manchuria, east of the district supplied through Tientsin, for, though it is true that the native opium was started as long as 21 years ago, it was only on a very small scale, and it found very little favour until quite of late years. The population has increased very rapidly, but not in the same proportion as the native opium, and the conclusion is inevitable that opium smoking has increased enormously.

Chinese and Indian Teas.

One of the great advantages which Chinese teas are said to possess over those of India is their greater wholesomeness. On this subject the British Consul at Hankow, in his last report, gives a table of analyses of the two kinds of tea made by Professor Dittmar, F.R.S., from which it appears that the quantity of tannin in Indian tea is 9.68 per cent. and in Chinese 6.01. After 20 minutes' infusion of 100 grains of each there is present in the respective liquors 2.96 grains theine and 6.53 grains tannin in the Indian and 3.37 grains theine and 3.86 grains tannin in the Chinese tea. "The teas in question," concludes Mr. Allen, "were both high-class teas, and the analyses given above certainly tend to show that there is an excess of tannin, with all its astringent and deleterious qualities, in the Indian tea."

TRIPOLI.

Drugs and Perfumery.

Drugs and perfumes are by far the most important articles of import into Bengazi, a port on the coast of Tripoli which carries on its principal foreign traffic *via* Malta. Last year 7,500 cwt. of these articles, valued at 37,500*l.*, were imported into Bengazi, against only 720 cwt., worth 3,600*l.*, the year before. Of oil and soap the imports were worth 10,650*l.*, against 10,400*l.*, the year before. The harvest last year appears to have been very good, and, as the Consul says, an abundant harvest means large purchases of drugs, perfumes, and certain luxuries. A Manchester firm has recently started a branch agency at Bengazi.

TURKEY IN EUROPE.

Gum Tragacanth.

Constantinople was formerly the great market for gum tragacanth, but it is now shipped extensively from Bagdad, Beyrout, and Mersine, to which ports the entire produce of Syria and Arabia is at present despatched. In 1887 the business done in this gum presented no noticeable feature, but in 1888 there was a brisk demand for the best qualities from London, and a consequent increase in the supplies, though not in prices. The exports were, in 1887—88, 1,200 cases, and in 1888—89, 2,000 cases.

Opium at Constantinople.

The exports of opium from Constantinople for the years named respectively were as mentioned below, the cases containing 155 lb. each:—

Year.	Arrivals.	Exports.
	Cases.	Cases.
1886—87	768	906
1887—88	2,790	2,243

Consignments of this article to America have considerably increased during the past year.

VICTORIA.

Trade in the Colony.

Among the exports of Victoria-made articles from the colony of Victoria during the quinquennium 1883—87 are named:—

	1883.	1884.	1885.	1886.	1887.
	£	£	£	£	£
Drugs and chemicals...	15,400	12,398	17,144	13,164	10,647
Soap	12,709	15,559	18,189	13,354	10,482
Oilman's stores	13,133	15,421	14,400	11,898	13,622

In 1887, according to value, over two-fifths of the Victorian imports were from, and nearly half the exports were to, the United Kingdom. About 38 per cent. of the former, and 40 per cent. of the latter, were conveyed between Victoria and the neighbouring colonies, chiefly New South Wales. In regard to foreign countries, the imports therefrom amounted to 12½ per cent. of the total imports, and the exports thereto to over 7 per cent. of the total exports.

The imports of foreign goods into the colony show considerable fluctuations, as will be seen from the following quinquennial table:—

Imports.	1877.	1882.	1887.
	£	£	£
Drugs and chemicals..... Value	54,191	84,365	92,155
Opium	79,149	77,089	37,280
Paints and colours.....	60,486	79,636	71,436
Tea	599,725	745,226	694,898
Oils	241,001	183,558	198,074

The import duties received in 1886 and 1887 amounted to nearly 12 per cent. of the total value of imports. Some idea of the extension of Victorian commerce may be formed from the circumstance that, although the population of the colony increased by less than 60 per cent. during the twenty years ended with 1887, the tonnage of vessels entered and cleared in the last as compared with the first year of that period increased nearly threefold. The number of miles of railway open in the colony on June 30, 1887, was 1,880, consisting of 1,643½ miles of single and 236½ miles of double line.

THE CHINA TRADE AT LIMOGES.

(United States Consular Reports, 1889, 386—389.)

Further improvement took place in this trade in 1888. The following table shows the number of furnaces fired during each year from 1882 to 1888:—

Year.	Coal.	Wood.
1882	2,590	507
1883	2,230	544
1884	1,805	448
1885	1,560	335
1886	1,528	323
1887	1,621	324
1888	1,705	339

The increase in manufacture is due to a better attention to the requirements of modern business, a withdrawal from competition in certain lines, and special devotion to those branches of manufacture which could be worked with the best advantage. As a result the trade consists of dinner and

tea ware, higher grade, ornamental, and decorated work, such as vases, plaques, bisque figures, &c. Machinery has largely supplanted hand labour, with the result that the waste unbaked broken ware is all reground and used, and the broken china is used as an ingredient in the enamel. Machine moulding is also an advantage. A great gain has been made also by an improvement in the construction of Minturn's reverse flame furnace. Instead of the flames from the lower chamber passing up into the upper one through the centre, they are made to enter the latter through apertures in its floor, thus adapting the same principle to heat both. There are as many apertures—generally about 10—as there are fire-boxes, and the second chamber is thus heated evenly. By this improvement 25 per cent. of fuel is saved, and 30 per cent. in the breakage and quality of the china. The furnaces now are one-fourth larger than formerly, consequently the 2,044 furnaces fired last year really correspond to 2,555 of the 1882 type. There has been a rise in the value of the decorated ware from 300 francs per cask to 500 francs. The amount of china decorated in the locality last year was valued at over 11 million francs, and that together with the white manufactured at Limoges at about 18 million francs. The price of labour varies very little, but there has been a decrease of 10 per cent. in 10 years. There are no strikes, as both the manufacturer and the workman has his own syndicate, and all disputes are settled by a joint committee. The price of English coal has advanced $5\frac{1}{2}$ francs per ton, but all other materials remain the same as last year. Trade prospects are good, heavy orders from the United States being reported.—A. W.

MANUFACTURE OF ZINC IN BELGIUM.

(United States Consular Reports, 1889, 441—447.)

The eleven works of the various Belgian companies are all in full work. In 1882 the output of each company was as follows:—

	Tons.
Vieille Montagne.....	35,940
Austro-Belge.....	8,009
De Laminne.....	6,255
G. Dumont and Bros.....	5,500
Nouvelle Montagne.....	5,480
Bleyberg.....	4,647
Ougrée.....	4,144
Prayon.....	1,500
Total.....	71,565

This total represents about one-third of the whole production of Europe. In 1887 the Vieille Montagne Company alone produced over 60,000 tons, and the other companies have also increased their out-turn. All the works receive part of their supplies of ore from abroad, first from Spain, and later from Sardinia, Greece, Algeria, Sweden, France, Germany, and England.

Belgium manufactures, yearly, about 40,000 tons of rolled sheet-zinc, and the Valentine Coeq. works of the Vieille Montagne Company produces annually 3,000 tons of zinc white. The production of zinc exceeding the demand, a syndicate was formed last year by the members of the Franco-Belgian group for the limitation of zinc production, when the amounts agreed upon were as follows:—

	Agreed Maximum Production in Tons.
Vieille Montagne.....	52,532
Company Royal Asturienne.....	15,574
Society Austro-Belge.....	9,270
Mr. L. De Laminne.....	6,697
Company Escambrera Bleyberg..	5,579
Nouvelle Montagne.....	5,168
Eschger, Ghesquire and Co.....	4,030
Society Metallurgique de Prayon.	3,965
	102,755

—A. W.

MISCELLANEOUS TRADE NOTICES.

NEW REGULATIONS CONCERNING EXPORT OF MEDICINAL TINCTURES.

The following letter has been received in reply to one from the Chairman of the Chemical Trade Section of the London Chamber of Commerce:—

"Inland Revenue, Somerset House,

"Sir,

"1st August 1889.

"I AM directed by the Board of Inland Revenue to acknowledge the receipt of your letter of the 26th ultimo, and to acquaint you in reply that further amendments to the regulations as to the exporting of medicinal tinctures will be introduced, so that in future the name of the person for whom the tinctures are bottled, or some distinguishing mark without the name, will be allowed to be placed on the outside of the case instead of the maker's name, on condition that the licensed maker, after filling in the form 114—4, will write after the particulars of notice the full name and address of the person for whom the tincture is bottled and in whose name it is to be exported, or specify instead the distinguishing mark which the exporter intends to use.

"General instructions on the subject will be issued to the Board's officers without delay.

"I am, Sir,

"Your obedient servant,

"ROBERT MICKS,

"Secretary."

THE SALT DEPOSITS OF IRELAND.

(See this Journal, 1887, p. 688.)

The new salt mine at Carrickfergus has been sold to Charles Tennant and Co. (Limited), chemical manufacturers, Glasgow, who have commenced boring operations.—*Chemist and Druggist*.

BARYTES IN IRELAND.

A barytes mine has been discovered at the foot of Mount Gabriel, on the Rosbrin estate, co. Cork. Samples of the mineral have been sent to England, and have been considered excellent.—*Ibid*.

PREPARATION OF CHINA GRASS.

(Journ. Soc. Arts, Nos. 1888 and 1890.)

In a late number of the "Kew Gardens Bulletin of Miscellaneous Information," is a report on the series of trials of methods for preparing China grass, undertaken by the French Government, which was drawn up by Mr. D. Morris, Assistant Director of Kew Gardens, who attended the trials on behalf of the India Office. The general conclusions drawn after a tolerably exhaustive inquiry and report are of considerable interest, and they may be stated as follows:—

There is no doubt that China grass is exciting great interest in many parts of the world, and many people are experimenting with various processes for extracting the fibre cheaply and quickly. Up to the present no results are quite satisfactory. The fibre is either imperfectly freed from gummy matter, or the process breaks down in the matter of cost, or owing to the local conditions under which it must be carried on. No system of preparation which cannot produce the clean, unbleached fibre under 30l. per ton, is likely to succeed in establishing this article firmly in the estimation of English textile manufacturers. It is quite possible that some machine or process will eventually solve the problem, but the exploitation of China grass, in spite of years of labour, and the expenditure of large sums of money upon it, cannot be said to have yet emerged from the experimental stage.—*Ibid*.

MINERAL INDIA-RUBBER.

An article formerly considered worthless has been added to the useful products, and is known as mineral india-rubber asphalt. It is produced during the progress of refining tar by sulphuric acid, and forms a black material

very much like ordinary asphalt, and elastic like india-rubber. When heated so that the stony matter is reduced to about 60 per cent. of its former size, a substance is produced hard like ebony. It can be dissolved in naphtha, and is an excellent non-conductor of electricity, and therefore valuable for covering telegraph wires and other purposes where a non-conducting substance is needed. Dissolved, the mineral india-rubber produces a waterproof varnish. The manufacture of the material is said by an exchange to be profitable.—*Engineering and Mining Journal*.

THE REPORT OF THE BERLIN CHAMBER OF COMMERCE.

The report of the Berlin Chamber of Commerce on the condition of the drug and chemical branches in that city during the year 1888 asserts that so far the only result of the incorporation of Hamburg into the German Customs Union has been a considerable increase in the Hamburg charges on the handling of merchandise, a perceptible decrease in the promptness with which goods are transhipped in that port, and the creation of competition of the Hamburg traders in the interior of Germany. The exceptionally low value of the Russian exchanges, the severe winter and consequent delay in the opening of river and sea communication, and the uncertainty of the political situation, were the reasons that business during the first half of the year remained very unsatisfactory. Later on a remarkable increase in the export trade of drugs and chemicals became perceptible. On the whole the industrial combinations and conventions, the number of which is constantly growing, have not operated to the disadvantage of the industry. A striking feature in the drug trade is the growing popularity of certain American drugs, especially *casearia sagrada*, *hydrastis canadensis*, and *senega*. The trade in German vegetable drugs, on the other hand, especially for export, is falling off seriously, and even prices at which the planters cease to have any profit fail to rehabilitate this branch of trade. The manufacture of chemical and pharmaceutical preparations has been very brisk, and is still rapidly growing.—*Chemist and Druggist*.

THE TRADE IN MASTIC.

The price of mastic, in common with that of so many other products, has been at a very low ebb of late, so low in fact that the Administrative Council of the island of Chio, in the Greek Archipelago, where the mastic is obtained, and where its collection forms an important branch of industry, have recently made a study of the best means of raising the price of the article. Among other measures it was decided to prohibit: (1.) The repeated incisions in the trees. (2.) The offering for sale of impure, yellow, or black mastic. (3.) The mixing of the native product with dust or with residues of the tree bark, more or less impregnated with mastic. Since these measures have been adopted and carried out, the price of the mastic is said to have advanced locally to an appreciable extent, and the Government of the island now inform the commercial world that, for the future, the bark of the mastic resinous trees must not be tapped more than twice a year, and that at fixed and determined periods. The only kind of mastic which is allowed to be gathered is the white mastic, free from powder or from any other foreign substance.—*Ibid*.

SCHNEIDER AND CO.'S PATENT COPPER CASTINGS.

Schneider and Co., Creusot, France, have patented a process, which consists in making, in a blast furnace, a cupola or a reverberatory furnace, castings having a variable proportion of copper with a proportion, likewise variable, of the ordinary constituents of cast iron. These copper castings are used for the manufacture of the copper steels which serve for the preparation of articles such as sheathing and armour for vessels, cannon, projectiles, bed-plates, steam cylinders, rolls, &c., the articles, when desired, being case-hardened or hardened in oil. Copper ore is mixed with the charge in the blast furnace, or copper alloys with the charge in the cupola. Also copper filings can be mixed with coal to form a copper coke, which is used for heating the blast furnace or cupola; or copper compounds can be

melted in a reverberatory furnace, with a mixture of steel or iron under a layer of anthracite to prevent oxidation.—*Ironmonger*.

INTERNATIONAL CONGRESS OF CHEMISTRY.

The International Congress of Chemistry was opened on Tuesday, July 30, at precisely 8.30 p.m., by M. Berthelot, in the grand amphitheatre of the Arts-et-Métiers Conservatory. The attendance was large, and included a number of foreigners. M. Berthelot briefly exposed the objects of the Congress. "Theories are not to be considered," he said, "but only practical questions, such as relate to analytical methods and nomenclature. The last urgently needs revision and improvement. The system hitherto followed has become insufficient. So many new compounds have been discovered that they are bursting through the frames formerly intended and thought wide enough to contain them. This is especially true of the hydrocarbons and the numberless substituted azo-compounds derived from coal distillation, and used in pharmacy and the arts. We cannot keep on adding syllables and forming endless names for new combinations. A new and clearer system is absolutely necessary, with lines broad enough to last for some time at least." After expressing his wishes and hopes for successful results, the chairman, on behalf of the organising committee, proposed for the various sections of the Congress the names of presidents and secretaries, which were unanimously confirmed. They were as follows:—Section I. Unification of the Nomenclature in Organic Chemistry: president, M. Riche; secretary, M. Bischof. Section II. Chemical Analysis of Organic Bodies: president, M. Joulie; secretary, DeMoussy. Section III. Analysis of Alimentary Substances: president, M. Friedel; secretary, M. Bouvean. Section IV. Analysis of Pharmaceutical Products: president, M. Petit; secretary, M. Boequeron. Wednesday and Thursday, at 3 p.m., were set apart for considering the questions of cinchona, opium, quinine, chloroform, phenol, pepsin, salicylic acid, and analgesin analysis and testing. On Wednesday afternoon, at the hour appointed, the meeting was resumed, with M. Petit in the chair, assisted by Secretary Boequeron and MM. Marty, Konya, of Roumania, and Rio de la Loza, of Mexico. The testing and assaying of quinine, cinchona bark, and morphine were the subjects of an earnest exchange of views between Professors Marty and Jaogleich and MM. Petit, Boequeron, Taillandier, Tanret, Léger, and others. In respect to quinine and cinchona assay, the conclusions arrived at were that the Codex tests, as modified by the Paris Society of Pharmacy, and supplemented by polarimetric tests, are necessary, but sufficient for a pharmaceutical estimation. As regards morphine, after a long discussion a committee was appointed, composed of MM. Yvon, Tanret, Boequeron, and Petit, to embody the views expressed, and present them to the general meeting.—*Ibid*.

RAILWAY RATES.

A very large meeting was held at the Mansion House on Friday, July 26, under the presidency of the Lord Mayor, "for the purpose of considering what further steps should be taken to prevail upon the railway companies to agree to terms more equitable to traders, and also to establish a central organisation for concerted common action among the mercantile representatives." The meeting gave evidence of the unanimity of the trading classes of the country in condemnation of the unfair classification of goods which has been proposed by the railway companies. It was resolved, on the motion of Mr. Howard, that in view of the serious objection taken to the classifications submitted by the railway companies, the Board of Trade should invite the aid of a commission of experts with the object of assisting the department to frame a classification upon a fairer basis than that presented. After 40 years' experience in railway work, the mover said, it could not be impossible to make a proper classification. Other countries had done this, and what was possible with others should be possible to Great Britain. It was also resolved to form an association to concert common action and to be representative of agriculture, commerce, and of the various other interests affected.—*Chemist and Druggist*.

DEODORISING OPERATIONS.

At the weekly meeting of the London County Council, held at the offices, Spring Gardens, S.W., on July 30th, Lord Rosebery presiding, the Main Drainage Committee reported that they had received from the chemist a further report on the condition of the River Thames, and on the deodorising operations. The report was to the effect that the river was now in a much more satisfactory condition, the change in the weather having effected a material improvement. With regard to the deodorising operations, the chemist stated that, from July 11 to 20, 128 tons of manganate and 47 tons of sulphuric acid had been used at the outfalls, and 9 tons of manganate and 2 cwt. of sulphuric acid at the various storm overflows. The quantity in stock on the last-named date was:—At the outfalls: manganate, 16 tons; sulphuric acid, 31 tons. At the storm overflows: manganate, 37 tons; sulphuric acid, 15 tons. The committee recommend that the seal of the council be affixed to the following documents:—(Contracts with Messrs. C. Tennant, Sons, & Co., the Widnes Alkali Company (Limited), and Middleton, Kirkpatrick, and Barr, for the supply of manganate of soda; and with Sadler & Co. (Limited), for the supply of sulphuric acid. The recommendations were approved without discussion.—*Ibid.*

The Basic Bessemer Process in the United States.
W. B. Phillips. Eng. and Min. Jour. 1889, 2, 30.

THE following tabulated figures showing the world production, in tons, for the past eight years, of both acid and basic Bessemer iron, have been collected from various sources and are approximately accurate:—

—	Basic.	Acid.	Per Cent. of Ratio.
1881	260,000	4,333,470	4.44
1882	572,604	4,687,143	10.83
1883	634,373	4,482,719	12.39
1884	864,000	3,338,145	18.00
1885	945,317	4,090,831	18.80
1886	1,313,631	4,814,361	21.50
1887	1,702,252	5,647,741	23.15
1888	1,984,184	4,912,171	29.10

The production of basic slag in 1888 was 600,000 tons.

—A. W.

Number and Description of Furnace.	Class of Ore treated.	Capacity per 24 hours.	Number of Workmen per Furnace.	Fuel per Ton of Ore.	Price Treating the Ore per Ton.
		Tons.		Lb.	Cents.
1. Idria, modified by Auerbach	4	20	5½	80	80
2. Trong system, Auerbach	4	40	5½	70	66
1. Idria double reverberatory	3 and 2	8	7½	250	272
1. Chermak's combined reverberatory and cupola	3 and 2	40 to 45	9½	88	68
1. Auerbach	1	7	3	120	80

—A. W.

The Causes of the Principal Defects of Wrought Iron.
A. D. Elbers. Eng. and Min. Jour. 1889, 2, 31.

THE author, after quoting from Karmarsch (edition of 1866, Hanover), gives his own views in explanation of the properties of cold, blue and red-shortness of different kinds of iron, and endeavours to connect the effects of impurities at various temperatures with the properties of those impurities themselves under similar conditions, but admits that his remarks are not intended to appear authoritative. An impurity with less tenacity than iron tends to render the latter cold short, and, if the dissimilarity increases on heating, also blue and red short. If the impurity melts below a red heat the injurious effect is still greater as the temperature increases, until the iron commences to lose its own rigidity, when it decreases,

CALIFORNIA BORAX.

New borax works have recently been started in Saline valley, Inyo county. They have 18 crystallising tanks, each of a capacity of 1,000 gallons. Three of these tanks are emptied daily, yielding about two tons of borax. The crude material from the borax marsh is first boiled in a boiler of 3,000 gallons capacity, and the solution is then run off into the tanks, where it is allowed to cool off and crystallise for about six days. The borax accumulates on the zinc sides of the tanks, and on plates of that metal hung in them, seven being used to each tank. The works are about 55 miles from Alvord station, and are close to the great Inyo mountains, which rise like a wall to a height of 11,000 feet above the sea level.—*Scientific American.*

Quicksilver in Russia. W. A. Abegg. Eng. and Min. Jour. 1889, 2, 26.

THIS is a description of the recent working of a new cinnabar mine in the Baku mouth district of Russia.

The lode is estimated to contain 194,000 tons of ore, containing nearly 1 per cent. of mercury.

The ore is blasted with dynamite (90½ lb. of dynamite for about 18 tons of ore), and, after crushing, is divided into four classes according to size, the finest being the richest.

The output of ore for the first year of working, 1887, was 11,527 tons of 2,000 lb. separated into the following proportions:—

About 2.5 per cent. of No. 1 ore, containing 4.85 per cent. of mercury.

About 10.0 per cent. of No. 2 ore, containing 2.20 per cent. of mercury.

About 15.0 per cent. of No. 3 ore, containing 1.23 per cent. of mercury.

About 72.5 per cent. of No. 4 ore, containing 0.65 per cent. of mercury.

The works delivered, in 1887, 141,009 lb. of quicksilver, and in 1888, 362,366 lb., but furnaces have been put down capable of producing over 800,000 lb. per annum. The following table shows the particulars of production by the various systems used:—

whereas an impurity which is then more rigid than iron tends to lessen its plasticity. This is said to explain apparent inconsistencies, such as copper rendering iron red and weld short, and sulphur only cold short.

Explanations are also given of the causes of iron losing its tenacity by repeated heatings, by which it is demonstrated that iron with small quantities of impurities is apt to be affected more quickly in this respect than iron containing a larger quantity of them. Finally the causes of the appearance of different fractures are discussed.—A. W.

JAPAN AS A COAL PRODUCER.

(Eng. and Min. Jour. 1889, 2, 32.)

VAST coal fields have recently been discovered in the islands of Kinsin and Yesso. Karatin coal beds exist five feet in

thickness and extend over an area of 120 square miles. Collieries exist near Tokio, anthracite has been found in the island of Amakusa, and lignite can be obtained in all the Japanese provinces. The total output in 1881 amounted to about 700,000 tons, and has since been steadily on the increase. The machinery employed is chiefly German.

—A. W.

VICTORIAN DRUG DUTIES.

It has been proposed in the Victorian Legislature to admit duty free the following drugs now dutiable:—Carbolic, oxalic, and picric acids, aloes, cannabis indica, faba amara, grains of paradise, potassium (bromide), potassium (iodide), and quassia. Perfumery to be increased from 10 per cent. to 20 per cent.—*Chemist and Druggist*.

CONSUMPTION OF QUININE IN THE UNITED STATES.

The imports of foreign-made quinine into the United States between January 1 and August 3 have been 1,877,614 oz. against 997,200 oz. during the corresponding period of 1888. In St. Louis and other districts liable to malarial fever quinine is said to be in better demand this year than in any previous season.—*Ibid*.

THE TRADE IN KOLA NUTS.

The trade in kola nuts in the British settlements of Gambia (West Coast of Africa) is increasing. The imports during the year 1887 were 356,579 lb., and in 1888 409,735 lb. The import duty of 1d. per lb. on the nuts has recently been reduced to $\frac{3}{4}$ d. per lb.—*Ibid*.

THE GERMAN CUSTOMS DUTIES.

The German Customs duties yielded 290,160,365 m. in 1888, against 270,446,981 m. in 1887. Drugs, chemicals, and dyestuffs together brought in 1,022,798 m., and 1,000,074 m. respectively. The most remunerative articles of this class are dyewood extracts, from which was collected last year 181,845 m.; bleaching powder, 175,233 m.; lacquers and varnishes, 117,220 m.; glue, 67,299 m.; caustic soda, 66,948 m., and oil varnishes, 63,240 m.—*Ibid*.

INSECT FLOWER GROWING IN CALIFORNIA.

It appears that insect flowers (*Pyrethrum cinerariaefolium*) are now being grown on a large scale in California, and that the powdered flowers are sold in that State under the name of buhach. The plant was first introduced into California about 12 years ago by a Mr. Mileo, a native of Dalmatia, who succeeded, after some trouble, in growing the plant on an extensive scale, and in 1880, associating himself with other capitalists, established the Buhach Producing and Manufacturing Company. At the present time the company have about 300 acres of this plant under cultivation at their farm near Atwater, Merced county, California, and own mills for grinding the dried flowers to powder at Stockton, near San Francisco. The cultivation of the *Pyrethrum* requires careful and intelligent supervision, and it cannot be grown successfully without irrigation. It requires three years from the time of sowing to grow plants capable of producing a paying crop of flowers, and then they will bear from four to five years longer. It is at its prime, however, in its fourth or fifth year. The plant grows about 30 inches high, and is set out in rows 4 feet apart, and from 15 to 24 inches apart in the rows. The flowers are harvested towards the latter part of May. The stalks are cut just above the roots, and the flowers stripped from them by passing the plants through a kind of comb. The detached flowers fall into a box below, and are carried to the drying-ground, where they are spread on sheets and exposed to the rays of the sun during the day, being repeatedly turned over in the meanwhile. They are covered during the night to prevent their absorbing moisture, as the perfect drying of the flowers is most important in order to retain the volatile oil which gives the powders its insecticide properties. It is also very necessary that this operation should be done quickly, and that the flowers during the drying process should be protected from moisture. A slight dew falling upon the flowers at this time will injure their colour, and reduce their strength

as an insect destroyer. In this respect the Californian-grown flowers are said to be better cured, and consequently more valuable, than those produced in Dalmatia, the particular conditions of soil and climate in California being extremely favourable to the growth and curing of plants rich in the essential oil which renders them so destructive to insect life.—*Ibid*.

RUBIDIUM.

Professor Laufenauer publishes in the "Therap. Monatsch.," a preliminary note on rubidium-ammonium-bromide. The double bromide was used as being cheaper than the rubidium bromide. It consists of $\text{RbBr}_3(\text{NH}_4\text{Br})$, representing in 100 parts 36 parts RbBr and 64 NH_4Br . The author has studied its epileptic action in 17 cases, the doses given varying from 1 drachm to 2 drachms; the effect was similar to that produced by potassium bromide, but more intense. The hypnotic action was very satisfactory. On the whole it acts very like the other alkaline bromides, but more decidedly. The author reserves to himself the priority of using similar compounds of cesium.—*Ibid*.

DISCOVERY OF MINES IN SWEDEN.

A company which was formed this year for the purpose of prospecting the district of Gellivara, in Sweden, has discovered extensive mines of argentiferous lead, copper, manganese, graphite, and iron to the north of Gellivara, and at no great distance from the railway. The lead ore, which exists in great abundance, is said to contain more silver than that found in the celebrated Sala mines, and is pronounced by experts to be the richest ore of the kind hitherto found in silver. Gold sand has also been met with in some of the mountain streams. About 30 years ago some Russian geologists obtained 5 lb. of gold and some platinum in the same neighbourhood after working for a few weeks, but the washings were abandoned, owing to the Government insisting that the Russians should become Swedish citizens. The copper mines at Skrikerum, which had not been worked since 1832, have recently been reopened under the management of Professor Blomstrand, Luna, and Dr. Rudelins. It was in these mines that selenium was first discovered by Berzelius in 1817.—*Ironmonger*.

IMPORTANT DISCOVERY OF URANIUM IN CORNWALL.

A few weeks ago the Devon and Cornish papers reported a very rich find of the rare and precious metal known as "uranium." It now transpires that the discovery is of even greater importance than was at first thought. A continuous lode of this mineral has been opened, a thing perfectly unique in its history since the mineral was first discovered by Klaproth, a German chemist, exactly 100 years ago. Klaproth isolated from a dark-coloured material known as pitch-blende a yellow oxide which he, after testing, declared to be the oxide of a new metal, to which he gave the name of uranium in honour of the planet Uranus, which Herschell had then recently discovered. Different varieties of uranium were shortly afterwards found in districts of Bohemia and Saxony, and after the lapse of several years traces of the precious ore were found in Cornwall. Curiously enough, the enormous find of uranium at Grampound Road, in Cornwall, has taken place in the centenary year of the original discovery. Hitherto this mineral has only been found in pockets and patches. The discovery at Grampound Road is what is known as a true fissure vein, and the ore contains an average of 12 per cent. of the pure metal, going up as high in many places as 30 per cent. The importance of the discovery will be understood when it is stated that the market price of the pure metal is 2,400l. per ton.—*Ibid*.

THE ADULTERATION OF LARD IN THE UNITED STATES.

The following information respecting the adulteration of lard in the United States is extracted from a memorandum recently issued from the Agricultural Department of the Privy Council Office:—

It appears from a report just published by the United States Department of Agriculture, and prepared under the

direction of the chemist at the head of the division of chemistry, that lard is very largely adulterated with cotton-seed oil and fat from animals other than pigs.

Lard is technically the fat of certain parts of the pig. This is the British idea of lard, but according to the chemist of the United States Department of Agriculture, lard is a term applied to the fat of the slaughtered hog, separated from the other tissues by the aid of heat; but he admits that the heads and much of the viscera and other parts of the animal are put into the "rendering tanks," and, indeed, by the definitions of the Chicago Board of Trade, any part of the hog containing fat can be legally used for the manufacture of lard.

With respect to the fat of other animals than pigs, it is stated that oleo-stearin, made chiefly from the caul fat of cattle, is employed to a considerable extent to adulterate lard. This is produced in open kettles, the tallow resulting from this is placed in ears in a "granulating room," where it is allowed to remain at a temperature of from 80° to 90° F. The contents of the ears are then mixed and placed on a revolving table, where they are made into cakes. These are wrapped in strong cotton cloths and placed in a press, where a gradual pressure at 90° F., becoming very strong at the end, is applied for one or two hours. The expressed oil, known as oleo-oil, is used in the manufacture of butterine. The stearin is removed from the press as white hard cakes, and is used for adulterating lard.

It is said concerning beef fat that before the day of oleo-margarin all fat rendered from the tissues of cattle was known commercially as tallow. Since then differentiation has taken place and the term tallow is no longer sufficient to designate the several products obtained from the rendered fat of the beef. There is first "butter stock," which is rendered from the caul fat at a low temperature, and from which is manufactured by means of pressure, 1st, oleo-oil; 2nd, oleo-stearin, beef-stearin.

A fine article of mutton tallow is also sometimes used in lard, but the objection to the flavour is sufficient to limit its use to a small amount.

The term "refined lard" has long been used, says the chemist, to designate a lard composed chiefly of cotton oil and stearin. The largest manufacturers of this kind of lard have now abandoned the term, and are using the label "lard compound" instead. This, it is added, is but just to the consumers of this article, who are likely to be misled by the term "refined lard."

The natural lard in a state of fusion, the stearin from beef fat, and the refined white cotton-seed oil are measured in the proper proportions and placed in a tank at a temperature of 120° to 160° F. These various ingredients are thoroughly mixed by means of paddles worked by machinery. After it is mixed the compound lard is passed into artificial coolers, where it is chilled as soon as possible. From thence it is run off into small tin cans or large packages and prepared for market.

In external appearance and to an unskilled person it is said that adulterated lards are not appreciably different from the pure article. "An expert, however, is generally able to tell by taste, odour, touch, and grain, a mixed lard from a pure one. There is usually enough lard in the adulterated article to give it the taste and odour of a genuine one. Mixtures of fat have been made and perhaps sold as lard which contained no hog's grease whatever."

Alluding to statements that other adulterants of not so harmless a nature are used in making lard, the chemist remarks: "Among these substances dead-hog grease, or dead-hog stearin, is the one most frequently mentioned. The term dead-hog grease is used to indicate the oil or lard obtained from animals which die of disease, or are smothered in transportation, or die on the way to the slaughtering houses. The fat of animals recently dead, unless death takes place from disease, and taken before decomposition sets in, has chemically the same characteristics as that derived from animals slaughtered. If, however, the animals had been dead some time a considerable decomposition of the glycerins takes place, and the amount of free acids in the fat is thus largely increased. Such fat also shows a distinctly unpleasant odour, by which it can be readily detected from genuine lard."

Pea-nut oil and other vegetable oils are also mentioned as lard adulterants, but of these the chemist remarks: "While it may be true that many attempts have been made to use the above substances in the adulteration of lard on a small scale, it is also quite true that such attempts have never attained any importance from a commercial point of view."

CONSUMPTION OF NITRATE OF SODA IN THE UNITED STATES.

The *South American Journal*, in its issue of the 27th July, in illustration of the statement that the use of nitrate of soda is obtaining a firm footing in the United States, quotes the following statement of a leading New York firm:—

The consumption at Charleston of nitrate of soda (used chiefly in the manufacture of artificial manures) is increasing to a remarkable extent. Up to this year Charleston has never taken more than one cargo of nitrate, but in 1889 we have succeeded in placing four cargoes, and have an inquiry for another. Hitherto great difficulty has been experienced by manufacturers in getting their artificial manure sufficiently dry for the distributors when mixed with nitrate of soda. Now, however, we learn that they have entirely overcome this difficulty, and the consequence is, as we have said, that they have taken four or five times as much nitrate of soda this year as in the past, and we think there is every prospect of a still further increase in the consumption.

PRODUCTION OF COTTON-SEED OIL IN TEXAS.

The following particulars respecting the production of cotton-seed oil in Texas are extracted from a recent report by the French Vice-Consul at Galveston:—

The factories engaged in the cotton-seed oil trade in Texas produce annually 130,000 tons of oil-cake and five million gallons of oil. The latter article is forwarded to the manufacturing towns of the west and north, chiefly to Chicago, Kansas City, St. Louis, and New York. It is used as burning oil, mainly in the mines, and it is largely used for the manufacture of soaps and candles; this is the use to which it is honestly put. The unscrupulous find it most profitable in many commercial adulterations. Refined, it is sold for olive oil; mixed in certain proportions with tallow, it assumes in the market the name of fat and lard. But the great fraud was its substitution for butter. A law of the United States has put an end to this fraud by requiring the seller of oleo-margarin to declare the real nature of their product, and, for this reason, with very rare exceptions, artificial butters are no longer sold here, except as such and at prices commensurate with their composition.

It is possible that the fraud has found its way across the Atlantic and is now practised on the European side of the ocean. According to statistics published on the 7th November last, by the *New York Oil, Paint, and Drug Reporter*, it appears that from the 1st September, the date of the opening of the cotton season, to the 3rd November 1888, the Netherlands imported from the United States 229,130 gallons of cotton-seed oil. Its imports of the same product during the same period of the previous year only amounted to 3,767 gallons. On the other hand, the butter trade in the Netherlands, already very considerable, goes on increasing. This simultaneous increase in the sale of butters and in the purchases of cotton-seed oil, may be only a curious coincidence; but the case seems worthy of attention and should be noticed. The export to Germany of cotton-seed oils has also increased in a large proportion. From the 1st September to the 3rd November 1887, it was 1,849 gallons; from the 1st September to the 3rd November 1888, it reached 60,204 gallons.

SISAL HEMP TRADE AND COMMERCIAL IMPORTANCE OF YUCATAN.

In a letter to the *South American Journal* dated Merida, June 15th, a correspondent writes as follows in regard to the important progress of Yucatan:—

"To give an idea of the importance of henequen (sisal hemp), over 100,000 bales will be exported for the first six

months of this year, representing a value of over 5,000,000 dols. Last year's export reached 214,069 bales, weighing over 76,000,000 lb., and of a value of over 10,000,000 dols. gold. You can therefore easily realise how an article grown from the soil, with little or no cost attached to it, selling now at the rate of 50*l.* to 55*l.* per ton, must enrich Yucatan, which, all told, has not a population of more than 300,000 inhabitants. Yucatan, in fact, is now so prosperous that money is a drug; people do not know what to do with it, and they are willing to buy all kinds of goods, even the most costly. As I said before, here is a most favourable field for English commerce."

BENGAL OPIUM SALES.

The following is extracted from the *Calcutta Englishman* for the 22nd June last:—

It is notified that in the calendar year 1890 not more than 57,000 chests of Bengal opium will be offered for sale, and not more than 4,750 chests in each month of the year. Of the quantity to be offered for sale in each month, not more than 2,500 chests will consist of Benares, and not more than 2,250 chests of Patna opium, and no reduction will be made in this quantity without three months' previous notice.

PETROLEUM BEDS OF UPPER BURMAH.

The *Burmah Gazette* contains the following account of a survey of the petroleum beds of Upper Burmah by Dr. Fritz Noetling, of the Geological Survey:—

The oil wells of Yenangyoung, or more properly Twingoung, and Bené, have long been famous, but hitherto there has been the greatest discrepancy in the various accounts of their number and productiveness. The field at present contains 524 wells, but of these only 281 are productive; and Dr. Noetling estimates the daily yield to be at the very least 15,000 vis, or 450,000 viss a month (a viss is about a gallon), a remarkable confirmation of the estimate of Major Storer, published in 1871, which put it at 4 lakhs of vis a month. The output, however, is nothing to what it might be with proper methods and appliances. The oil-bearing strata consist of soft sandstone, which the Burman, with his primitive tools, digs through at a great expenditure of time and labour. In no case does he get lower than 310 feet, leaving nearly 100 feet of the oil-bearing stone, the richest portion of the field, wholly untouched. Under other conditions Dr. Noetling estimates that the production might be raised to 50,000 vis a day. This gives 18½ million vis a year, or about half the total importation of both Russian and American oil in 1887—88.

DISCOVERY OF COAL IN CEYLON.

The *Ceylon Observer* (overland edition) for the 10th June last announces the discovery among some samples of plumbago dug out of a Pussellawa estate, of a piece of true bituminous coal, the first, it is supposed, ever found in Ceylon.

GERMAN PETROLEUM.

Concerning the position of the German petroleum industry the following extract from the report of the Board of Directors of the United German Petroleum Works for 1888, which is just issued, gives some interesting information.

At the beginning of the year 1888 there were two borings only at Hänigsen that had been made for the purpose of obtaining raw petroleum, and during the course of the year eight more borings were undertaken.

Of these ten oil wells, six yielded petroleum, three had to be given up as useless, and one was still being experimented upon.

The output of the two older wells at Hänigsen has not appreciably diminished during the past year. At the beginning of 1888 there were twelve wells being pumped at Oelheim; of these four had to be given up, while six became more productive during the course of the year.

At the commencement of 1889 there were no less than 14 wells being pumped from.

The following figures exhibit a comparison between the outputs for the years 1887 and 1888:—

	Kilogs.
Hänigsen.....	54,342
Oelheim.....	982,003
Total (1888).....	1,036,435
Total in 1887.....	1,003,023

In the refinery at Peine raw oil was worked up as shown by the following:—

	Kilogs.
1887.....	2,323,904
1888.....	2,068,828

According to the report, negotiations are being carried on to considerably increase the refinery business in an advantageous way.

The United German Petroleum Works Company has made a net profit of 20,026 marks, which, considering the difficulties it has had to contend with, is a very fair result.—*Oil and Colourman's Journal*.

REPORTS FROM THE STATES.

Reports from the States speak of the continued decrease in the quantity of petroleum in stock. There has now been an unbroken record of decreasing stocks in each monthly statement since July 1887, and the indications warrant the expectation that stocks will continue to grow smaller, as the field developments do not show the increase in production looked for. As the season of increased consumption approaches the difference between runs and deliveries will grow larger, while the operations in the fields will be pursued under less favourable conditions. At present we are in the season of lightest demand and most favourable conditions for field work, and yet the stocks have been drawn upon to the extent of nearly half a million barrels to make up the difference between production and consumption. After the present month this gap may be expected to widen unless far better success attends new drilling ventures than has been shown during the past year and a half.—*Ibid*.

THE INDIAN TRADE IN MINERAL OILS.

The *Times of India*, with reference to the Indian trade in mineral oils, says:—

"In 1887 the imports of oil of the United States into India reached a total of 29,144,942 gallons, while last year they were only 25,040,517. The import of Russian oils, however, increased from 1,577,392 gallons in 1886—87, when the trade was inaugurated, to 5,036,055 in 1887—88, while in eight months of 1888—89 over 11,000,000 gallons were imported. Whether the progress of the trade was temporarily interrupted by higher prices or by the imposition of a duty of half an anna per gallon in January of last year is not quite clear; but there can be no doubt, as the report says, that now that the use of the oil has become so common, and its advantages, when compared with the smoky and dull light given by the vegetable oils which kerosene is superseding, are so much appreciated, it is improbable that the trade will not further advance. Petroleum in abundance has been found in Afghanistan, but its quality makes it unfit for use, except as fuel for locomotives. The petroleum of Upper Burmah is used to but a small extent for illumination, being chiefly employed for machinery. The wells of Arakan are not now worked, except in a very small way by natives, the European company formed for their working having failed. There are hopes of finding large quantities of oil in the Rawal Pindi district, where the oil is now used in a small way for making gas by the military authorities, and a concession of mining rights has recently been given on very liberal terms to an association of capitalists who propose to seek for oil in that district. But, so far, it may be said that India is entirely dependent on its imports for mineral oil for illumination. Until recently the United States have had the practical monopoly, but, as we have shown, Russian oil is now making a considerable figure in the trade."—*Ibid*.

NAPHTHA RESIDUUM AS FUEL.

Consul Michell, of St. Petersburg, writes:—Naphtha residuum is being more and more employed as fuel in Russia. All the steamers of the Caspian, and many of those plying on the Volga, have for some time past been fuelled with it. Now manufactories and railways are adopting it in the place of wood and coals. It is also being utilised for domestic purposes in stoves of special construction, ingenious specimens of which were exhibited last year at the St. Petersburg naphtha products exhibition. By the employment of this new combustible a serious saving is effected under the head of fuel. Some large manufactories in Moscow and its immediate neighbourhood employ naphtha residue in their furnaces, because, in addition to its great cheapness, it possesses the great advantage of occupying less space than wood or coals for storage. It is kept under ground in large cisterns, communicating by pipes with the furnaces, and, owing to this method of storage, it is also less exposed to danger from fire. It is established that the cost of naphtha dregs as fuel is about 35 per cent. less than that of wood and coal, and this too at Moscow, which is 1,500 miles distant from the source of supply at Baku, whence naphtha dregs are conveyed by water to Nijni Novgorod, and beyond by rail to Moscow. Several manufacturers of the province of Vladimir have also adopted the new combustible, and the railway lines existing in the Tamboy and Riazan provinces are on the point of doing the same. During 1888, 54,000,000 of pounds (867,857 tons) of naphtha residue were transported from Baku, up the Volga, for use in the interior provinces and in those bordering the Volga. It is expected that in 1889 the supply will exceed 70,000,000 pounds (1,125,000 tons). In the northern zone of the Empire wood will, it must be presumed, hold its own as fuel for some time to come.—*Ibid.*

THE CRISIS IN THE BAKU NAPHTHA TRADE.

Nearly all the railway companies in Russia are using naphtha as a fuel instead of wood or coal, but as its price has gone up very rapidly through the flow becoming less daily the naphtha owners are afraid that the supply will terminate altogether. The Government were asked to send competent engineers to Baku to inspect the mines, and to ascertain how long the naphtha will flow. Accordingly, a civil engineer (Mr. Koushin) inspected the mines, and he has sent a report to the Government advising them to find new fields of naphtha, as the naphtha from the Balakhovskiy mines will eventually cease altogether.—*Ironmonger.*

THE SUPPLY OF RUSSIAN PETROLEUM.

The statement that the oil wells in the Baku district of the Caspian section of Russia are showing symptoms of exhaustion is a matter of considerable importance to all dealers in and users of that class of oil and its products. In Europe—at all events in Western Europe—the Russian oil has never been in really serious competition with the American article, but in the Levant, in Asia Minor, and in India the Russian oil has made great strides, and has secured a strong footing in successful competition with American petroleum. The general progress of the Russian oil is shown by the following figures, which give the production and export in pounds, each pound being a fraction over 36 lb. in weight:—

Years.	Production.	Export.
1884	80,000,000	54,685,429
1885	115,000,000	68,601,310
1886	123,000,000	72,849,104
1887	131,000,000	79,495,123
1888	165,000,000	117,821,020

In India the Russian oil is sold at rather lower prices than the American, and being packed in the same way (in cases of two 4-gallon tins) has made rapid progress, as is demonstrated by the following figures, which represent millions of gallons:—

Years.	American Oil.	Russian Oil.
1880	9½	..
1883	12½	..
1884	26	..
1885	20	..
1886	20	1½
1887	25	5
1888	20	17½

During the first half of this year, however, the exports of American oil to India seem to have increased greatly, the total for the six months being over 20,000,000 gallons from the port of New York alone. Generally speaking, indeed, the exports of American oil have increased this year, as is shown by the subjoined figures, which relate to New York only, and are for the period from January 1 to July 23, 1889:—

Refined Oil.

Destination.	1889.	1888.
	Gallons.	Gallons.
England	23,000,186	21,825,038
Germany	39,188,246	44,087,278
Sweden and Norway	1,962,866	1,527,545
Denmark	889,216	1,570,832
Belgium	11,506,073	16,814,340
Holland	20,260,737	10,972,468
Mediterranean	1,527,030	1,971,080
India	20,281,621	16,791,490
China and Japan	26,632,460	18,331,420
Philippines, Funa Islands, and Straits	26,729,540	15,569,410
Africa	3,627,552	2,015,808
Australasia and Oceania	4,561,067	5,290,816
South America	11,305,252	9,347,676
Rest of America	5,176,269	6,153,902
Totals	196,648,115	172,308,112

Crude Oil.

Destination.	1889.	1888.
	Gallons.	Gallons.
France	16,114,678	11,396,719
Germany	1,288,003	817,022
Rest of Europe	2,807,513	7,862,309
Cuba	1,769,529	1,741,949
Mexico	2,280,644	..
Totals	24,920,367	21,727,999

In addition to this total about 85,000,000 gallons were exported from Boston, Philadelphia, Baltimore, and Perth

Amboy, so that the aggregate exports of American oil have increased by over 13 per cent., comparatively, during the period indicated. If it is true that the Russian supplies are decreasing, it follows that the American oils will be used all over the world in larger quantities than before. The employment of tank steamers is advantageous for the American shippers, and that system can probably be used more economically and more largely by the Americans than by the exporters of the Batoum district.—*Ibid.*

THE RUSSIAN PETROLEUM SUPPLY.

According to the Baku correspondent of the *Chemiker Zeitung* a crisis in the Russian petroleum industry is rapidly approaching, owing to the exhaustion of the springs on the Caspian shore. At the present moment, says the correspondent, the springs are drying up with alarming rapidity, and the new borings yield very little indeed. Nearly all the refineries in Baku, including the large works of the firm of Nobel, are suffering greatly from the want of raw material, the price of which has quintupled within a short time. Occasionally the new borings tap a fresh supply, but all these fresh springs dry up after one or two days. Messrs. Nobel have had to turn to Bibicibat, a place considerably removed from their works, but where the oil is still running freely, for the requisite supply, and the representative of the Rothschild interest at Baku has been suddenly called away to headquarters in Paris to discuss the situation. Besides the Baku region petroleum springs are found all through the Caucasus, but they have never been properly surveyed, and a cessation of the supply at the headquarters of the industry would be little short of a disaster to the whole of the Russian empire.—*Chemist and Druggist.*

THE CANDLE TRADE IN JAPAN.

A Shanghai correspondent says that notwithstanding the increasing consumption of American petroleum in Japan the demand for stearin candles has improved considerably in that country since the year 1885, and during the past year 290,331 cetties were imported, valued at 44,000 yen. The candles imported at present into Japan are mostly obtained from France and Holland, Great Britain's share of the trade being comparatively unimportant. They are nearly always white, and vary in length from seven to nine inches. The weight of the packets is also various, although 12-ounce packets seem to meet with most demand, and the candles are invariably packed in wooden cases containing 25 packets of six candles each. In order to protect the native manufacturers the Japanese Government imposes a duty of nearly $\frac{3}{4}$ yen per picul on all foreign candles.—*Ironmonger.*

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ended 31st July.	
	1888.	1889.
	£	£
Metals.....	1,865,034	1,833,048
Chemicals, dyestuffs, and tanning materials.....	511,412	643,376
Oils.....	491,122	793,559
Raw materials for non-textile industries.....	3,731,094	5,009,843
Total value of all imports.....	30,706,412	35,873,247

SUMMARY OF EXPORTS.

	Month ended 31st July.	
	1888.	1889.
	£	£
Metals (other than machinery)	3,329,541	3,303,409
Chemicals and medicines	552,035	612,575
Miscellaneous articles.....	2,514,673	2,751,161
Total value of all exports.....	20,762,178	22,050,379

IMPORTS OF METALS FOR MONTH ENDED 31ST JULY.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
			£	£
Copper:—				
Ore..... Tons	15,721	14,276	135,692	87,530
Regulus and precipitate	11,164	11,886	404,495	312,492
Unwrought "	3,536	1,787	275,177	81,051
Iron and steel:—				
Iron ore	345,992	322,531	231,923	235,240
Bar, bolt, &c. ... "	14,655	10,254	140,824	100,381
Steel, unwrought ..	519	2,176	5,765	16,420
Lead, pig and sheet ..	9,516	13,283	129,591	169,624
Pyrites	58,912	50,810	102,732	99,832
Quicksilver	22,125	195,950	2,196	20,096
Tin	22,133	54,795	107,928	246,931
Zinc	3,649	5,379	62,157	95,550
Other articles.....	..	..	266,554	367,892
Total value of metals	..	..	1,865,034	1,833,048

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDED 31ST JULY.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
			£	£
Alkali..... Cwt.	6,243	3,895	6,242	2,946
Bark (for tanners and dyers)..... "	47,598	80,266	25,444	43,742
Brimstone	60,800	76,946	13,851	15,882
Chemicals..... Value £	..	..	100,918	132,349
Cochineal	152	690	917	4,503
Catch and gambier Tons	1,496	2,265	35,600	64,221
Dyes (coal tar):—				
Aniline .....	..	..	22,115	23,127
Alizarine .....	..	..	20,802	26,630
Other .....	..	..	962	1,132
Indigo	1,975	2,871	31,687	43,812
Madder	2,101	1,225	2,082	1,609
Nitrate of soda.... "	112,020	198,800	49,049	88,011
Nitrate of potash . "	18,809	24,367	16,217	21,653
Valonia	2,678	2,639	37,104	39,176
Other articles... Value £	..	..	148,422	134,581
Total value of chemicals	..	..	511,412	643,376

IMPORTS OF OILS FOR MONTH ENDED 31ST JULY.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Cocconut Cwt.	2,713	25,398	£ 2,982	£ 31,491
Olive Tuns	586	3,323	22,801	116,388
Palm Cwt.	75,397	103,759	72,778	101,205
Petroleum Gall.	8,702,755	10,540,235	204,488	250,203
Seed of all kinds .. Tons	714	1,151	17,854	28,481
Train, &c. Tuns	1,456	2,354	28,776	45,801
Turpentine Cwt.	71,248	95,058	94,484	143,321
Other oils..... Value £	..	..	47,739	73,963
Total value of oils ...	..	..	491,422	796,559

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Bark, Peruvian .. Cwt.	14,072	8,009	£ 41,747	£ 27,783
Bristles..... Lb.	245,365	393,394	31,159	63,002
Caoutchouc..... Cwt.	12,119	14,171	117,363	131,883
Gun :— Arabic..... ..	6,853	7,013	21,588	22,488
Lac, &c..... ..	8,157	4,319	19,391	13,417
Gutta-percha	1,015	3,773	7,623	47,531
Hides, raw :— Dry..... ..	42,400	52,981	135,317	153,753
Wet	41,749	75,871	93,495	175,486
Ivory	1,222	1,198	58,424	55,734
Manures :— Guano..... Tons	119	2,587	3,158	15,781
Bones..... ..	3,099	2,544	14,343	12,284
Paraffin..... Cwt.	30,532	18,789	37,801	21,011
Rags and paper materials :— Linen rags.... Tons	4,226	3,624	47,830	38,401
Esparto, &c.	23,011	14,306	108,579	70,297
Pulp of wood	8,636	9,457	54,742	56,859
Rosin..... Cwt.	158,496	115,027	31,626	25,853
Tallow and stearin ..	112,822	145,893	131,093	186,232
Tar Barrels	21,700	15,477	10,411	9,246
Wood and timber :— Hewn Loads	221,430	274,052	503,524	688,533
Sawn, &c..... ..	724,773	921,956	1,501,774	2,211,998
Staves	11,217	21,062	46,797	70,322
Mahogany Tons	4,327	2,804	35,123	24,752
Other articles.... Value £	..	..	678,267	866,277
Total value of raw materials for non-textile industries. }	..	..	3,731,004	5,000,843

Besides the above, drugs to the value of 54,262*l.* were imported during the month, as against 62,665*l.* in July 1888.

EXPORTS OF METALS OTHER THAN MACHINERY FOR MONTH ENDED 31ST JULY.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Brass..... Cwt.	6,401	9,007	£ 32,163	£ 42,350
Copper :— Unwrought	100,390	72,415	399,611	158,331
Wrought..... ..	7,383	30,283	35,452	79,189
Mixed metal	9,438	33,836	33,180	80,616
Hardware Value £	..	..	270,947	230,093
Iron and steel :— Pig iron..... Tons	106,546	110,226	210,802	250,365
Bar, angle, &c..... ..	25,261	19,553	140,651	126,161
Railroad..... ..	76,329	85,317	354,907	407,597
Wire..... ..	5,388	4,298	73,758	61,475
Hoop and sheets.. ..	35,881	33,813	312,122	339,722
Tin plates..... ..	36,837	31,844	507,390	445,055
Cast and wrought. ..	37,469	40,865	405,681	475,265
Old	16,821	13,974	46,686	39,384
Steel..... ..	14,663	11,480	136,359	134,885
Other kinds..... ..	1,725	1,325	51,977	48,482
Lead	4,229	4,130	57,843	58,717
Plated wares... Value £	..	..	31,750	35,736
Telegraphic wires. ..	..	..	21,571	32,909
Tin Cwt.	12,571	11,768	56,722	55,112
Zinc	15,271	17,373	10,632	12,860
Other articles .. Value £	..	..	140,458	187,096
Total value of exports of metals other than machinery .....	..	..	3,329,541	3,303,499

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDED 31ST JULY.

Articles.	Quantities.		Value.	
	1888.	1889.	1888.	1889.
Alkali..... Cwt.	458,599	389,222	£ 119,578	£ 104,834
Bleaching materials ..	116,639	126,848	45,366	46,218
Chemical manure Value £	..	..	125,619	142,242
Medicines..... ..	..	..	65,716	77,659
Other articles ... ..	..	..	196,456	241,622
Total value of chemicals exported..... }	..	..	552,955	612,575

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDED 31ST JULY.

Articles.	Quantities.		Value.	
	1888.	1889.	1888.	1889.
			£	£
Ammunition :—				
Gunpowder..... Lb.	1,479,700	957,000	36,913	21,019
Other kinds Value £	..	..	113,084	76,361
Candles..... Cwt.	890,600	1,158,800	15,842	20,161
Caoutchouc Value £	..	..	96,435	100,946
Cement..... Tons	46,851	62,553	87,723	121,763
Earthenware Value £	..	..	165,096	186,281
Stoneware ..... „	..	..	8,505	19,284
Glass :—				
Plate..... Sq. Ft.	368,093	276,665	22,303	18,231
Flint..... Cwt.	10,749	10,588	22,360	21,344
Bottles..... „	69,419	87,941	31,408	43,125
Other kinds..... „	18,883	18,077	15,179	12,742
Leather :—				
Unwrought „	13,409	11,051	122,410	106,969
Wrought Value £	..	..	31,133	31,749
Seed oil..... Tons	5,353	4,881	108,387	108,091
Floor cloth Sq. Yds.	1,443,500	1,435,600	66,230	71,674
Painters' materials..... Value £	..	..	115,712	133,633
Paper of all kinds..... Cwt.	85,120	80,281	146,200	147,129
Rags..... Tons	5,161	4,406	38,836	32,946
Soap..... Cwt.	37,493	46,977	35,775	41,863
Total value of exports of miscellaneous articles..... }	..	..	2,514,673	2,751,161

TWENTY-FIFTH ANNUAL REPORT OF ALKALI, &c. WORKS BY THE CHIEF INSPECTOR. PROCEEDINGS DURING THE YEAR 1888 PRESENTED TO THE LOCAL GOVERNMENT BOARD AND TO THE SECRETARY FOR SCOTLAND. 11d. 1889.

The number of works in England and Ireland registered under the Act at the close of 1888 was 926. In Scotland there were 131, making a total of 1,057 in the United Kingdom. The number of works in 1887 was 1,066, showing a diminution of nine on the whole year.

The following tables show the relative distribution of the various works as regards locality and also with reference to the various processes carried on in them :—

NUMBER OF REGISTERED WORKS.

	Dist. I.—Ireland.	Dist. II.—North of England.	Dist. III.—Cheshire, N. Wales, and part of Lancashire.	Sub-Dist. Widnes.	Dist. IV.—East Lancashire and Yorkshire.	Dist. V.—South Midland.	Dist. VI.—South-West of England and South Wales.	Dist. VII.—South-Eastern Counties.	Sub-Dist. VII.—Eastern Counties.	Total.		
										1888.	1887.	1886.
Alkali works.....	2	19	15	18	38	10	7	1	9	119	116	118
Other works	42	85	103	12	132	125	125	87	96	807	811	792
Total	44	104	118	30	170	135	132	88	105	926	927	910

TABLE OF SEPARATE PROCESSES UNDER INSPECTION.

	Dist. I.—Ireland.	Dist. II.—North of England.	Dist. III.—Cheshire, N. Wales, and part of Lancashire.	Sub-Dist. Widnes.	Dist. IV.—East Lancashire and Yorkshire.	Dist. V.—South Midland.	Dist. VI.—South-West of England and South Wales.	Dist. VII.—South-Eastern Counties.	Sub-Dist. VII.—Eastern Counties.	Total.	
										1888.	1887.
Alkali.....	2	13	14	16	13	5	4	..	2	69	66
Hydrochloric acid (cylinder).....	..	..	..	..	18	3	..	1	7	29	28
Copper (wet process).....	..	4	3	1	3	2	3	..	..	19	21
Cotton carbonising (alkali) .....	..	..	..	..	8	..	..	..	..	8	7
Sulphuric acid.....	11	25	21	18	43	28	42	4	29	221	224
Chemical manure	17	34	14	3	26	43	40	8	45	230	242
Gas liquor .....	..	2	3	1	17	5	..	..	..	28	26
Nitric acid.....	..	2	6	1	40	21	2	5	14	91	90
Sulphate and muriate of ammonia	17	32	23	7	54	58	60	35	34	320	311
Chlorine and bleaching powder ..	2	9	17	20	7	3	1	1	1	61	58
Salt.....	12	7	53	1	..	4	..	..	..	77	78
Cement	1	13	1	..	5	7	8	40	13	88	94
Total	62	141	155	71	234	179	160	94	145	1,241	1,245

It will be noticed that the number of works remains almost unchanged, but there appears to be a general tendency for the larger works to increase in size and for the smaller ones to be gradually extinguished.

The total number of visits paid by the various inspectors was 5,101, and the number of tests taken 4,212. There were nine prosecutions undertaken under the Act, in the majority of instances for non-registration.

Various tables of statistics are given relating to the amounts of substances used and of those manufactured, from which the following details are extracted:—

There were 618,582 tons of salt decomposed in the Leblanc process, of which 123,887 tons were taken in District II., 146,640 in District III., and 229,360 in sub-district Widnes. There were, in addition, 37,370 tons consumed in Scotland, giving thus a total of 655,992 for the United Kingdom. Allowing 10 per cent., however, for stoppages, repairs, &c., the above figures become 590,312 tons of salt employed. Besides this, the copper extraction works took for their own requirements 56,750 tons of salt, and there were in addition 212,181 tons of salt decomposed in the ammonia-soda process, showing a grand total of 859,243 tons of salt consumed in 1888.

The total amount of salt manufactured was 2,039,867 tons, of which Cheshire contributed 1,505,667 tons and Staffordshire 6,500.

The total quantity of brimstone burned was only 17,975 tons, whilst the consumption of pyrites approximated very closely to 600,000 tons.

The amount of ammonia produced was equivalent to 122,785 tons of sulphate of ammonia, and this, at 12*l.* per ton, corresponds to a value of 1,473,420*l.* This amount of ammonia was obtained from the following sources, and was at one time entirely wasted:—

AMOUNT OF SULPHATE OF AMMONIA PRODUCED IN THE UNITED KINGDOM.

	1888.	1887.	1886.
	Tons.	Tons.	Tons.
Gas works.....	92,596	85,022	82,480
Iron works	5,280	5,098	3,950
Shale works.....	22,072	21,098	18,080
Coke and carbonising works	2,537	2,678	2,100
Total	122,785	113,896	106,610

One of the most important advances made in the Leblanc process has been that of the recovery of sulphur from alkali waste by Chance's process. The alkali waste contains from 11 to 15 per cent. of sulphur, and some 750,000 tons of it are produced annually, containing about 100,000 tons of sulphur. By this process about 90 per cent. of the total sulphur present in the waste is recovered as sulphuretted hydrogen, and of this from 80 to 85 per cent. of sulphur can be obtained in the solid form, or from 98 to 99 per cent. as sulphuric acid. It seems likely, further, that as the knowledge and skill with which the process is manipulated increases, so a still greater percentage of the sulphur may be recovered. Another process to which reference is made is that of Gossage, of Widnes. In this process sulphate of soda, mixed with about 30 per cent. of salt, is heated with slack, and thus reduced to the sulphide. The mass is lixiviated with water, and carbon dioxide gas is passed in with the evolution of sulphuretted hydrogen gas, which is employed in the manufacture of more sulphuric acid, and with the formation and precipitation of bicarbonate of soda from the solution. Salt is mixed with the sulphate both because it increases the fusibility of the mixture, and also because it lessens the action of the sulphide on the ordinary black-ash furnace which it is probable will be used.

Various methods for dealing with sulphuretted hydrogen gas have been proposed at different times, such as burning in a special fire, burning to form sulphuric acid, burning in a Claus kiln, with the formation of sulphur, or absorbing with hydrated peroxide of iron. The more usual methods are modifications of the last of three plans.

The oxide of iron employed is usually either dry or in a slightly damp condition, but Mr. G. E. Davis has used it suspended in water which seems to answer well, but a steam jet must then be employed to force the gases onward.

Very full tables are given of the works which make ammonium sulphate, and of the arrangements which they adopt for preventing the escape of sulphuretted hydrogen during the manufacture. The greatest amount made in the 24 hours was 40 cwt. and the least 1½ cwt. The superficial area of the purifier varied from as much as 532 sq. ft. to 4½ sq. ft. The depth of the oxide varied from 5½ ft. to half a foot in depth. The number of cubic feet of oxide per cwt. of salt produced in 24 hours varied from 200 in the highest to 1 in the lowest case. The oxide was found to remain

active from 180 days in one works to only 2 days in another plant. In some places it is only removed four times in the year, though in these cases the process is worked only intermittently. The oxide is re-vivified either in situ or by being turned out and exposed to the air. Very varied forms of apparatus are used for condensing the steam from the sulphuretted hydrogen gas, water or air cooled pipes or coke towers being on the whole the most suitable. A prominent feature in the report is the series of analyses of chimney gases given when smoky, slightly smoky, and clear. It had been stated, and even pleaded in a court of law, that if the gases were clear, that then probably carbon monoxide gas would be present, and hence that the presence of the black coal smoke was by no means an unmitigated evil, inasmuch as none of the former poisonous gas would then be present. As was to be expected, it is shown that in no single case, out of some 50 analyses made of the products of combustion from both hand-fired furnaces and mechanical stokers, was there a trace of carbon monoxide present where the gases were completely clear, whilst where there was black smoke as much as 3.25 per cent. CO was on one occasion found. Comparing the general results obtained with solid and gaseous fuel, attention is drawn to the much more favourable results obtained with the latter, and points out how much easier it is to exactly regulate the supply of air, so that there shall not be an excess of oxygen, and hence also of nitrogen, on the one hand, nor unburnt carbon on the other. Other advantages are that the gas burns quietly and regularly without waste of any kind, and that there is no smoke or soot, and, further, owing to the more equal distribution of the heat, the action on the metal boilers is much reduced. In this connexion is mentioned Mond's process for obtaining the ammonia produced in carbonising the coal, and which by other methods is lost, and the amount thus obtained averages about 66 lb. of sulphate per ton of slack carbonised.

After the report of the chief inspector come the separate reports of each district inspector, and the chief features in these are given briefly. In all cases statements are given as to the number of works under inspection, and of the various processes therein carried on, average analyses of chamber exit gases, chimney gases, &c., and of the various improvements effected in the plant at different works.

In District No. 1 (Ireland) there are 44 works, only two of which are alkali; the number of separate manufacturing processes carried on being 59. During the year 7,446 tons salt were decomposed, 2,832 tons bleaching powder produced, 22,700 tons pyrites, and 180 tons brimstone burned, 43,200 tons chemical manure, 2,508 tons sulphate of ammonia, and 9,700 tons salt manufactured.

In District No. 2 (North of England) the inspector reports that the average total acidity of manure gases at the exit was 0.124, the average of the three preceding years being 0.160. In the Widness sub-district 30 works were registered, 18 of these being alkali. During the year there were 149,000 tons of pyrites burnt, 229,360 tons of salt converted into salt-cake, and 203,000 tons used in the wet copper extraction works, and 72,930 tons of bleaching powder manufactured (including potassium chlorate). Attention is drawn to a valuable improvement in the Weldon plant, whereby the acid liquors are completely neutralised in the stills themselves by the addition of more Weldon mud. Hence the special neutralising well is no longer necessary, and besides the saving of the limestone therein employed, the amount of the base in the mud is reduced so that a ton of bleaching powder can be made from about 45 cwt. of salt instead of requiring about 50 cwt. In most of the works no bleaching powder chamber is now opened if it contains more than 5 grains of chlorine per cubic foot of its atmosphere.

Usually not more than half this amount is present. For the purpose of absorbing the residual chlorine Brock and Minton's lime-sprinkling machine has been found very efficacious, and at the works of the patentees some 200 tons of bleach have been obtained by its means from lime injected into the finished chambers. Some new methods for obtaining chlorine direct from hydrochloric acid by the action of this latter on nitric acid are given. The nitrous oxides

simultaneously produced are recovered, and re-converted into nitric acid, and this is again decomposed as before.

In District No. 4 (East Lancashire and Yorkshire) the lime-dusting machine has also been used with beneficial results, both as to the increase in the manufacture, and as to the diminution of nuisance in packing. The average test for the chamber exits for 1888 was 1.04 grains SO_3 per cubic foot as compared with 1.14 in 1887. For the first time the average escape from vitriol works, other than alkali works, has been less than in the alkali works themselves, being 1.01 grains SO_3 per cubic foot, the average escape from the latter being 1.07 grains SO_3 per cubic foot. Some results are given as to the behaviour of the Claus kiln in the works using it. Experience has shown that both SH_2 and SO_2 leave the sulphur depositing chamber in greater or lesser quantity, and that to remove the latter an alkaline wash tower should be employed, and for the former a final catch purifier. More SH_2 than SO_2 is usually present in the escape, thus an actual example shows:—
Total S = 3.25 grains per cubic foot, S as SO_2 found = 0.13 grains, S as SH_2 by difference = 3.12 grains per cubic foot. Some 100 tons of sulphur were recovered during the year in this way.

In District No. 6 (South-West of England and South Wales) 132 works with 160 separate processes under inspection were registered. There are 42 works where sulphuric acid is manufactured. The sources of sulphur are various, pyrites (Spanish, Norwegian, and Cornish), coppers, sulphuretted hydrogen, and brimstone having been all employed. The largest source was pyrites, but 7,626 tons of brimstone were burnt. In one works where there was considerable difficulty in disposing of the gas liquor, a plant capable of turning out 50 tons of sulphate of ammonia per annum was put up for less than 100*l*. A coke scrubber was used for the condensation of the steam, and the purifier was a heap of oxide of iron, below which the SH_2 was introduced by an ordinary iron pipe terminating in four channels of loosely arranged bricks. This very simple form of purifier seems to work well and has been generally adopted in other works.

In Sub-district No. 7 (Eastern Counties) the average chamber exit escape for 1888 was 1.55 grains SO_3 per cubic foot, the average in 1887 being 1.97 grains SO_3 per cubic foot. In one works, owing to insufficient pound space and also to the cost of the water required for condensing purposes, a considerable escape was found to exist. To meet these requirements the following form of condenser was devised. It consists of an outer lead-lined shallow vessel, 11 ft. 6 in. by 6 ft. 3 in. by 1 ft. 6 in., nearly filled with water. Within this is placed a wooden chamber 10 ft. 6 in. \times 5 \times 5 in which the water is at the same level as in the outer vessel, and passing through the axis of which is a wooden shaft carrying paddles in two sets, the one set being attached transversely to the shaft, the other set longitudinally, and both plunging beneath the surface of the water. The paddles are further kept moistened by means of a perforated pipe running the length of the outer vessel through which the water falls in a shower on the revolving paddles below. By suitable divisions the gases are carried through the apparatus in definite directions. A steam jet is also inserted in the inlet pipe and has been found to be a very useful adjunct to the apparatus. The efficiency of this condenser is shown by the following test analyses:—

Total acidity of gases entering revolver (1)	20.0 grains at SO_3
" " " (2)	23.4 " "
Total acidity of gases leaving revolver (1)	1.45 " "
" " " (2)	0.85 " "

(Excellent scale plan drawings, for which the report itself must be consulted, are given.)

A separate report is issued for Scotland. The number of registered works was 131, of which 16 were alkali works, the total number of processes carried on being 180, thus showing a reduction of eight works and 18 processes as compared with the similar figures for 1887. The number of

visits made was 467, and 227 analyses were made. The amounts of material employed and manufactured were as follows:—

Employed....	Salt	45,094	(37,370 in alkali works, 7,724 in wet copper works.
	Pyrites.....	72,248	
	Sulphur.....	3,982	
Manufactured	Bleach	10,300	
	Chemical manure	43,585	
	Ammonium sulphate.	36,831	9,829 from gas liquor. 4,550 iron furnace gases. 22,072 from shale works.
	Salt.....	10,900	
	Nitric acid.....	2,331	

The average escape of HCl for the whole of Scotland is 0.088 grains HCl per cubic foot of chimney gases, as against 0.09 grains in 1887. The whole of the sulphate of ammonia is produced from what at one time were waste products, and the value of the material thus saved to the county amounts to 441,972*l.*, taking one ton of sulphate of ammonia as being worth 12*l.* The sulphuretted hydrogen given off in the manufacture of the sulphate or chloride of ammonia is now absorbed by hydrated oxide of iron in 13 out of the 22 works manufacturing these articles. As in last year's report, so in this, reference is made to the anomalous wording of the Act by virtue of which some works come under inspection, whilst others, to the full as bad, in some cases worse, do not come under its provisions. It is again proposed not to schedule the processes to be inspected, but to extend inspection over the noxious gases evolved in the processes of manufacture. It would then be sufficient to draft a short Act, called the Noxious Gases Act, in which it would be sufficient to include the following substances:—"The acid compounds of chlorine, fluorine, sulphur, and nitrogen, chlorine and metallic fumes."

—S. G. R.

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

11,350. R. C. Garton, C. H. Garton, and W. Lawrence. Apparatus for evaporating, heating, or cooling liquids. July 15.

11,352. R. C. Garton, C. H. Garton, and W. Lawrence. Apparatus for evaporating or distilling, or effecting interchange of heat. July 15.

11,402. E. Bazin. Hydro-centrifugal apparatus for washing, amalgamating, and separating metallic ores, and for washing and separating other bodies of different densities. July 16.

11,466. H. H. Chapman.—From J. Donaldson, Australia. Automatic attachment for indicating pressures and levels of fluids and liquids in vessels. Complete Specification. July 17.

11,518. A. T. Clarksen and J. B. Spurge. Duplex and other apparatus for regulating the flow of gases under pressure. July 18.

11,600. A. G. Brown. Apparatus for separating water from steam. July 20.

11,691. E. Breadner. Humidifiers. July 23.

11,865. L. Perkins. Refrigerating and freezing apparatus. July 25.

11,925. C. A. Rempen and E. Andre. Valves for regulating the pressure of gas and other fluids. July 26.

12,206. W. Tipping. Machines for "distructing," drying, and calcining substances or materials. August 1.

12,207. W. Tipping. Apparatus for moistening atmosphere, damping materials or substances, and condensing vapours, or analogous purposes. August 1.

12,410. W. L. Wise.—From P. R. Bedlington, Grand Canary. Apparatus for measuring and indicating temperature and pressure. August 6.

12,473. H. B. Whetstone. Evaporating or distilling liquids, and drying or desiccating grain or other substances. August 6.

12,514. J. V. Johnson.—From La Compagnie Industrielle des Procédés Raoul Pictet, France. An improved mixture for use in apparatus for producing cold. Complete Specification. August 8.

12,636. C. W. Guy. Apparatus for evaporation and condensation. August 10.

12,681. L. Hill. Improvements in the means employed for utilising the escaping hot gases or products of combustion for heating the air supplied to the furnaces of steam boilers. August 12.

12,716. W. Matthews and J. Yates. Apparatus for humidifying air, pulverising fluids, and other similar purposes. August 12.

12,789. H. H. Lake.—From F. du Closel, France. Apparatus for extracting soluble from insoluble substances, and for filtering liquids. August 12.

12,834. W. Gordon. Gauges for indicating the level of water and other fluids in steam generators and analogous vessels. August 14.

12,835. W. Gordon. Gauges for indicating the pressure of fluids. August 14.

12,871. C. H. Roeckner, F. L. Roeckner, and R. L. Roeckner. Concentrating liquids, and burning off organic matter. August 15.

12,885. M. Miller. Steam or air superheater. August 15.

12,911. J. T. Griffin.—From J. W. Hatch, United States. Improvement in furnaces, apparatus to be used therewith, and in utilising solid and gaseous fuel therein. August 15.

12,973. The Water Softening Company, Limited, E. Easton, and H. Carrod. Apparatus for softening and filtering water or other liquids under pressure. August 16.

12,809. W. Maxwell. See Class XVI.

COMPLETE SPECIFICATIONS ACCEPTED.*

1888.

10,493. T. Slater. Multiple evaporating apparatus. July 24.

14,063. J. S. Fairfax. Metallic vessels for containing and supplying fluids under pressure. August 21.

14,394. W. G. Forster. Furnaces, &c. for heating pots and crucibles. August 21.

14,616. M. Heeking. Centrifugal pumps. July 24.

15,491. L. Serpollet. Pulverising, dividing, or gasifying liquids. July 24.

1889.

8898. W. B. Wright. See Class II.

9204. J. E. Warren. Apparatus for filtering. August 14.

10,423. J. V. Davis. Hydrometers, and apparatus connected therewith. August 7.

10,686. H. J. Haddan.—From J. P. y Rodereda and E. P. y Rodriguez. Machinery for triturating and crushing substances. August 7.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

11,432. C. McKenzie Dowie and A. L. Briggs. Improvements in apparatus for carburetting illuminating and other gas. July 17.

11,456. N. Meiklejohn. Improvements in anti-dips for hydraulic mains employed in the manufacture of gas. July 17.

11,459. J. Dheyne, Comte de Nydprück, and F. de la Hault. Improved apparatus for generating gas or vapour from combustible liquids. July 17.

11,462. J. Gilligan and A. Tilney. Improvements in apparatus for perfecting combustion and preventing smoke in house grates and other open fires. July 17.

11,463. J. G. Forge and A. Tilney. Improved methods of heating and apparatus therefor. July 17.

11,521. J. H. Glew. Improved compound or admixture of ingredients for the production of fire-lighters. July 18.

11,530. J. Enwright. Improvements in the manufacture of "water-gas" and of coal gas. July 19.

11,610. W. Hubbard. Improvements in the manufacture of compressed fuel blocks. Complete Specification. July 20.

11,624. F. J. Jones. Improvements in the manufacture of illuminating gas. July 20.

11,654. J. Drabble. An improved apparatus for the prevention and consumption of smoke, and more perfect combustion of fuel in steam boilers and other furnaces. July 22.

11,768. O. Rose. Improvements in apparatus for the manufacture of gas from hydrocarbon oil and water. July 24.

11,855. J. Morris. The manufacture of an improved artificial fuel. July 25.

11,899. C. Huelser.—From G. Kassner, Germany. Process for converting the oxygen of the atmosphere into a solid form by producing plumbate of lime, baryta, and strontia, and employing these substances for producing oxygen and for oxidising purposes. Complete Specification. July 26.

11,920. F. J. Jones. Improvements in the production of coke for foundry and other purposes. July 26.

12,043. J. F. L. Moniër. Improvements in or relating to the manufacture of gas from atmospheric air. July 29.

12,054. B. H. Thwaite. Improved method of distributing heating and lighting gas. July 30.

12,092. A. Weber. Improvements in coke ovens or furnaces. Complete Specification. July 30.

12,149. B. H. Thwaite. Improvements in the cycle of operations for producing combustible gases from hydrocarbonaceous materials, and in details of apparatus therefor. July 31.

12,266. B. H. Thwaite. Improvements in methods for effecting the operations involved in the production of the gas technically known as "water-gas," and in apparatus therefor. August 2.

12,296. A. Degallier. An improved system of economical heating apparatus. August 2.

12,460. S. Elliott. An improved method of and apparatus for the treatment of smoke. August 6.

12,584. R. R. Main, A. P. Main, and H. Darwin. Improvements in gas fires. Complete Specification. August 9.

12,655. J. Watson. Improvements in heating apparatus. August 10.

12,856. J. O. Spong. Improved means and appliances for carburetting gas and enriching the flame thereof. August 14.

12,897. R. Henderson. Improvements in the manufacture of tapers, torches, matches, and candles. August 15.

13,016. J. Dewar and B. Redwood. Improvements in the distillation of mineral oils and like products, and apparatus for that purpose. August 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

8559. The Gas Patents Syndicate.—From J. B. Areher. Apparatus for the manufacture of gas. August 14.

13,050. O. Langberg. Apparatus for generating illuminating gas and gaseous fuel, and for burning the latter. August 21.

13,066. T. L. J. Quennesson. Manufacture of artificial fuel and other moulded blocks, and apparatus therefor. July 31.

13,768. R. Stone. Manufacture of artificial fuel and refractory material for lining retorts, and apparatus therefor. August 21.

14,510. J. de Brouwer. Apparatus for the manufacture of gas. August 14.

14,575. H. H. Leigh.—From T. von Bauer. Coke ovens. August 14.

14,675. H. D. Fitzpatrick and G. Rose. Manufacturing gas from mineral or other oils, and apparatus therefor. August 14.

1889.

2246. G. H. Lloyd, A. L. Lloyd, H. Bewlay, and W. S. Sutherland. Producing water-gas, and apparatus therefor. July 31.

6130. S. Fox and E. Blass. Method and apparatus for adding volatile substances to gases. August 21.

6805. L. Paget and C. J. Kintner. Hoods or mantles for incandescence gas-lighting. July 31.

6854. H. W. Leonard. Means for feeding fluid fuel to furnaces. July 17.

8898. W. B. Wright. Means for feeding fluid fuel to furnaces, specially applicable to brick kilns. August 21.

9288. W. Clark. Apparatus for manufacturing gas. July 24.

10,101. W. J. Pughley. Manufacture of fuel. July 24.

10,256. A. J. Boulton.—From W. G. Wood. Manufacturing gas. July 31.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

12,028. J. D. Starck. See Class VII.

12,526. A. Patrick. See Class IX.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

11,613. O. Imray.—From The Society of Chemical Industry, Basle. Manufacture of new red and blue colouring matters. July 20.

11,666. O. Imray.—From The Farbwerke vorm. Meister, Lucius, and Brüning, Germany. Improvements in the production of an orange-red colouring matter from flavopurpurin. July 22.

11,795. H. H. Leigh.—From R. G. Williams, United States. Improvements in colouring matters. July 24.

11,848. O. Imray.—From The Society of Chemical Industry, Basle. Manufacture of blue colouring matter. July 25.

12,031. O. Imray.—From The Farbwerke vorm. Meister, Lucius, and Brüning, Germany. An improved manufacture of compounds for dyeing, consisting of a mixture of nitrite with basic amido-azo-compounds, or with the nitro compounds of aromatic monamines in the form of a paste, and the application of such paste for diazotising. July 29.

12,191. C. Kolbe. A process for obtaining carbon acids of meta-amido-phenol and its alkyl derivatives. August 1.

12,334. J. Dawson. Manufacture of a new base for colouring matters. August 3.

12,549. T. R. Shillito.—From A. Feer, Germany. Process for the manufacture of yellow to orange colouring matters. August 8.

12,560. S. Pitt.—From L. Casella and Co., Germany. Production of new red colouring matters. August 8.

12,567. E. M. Richford and J. Brown. An improvement in the preparation of colouring matters. August 8.

12,767. H. H. Leigh.—From R. G. Williams, United States. Improvements in the manufacture of mixed azo colours. August 13.

12,768. R. Holliday. Improvements in the manufacture or production of new azo colours. August 13.

12,784. O. Imray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, France. Manufacture of colouring matters derived from paratoluidine, α -metaxyldine, pseudo-cumidine, and mesidine, with tetramethyldiamidobenzhydrol. August 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

13,767. T. R. Shillito.—From J. R. Geigy. Production of new colours. July 31.

13,920. T. R. Shillito.—From J. R. Geigy. Production of yellow, orange, and brown colours of alizarin-like properties. July 24.

14,353. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. A new class of derivatives of alizarin-blue. August 14.

14,442. B. Wilcox.—From the Farbenfabriken vorm. F. Bayer and Co. Azo dyestuffs. August 14.

14,478. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Production of a colouring matter from carbazol. August 14.

14,479. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The production from carbazol of a new derivative, to be used in the manufacture of colouring matters. August 14.

14,884. G. Pitt.—From L. Casella and Co. New yellow dyestuffs called thioflavines. August 14.

15,179. E. Fischer. Production and treatment of oxidisable derivatives of ortho-nitro-benzylchlorides. August 21.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

11,549. F. N. B. Rosslyn, R. Rice, and A. T. Haines. See Class XIV.

12,626. G. W. Robertson, D. Black, and J. McGlashan. Improvements in the treatment of vegetable fibrous material to obtain fibre therefrom, and in apparatus therefor. August 9.

12,975. A. Deru. Process of and apparatus for automatically drying and purifying wool and other textile materials. August 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

14,100. L. de Kien. Process and apparatus for treatment of textile plants. August 7.

14,247. I. Singer and M. W. Judell. Apparatus for cleansing wool, &c. August 7.

14,705. E. P. Khug. Process for smoking or finishing textile threads. August 14.

1889.

6793. The Société Simons and Chapuis. Machine for drying and carbonising wool, &c., in combination with an elevator and purifying apparatus. August 21.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

11,382. G. B. Sharples. Improvements in machinery for the continuous bleaching, soaping, bluing, washing, finishing, sizing, dyeing, or otherwise analogously treating in the hank, of cotton, linen, woollen, silk, or other yarns, tapes, and similar manufactures. July 16.

11,938. R. Leigh. Improvements in sizes and methods for fixing colours in printing, painting, and staining paper, cloth, &c. July 27.

12,990. E. Barlow. A dyers' colour mixer. August 17.

COMPLETE SPECIFICATION ACCEPTED.

1888.

14,019. S. Mason, jun., and W. T. Whitehead. Machines for dyeing, bleaching, &c., yarns in cops or bobbins. August 7.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

11,351. R. C. Garton, C. H. Garton, and W. Lawrence. Improvements in the crystallisation of salts or crystallisable acids. July 15.

11,975. E. Augé. Improvements in the manufacture of soda alum. July 27.

12,028. J. D. Starek. Process and apparatus for the production of fuming sulphuric acid or of sulphuric anhydride from the acid waste or residual matter obtained in the petroleum, paraffin, and tar industry. July 29.

12,368. A. Brand. Improvements in the manufacture of alkali sulphides. August 3.

12,451. A. W. Wahlenberg and J. A. Wahlenberg. An improved process of producing ammonium nitrate. Complete Specification. Date applied for February 9, 1889, being date of application in Sweden.

12,464. J. B. Thompson. Improvements in the manufacture of soda and in the recovery of the material used in the process. August 6.

12,553. F. Candy. Improvements in the treatment and utilisation of certain products resulting from the purification of galvanisers' spent pickle and tinplate workers' waste or spent liquors, and other like waste or spent liquors. August 8.

12,843. W. Donald. Improvements in and relating to the treatment of common salt or other suitable chlorides for the manufacture of chlorine and recovery of the manganese. August 14.

12,948. G. Kerner and J. Marx. Improvements in, and apparatus for or connected with, the obtaining, liquefying, and storage of chlorine. August 16.

13,003. A. W. Ellis. Improvements in the treatment and distillation of ammoniacal liquor of gas and other works, and in the manufacture of sulphate of ammonia therefrom, and in the apparatus to be employed therein, and for the prevention of nuisance in such manufacture. August 17.

13,017. O. Imray.—From V. G. Bloede, United States. Process for the recovery of soda or potash from waste alkaline lyes. August 17.

13,018. O. Imray.—From V. G. Bloede, United States. Utilisation of waste or spent alkaline liquors. August 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

11,581. D. Gamble. Manufacture of chlorine and hydrochloric acid, and apparatus therefor. August 14.

11,926. W. E. B. Blekinsopp and F. M. Lyte. Production of basic lead carbonate, chloride, phosphate, oxalate, silicate, borate, or other insoluble or sparingly soluble salts of lead. July 24.

13,306. W. P. Thompson.—From W. Spilker and C. Loewe. Manufacture of soda, potash, and "ehlore." July 24.

14,026. R. H. Steedman. Treating impure carbonate of lime produced in making alkali, and recovering sulphur from alkali waste in order to utilise it for making cement, &c. August 14.

14,199. T. Parker and A. E. Robinson. Manufacture of chlorine, alkalis, and salts from the chlorides of sodium and potassium. August 7.

14,239. J. Greenwood. Generation of chlorine and formation of a solution therefrom, and apparatus therefor. August 7.

14,563. G. H. Bolton and T. A. Bullough. Washing, filtering, and otherwise treating lime, mud, black-ash, &c. in bulk, and apparatus therefor. August 14.

15,293. P. McLaren. Manufacturing acetate or pyro-lignite of iron or iron liquor. July 24.

16,523. W. Townsend. Vessels for boiling or evaporating acids or strong alkalis. July 31.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

11,690. M. Pommard. Improvements in the manufacture of flower vases, pots, or analogous receptacles. July 23.

11,839. W. Worrall. Improvements in printing on china, earthenware, glass, and other like substances. July 25.

11,945. H. C. Harrison. Improvements in the manufacture of earthenware toilet ware. 27 July.

11,979. H. H. Lake.—From A. Glibert, Belgium. Improvements relating to the enamelling of articles of copper. July 27.

12,158. T. Walton. Improvements in the manufacture of various kinds of glassware, and in machinery, apparatus, or moulds therefor. July 31.

12,362. J. Wade and J. Gosling. New or improved machinery for the manufacture of earthenware covers having knobs for teapots, jugs, dishes, and other vessels and articles. August 3.

12,923. J. Nash. Improvements in the manufacture of porous earthenware. August 15.

12,980. J. Nash. An improved process for hardening, preserving, and preparing porous earthenware. August 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

11,651. J. Armstrong. Method of making bottles, &c., and appliances therefor. July 24.

11,794. J. Armstrong. Method of making rolled glass and appliances therefor. August 14.

12,679. M. Green. Producing letters for cementing to glass, &c., in imitation of gold, silver, and jewels. July 24.

13,259. W. R. Pullen. Mosaic work in crystalline glass alone, or in combination with vitreous substances. July 24.

13,765. P. J. Guy. Dispensing with woad clay in plying and firing glaze ware. July 31.

14,466. S. Washington. Glass bottles. August 14.

14,644. J. Hamblet. Machinery for the manufacture of seggars, crucibles, melting-pots, pipes, &c., from clay or other plastic material. July 24.

14,830. W. M. Derrick. Method for the ornamentation of glass. August 21.

1889.

9979. E. Leak and H. Aynsley. Grooved shields for supporting potteryware while firing. July 24.

10,322. W. Lutwyche. Manufacture of translucent enamel, and application thereof in relief for the decoration of glass, metal, &c. August 7.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

11,385. R. R. Gibbs. Improvements in the manufacture of bricks and blocks. July 16.

11,444. M. J. Adams. Improvements in roofing tiles, and in the formation of iron and other sheets or plates for roofing and other purposes. Complete Specification. July 17.

11,663. J. W. Breakell and T. Breakell. Improvements in colouring and polishing calcareous and other stones. July 22.

11,922. G. F. Redfern.—From J. G. Maardt, Denmark. An improved composition for covering walls and the like. Complete Specification. July 26.

12,369. A. Brand. Improvements in the manufacture or treatment of fire-bricks, furnace-linings, crucibles, and the like. August 3.

12,526. A. Patrick. Improvements in the treatment of shales or other carbonaceous minerals for the manufacture of bricks and for the obtainment of condensable products, and in apparatus therefor. August 8.

12,550. M. J. Dickins. Improvements in road paving. August 8.

12,623. T. Shaw. Improvements in utilising the waste product from sewage works for building and other purposes. Complete Specification. August 10.

12,665. R. Haddan.—From W. Martin, Switzerland. A waterproof material for covering or ornamenting walls and other structures. August 10.

12,889. T. Smith and R. B. Wager-Taylor. An improved process for and method of manufacturing cement or artificial stone. August 15.

12,890. T. Smith and R. B. Wager-Taylor. An improved cement or artificial stone. August 15.

13,008. J. Wilson. Improvements in or relating to the construction of fire-resisting flooring, decking, and the like. August 17.

COMPLETE SPECIFICATION ACCEPTED.

1889.

9927. H. H. Lake.—From C. T. Lee. Compound for manufacture of articles by moulding. July 24.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

11,344. C. F. Jozs. Improvements in the manufacture of ornamental plates of metal or other sheets. July 15.

11,393. T. Parker. Improvements in and connected with the manufacture of iron and steel. July 16.

11,402. E. Bazin. See Class I. July 16.

11,406. E. Norton and J. G. Hodgson. Improvements in apparatus for use in the manufacture of sheet metal. Complete Specification. July 16.

11,407. E. Norton and J. G. Hodgson. Improvements in the manufacture of metal bars or rails, and in apparatus therefor. Complete Specification. July 16.

11,686. C. U. Fisher.—From H. F. Lord, United States. A new or improved welding compound. Complete Specification. July 23.

11,707. T. Parker and A. E. Robinson. Improvements in the manufacture of sodium, potassium, and magnesium. July 23.

11,788. D. Dennes.—Partly communicated by T. K. Rose, Denver, U.S.A. Improvements in obtaining precious metals from their ores, and in means or apparatus employed therein. July 24.

11,790. F. A. Kieffer. Improvements relating to the extraction of copper from its ores. July 24.

11,882. S. Trivick. Improvements in roasting certain ores in order to obtain metals therefrom, and in means or apparatus employed therein. July 26.

11,883. S. Trivick. Improvements in extracting precious metals from their ores, and in means or apparatus employed therein. July 26.

11,888. J. Potts. Improvements in or relating to the manufacture or treatment of material for the construction of guns, and for other purposes. July 26.

12,033. H. Bessemer, jun. Improvements in the production of aluminium, and in apparatus employed for that purpose. July 29.

12,113. C. L. Bath. Improvements in apparatus for forming copper ingots. July 30.

12,166. W. Ambler. Improvements in the manufacture of steel and other metal sheets and plates. July 31.

12,167. W. Ambler. Improvements in the manufacture of rolls, castings for guns and shafts, and other solid metal castings. July 31.

12,181. E. Guillemin-Tarayre. An improved method of working, preparing, and concentrating auriferous alluvium. July 31.

12,216. J. P. E. C. Stromeyer. A steel alloy for ship or boiler plates. August 1.

12,217. J. P. E. C. Stromeyer. A cast steel alloy for resisting the corrosive action of sea water. August 1.

12,315. G. Kamenisky. An improved process of refining gold. August 2.

12,322. F. L. Bartlett. Improvements relating to the treatment of ores containing lead, zinc, and other metals. Complete Specification. August 2.

12,500. T. Twynam. Improvements in the manufacture of ingot iron and steel. August 6.

12,556. W. P. Thompson.—From A. A. L. Levy, France. Improvements in coating or plating metal plates or articles of large or small size. August 8.

12,648. J. Clark. Improvements in obtaining alloys of aluminium with other metals. August 10.

12,649. D. Colville, jun. Improvements in arrangements and apparatus for charging materials into steel making or melting furnaces. August 10.

12,811. T. Hydes and S. W. Wilkinson. Improvements in apparatus for casting automatically molten metal, slag, and other molten material into pigs, blocks, or other like forms. August 14.

12,839. J. C. Bromfield. Improvements in or connected with the manufacture of iron and steel, and in the utilisation thereof of waste products. August 14.

12,945. H. E. Cooper. An improved method of moulding and casting metals. August 16.

13,013. N. M. de la E. Tenison-Woods. Improvements in precipitating metallic tin from solutions of oxides of tin in alkaline mediums, and separating any other metal soluble in the same alkaline solutions. Complete Specification. August 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

6326. A. G. Greenway. Manufacture of iron. July 31.

11,399. C. T. J. Vautin. Extracting gold from auriferous ores. August 7.

11,851. J. G. Thomas and G. H. White. Apparatus for coating metal sheets with tin, terne, or alloys. July 24.

12,626. H. W. Wallis. Manufacture of sodium and potassium. July 31.

12,982. C. F. Cockshott and J. E. Jowett. Method and apparatus for obviating pinholes and sponginess in cast brass or gun-metal shells, &c. July 31.

13,516. J. Frankland and W. H. Summerscales. Apparatus for forming sand cores for moulding purposes. July 31.

13,624. H. S. Maxim. Tempering and toughening ordnance, and apparatus therefor. August 21.

13,742. H. Eckardt. Alloys. July 24.

13,745. J. L. Walker. Construction of sheet metal hollow-ware. July 31.

13,843. H. J. Smith. Manufacture of steel and iron. July 31.

14,150. H. Schneider. Manufacture of alloys of steel and nickel. August 7.

14,240. J. Greenwood. Extraction of gold from refractory and other ores, and apparatus therefor. August 7.

14,299. J. Harris-James. Separating ores from the associated gangue. August 14.

14,397. J. G. Landstrom. Process and apparatus for enriching and separating ores. August 21.

14,517. W. A. McCool. Drawing metals, and apparatus therefor. August 14.

14,807. E. Brazier and J. Thompson. Method and apparatus for coating metal plates with tin, terne, or lead. August 21.

15,101. C. N. B. Wetzlar.—From W. L. Card. Dry concentrators for the treatment of ores. July 31.

16,231. J. Hilton. Cupolas, and means for operating same. July 24.

18,440. C. A. Burghardt. Production of pure zinc. August 21.

1889.

336. E. Britton. "Box piles" for converting iron or steel scrap into bar or plate. July 31.

345. C. N. B. Wetzlar.—From W. L. Card. Portable prospecting machine for use in mining and working on the dry process. July 31.

659. C. A. Burghardt. Reduction of zinc and tin from their ores. August 21.

3149. A. J. Boulton.—From W. G. Clark. Coating metals. August 21.

3916. D. I. Reisz, M. Berkovits, and J. Biehler. Metallic alloy for syphon heads, &c., and for tuning purposes generally. August 7.

5980. P. Schroedter and A. Schroedter. Purifying quicksilver. July 31.

7353. N. Lébédoff. Apparatus for extraction of metals from ores. August 7.

9206. J. T. King.—From W. R. Jones. Manufacture of iron and steel, and apparatus therefor. July 24.

9646. A. J. Boulton.—From J. M. Durafor and V. E. J. Durafor. Manufacture of articles in cast metal, with a coating of other metal. July 31.

11,407. E. Norton and J. G. Hodgson. See Application above. August 21.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

11,471. E. N. Reynier. Improvements in electric accumulators or storage batteries. July 17.

11,528. C. Beyer and G. Hagen. Improvements in electrode plates for electric accumulators. July 19.

11,590. F. King and W. P. Mendham. Improvements in primary batteries. July 20.

11,661. C. Huelser.—From H. Mestern, Germany. Improvements in thermo-electric and furnace batteries. July 22.

11,780. C. E. Buell. Improvements in electric generators. Complete Specification. July 24.

11,914. A. Reckenzaun. Improvements in the manufacture of plate for secondary voltaic batteries. July 26.

11,962. P. Naef. Improvements in or appertaining to the manufacture of peroxide of lead or alkaline plumbate and by-products. July 27.

12,145. P. M. Justice.—From E. G. Acheson, United States. Improvements in generating electricity or magnetism by the application of heat. Complete Specification. July 31.

12,402. W. P. Kookogey. A galvanic battery solution. Complete Specification. August 6.

12,474. H. W. Bishop and F. Brown. The inlaying of metals by electro deposition. August 6.

12,503. F. V. Andersen. Improvements in dynamo-electric machines. August 6.

12,731. W. P. Kookogey. A plate for secondary batteries. August 13.

12,752. H. G. Morris and P. G. Salom. Improvements in machines for filling secondary battery plates. Complete Specification. August 13.

12,772. A. de Castro. Improvements in means or apparatus for the generation and conversion of electric energy. August 13.

12,799. A. H. Chesnier and F. B. A. R. de la Bastie. Improvements in single fluid batteries. August 13.

12,906. E. Hermite, E. J. Paterson, and C. F. Cooper. Electrolytic treatment of vegetable matters and cereals for the production of starch. August 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

12,290. A. Schanschieff. Galvanic batteries. July 31.

13,402. S. A. Varley. Secondary batteries. July 24.

14,149. B. Willecox.—From C. S. Bradley. Dynamo-electric machines. July 31.

1889.

2297. C. Smith.—From W. L. F. Hellesen. Primary and secondary transportable galvanic dry elements. July 31.

8552. G. Nahusen. Electrolytic separation of aluminium, aluminium alloys, and magnesium from solutions of their salts. August 7.

8855. T. Harris and H. F. de Bathe Cameron. Secondary batteries. August 21.

9153. D. J. Arnold and H. B. Coryell. Dry galvanic battery. August 7.

9994. E. Maigrot and J. Sabates. See Class XVI.

10,889. E. M. H. Andreoli. Electrolytic production of hypochlorite of sodium. August 14.

11,044. W. P. Thompson.—From P. H. Alexander. Storage batteries. August 14.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

11,383. C. Lahsen and C. Feuerlein, Liverpool. Method of extracting pure neutral grease from wool or the like. July 16.

11,660. H. Schuster. Process for producing hard soap from vegetable or animal fats, or a mixture thereof, and caustic alkaline solutions, without employing carbonate of alkalis or chloride of sodium. Complete Specification. July 22.

11,817. C. R. Huxley. Ammoniated soaps. July 25.

12,259. E. Howell. Japanese magic soap for cleaning and polishing all kinds of furniture, painted woodwork, glass, marble, and metals. August 2.

12,598. A. L. Blackman. Improvements in or relating to oil presses. August 9.

12,992. G. L. Alemand. A new compound wax. August 17.

13,023. J. L. Moret. A new solid product, applicable for removing grease, washing, lixiviating, and bleaching all textile materials, cloths, rags, and similar materials, for the fulling of cloths, for removing hair from skins, and similar operations. August 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

15,124. J. C. A. Brunner. Purification of glycerin. August 21.

1889.

9382. E. Cuvclier. Crushing and extracting oil or liquids from oleaginous seeds, &c., and apparatus therefor. July 24.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

11,405. F. L. Bartlett. Improvements relating to the treatment of lead and other fumes in the manufacture of pigments, and to apparatus therefor. Complete Specification. July 16.

11,771. S. Banner. Improvements in or relating to paints or enamels. July 24.

12,034. H. Bedford. Improvements in the manufacture of sealing wax. July 29.

12,292. R. Condy. A new compound to be used in paint or pigment. August 2.

12,492. E. A. W. Dahl. A marine paint or anti-fouling composition. August 6.

12,756. R. Dick. Improvements in gutta-percha compounds, and in the modes and means of preparing and treating the same. August 13.

12,844. T. H. Wright. A new or improved composition for waterproofing and preventing the squeaking of boot soles. August 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

13,721. W. C. Nangle. Composition or paint for preserving metal, wood, &c. July 31.

1889.

10,858. E. S. Baldwin.—From J. Smith. New composition for waterproofing textile fabrics, and as a paint for wood, &c. August 14.

11,405. F. L. Bartlett. See Application above. August 21.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

11,411. H. E. Freudenberg. An improved machine for treating hides and skins. July 16.

11,549. F. N. B. Rosslyn, R. Rice, and A. T. Haines. A process for extracting grease and animal matters from tanned skins, hides, leather, wool, fur, &c. July 19.

11,797. A. Hommel. Process for the manufacture of soluble blood albumen extracts. July 24.

12,070. A. Weber. Improvements in furnaces or kilns for burning bone-black. Complete Specification. July 30.

12,521. J. Hauff. Improvements in the process for freeing kips, skins, and hides from lime, and for causing the same to swell. August 6.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

14,235. W. A. Burrows. Utilisation of leather waste. August 7.

1889.

10,110. J. Hauff. Freeing skins, kips, and hides from lime, and causing them to swell. July 24.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

12,021. A. Chapman.—From C. A. Matthey, West Indies. A process or method of extracting sugar from sugar cane or other sugar-yielding substances and apparatus for the purpose. July 27.

12,393. W. Fairweather.—From The Babcock and Wilcox Co., United States. Improvements in bagasse furnaces. Complete Specification. August 6.

12,809. W. Maxwell. Improvements in multiple effect evaporating apparatus for evaporating or concentrating sugar juice and other liquids. August 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

13,084. G. Adant. Manufacture of sugar and apparatus therefor. July 24.

13,595. J. G. Lorrain. Treatment of sugar solutions. July 31.

13,655. D. Stewart. Centrifugal apparatus for drying sugar or other granular matters. July 24.

1889.

9994. E. Maigrot and J. Sabates. Apparatus for the manufacture of sugar by electricity. July 24.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

11,339. P. L. F. E. Vignier. An improved mode of and apparatus for distilling whiskies. July 15.

11,623. W. Smith. Improvements in the treatment of malt liquors and spirits. July 20.

11,730. J. White. Improvements in the manufacture of flaked malts. July 23.

12,114. P. G. Wolkoff. An improved process of and apparatus for treating must and other fermented liquid to obtain and purify the alcohol contained therein. July 30.

12,186. P. C. Rousseau, M. J. de Chanterac, and M. J. D. A. de la Baume. A process for purifying alcohol, wine, and other alcoholic liquids and beverages. July 31.

12,187. L. Lederer. Improvements in the manufacture of French yeast and in the machinery employed therein. July 31.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

13,724. Brin's Oxygen Co., Limited.—From L. Q. Brin and A. Brin. Treatment of spirits, wines, and beer for ageing or maturing them. July 31.

14,328. J. C. Shears and A. Manbré, sen. Apparatus for acetifying alcoholic wash and liquor in the manufacture of vinegar. August 14.

1889.

1582. C. R. Bonne. Preparation of fermentable worts. July 24.

7964. R. Haddan.—From J. C. Severino. Manufacturing a new liqueur. July 24.

8277. J. Leslie. Application of oxygen in the distillation of alcoholic liquids. July 24.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

11,338. W. L. Wise.—From H. von Rom, Germany. Improvements in the treatment and preservation of organic substances, such as flesh or meat and the like. July 15.

11,355. C. H. Roeckner, F. L. Roeckner, and R. L. Roeckner. A new or improved nutritious product. July 15.

11,577. D. Politi. Zucarine jellies in powder. July 19.

11,796. E. Serrant. Process for preserving meat. July 24.

11,806. W. Palmer. The preparation of a solid extract of meat or condensed soup, and a preservative coating for same and other preserved foods. July 25.

12,614. C. W. Beesly and H. S. Holt. An improved compound for preserving milk and other animal matter. August 9.

B.—Sanitary Chemistry.

11,465. C. E. Gittins. Improvements in machinery for water softening and sewage purification. July 17.

11,798. C. G. Moor. Improvements in the treatment of sewage for the purification thereof and the production of valuable products therefrom. July 24.

12,405. H. W. Whiting. Improvements in refuse-burning furnaces. Complete Specification. August 6.

12,623. T. Shaw. See Class IX.

C.—Disinfectants.

11,398. E. Leman. A new preserving powder for meat and fish. July 16.

11,974. F. G. A. Roberts, A. Shearer, and W. B. Giles. An improved manufacture or preparation of antiseptics. July 27.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Sanitary Chemistry.

1888.

11,225. A. B. Lennox, T. Field, and W. Brown. Bread fermentation. August 7.

14,945. E. Edwards.—From J. Lapeyrère. A preparation to be used as a substitute for or in combination with coffee. August 21.

1889.

4893. E. Roberts, L. E. Roberts, and H. G. Roberts. Compound for use in the preparation of table cream, &c. August 7.

B.—Sanitary Chemistry.

1888.

11,663. T. Donnithorne. Treatment of sewage. August 21.

13,761. A. Bobrownicki. Treatment of towns' refuse and other putrescible matters. July 31.

1889.

6528. H. H. Lake. From J. Hirschfeld. Treatment of feculent matter, and apparatus therefor. July 31.

C.—Disinfectants.

1888.

5984. R. Hauman. Sanitary and antiseptic compounds. July 24.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATION.

11,809. W. Proudlock. Improvements in the methods of straining every kind of pulp used for the manufacture of paper. July 25.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

11,150. C. F. Dahl. Blowing out and washing process for making paper pulp from esparto, straw, &c. August 7.

11,458. H. Bache-Wüg, C. Bache-Wüg, and V. B. Drewsen. Producing pure cellulose. July 31.

12,190. C. Weygang. Manufacture of ordinary and waterproof papers, boards, &c. July 31.

13,396. F. Salomon and H. Brüniger. Protecting apparatus used in the manufacture of sulphite cellulose. July 24.

13,741. H. Schulte. Machinery for manufacture of paper. July 31.

15,189. H. J. Allison.—From K. J. Collins. Celluloid and analogous bindings. August 7.

1889.

8903. J. Groome. Machines for pulping materials used in the manufacture of paper. July 24.

9927. H. H. Lake.—From C. T. Lee. See Class IX.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATION.

13,027. A. M. Clark.—From the Firm of F. von Heyden's successor, Saxony. Improvements in the separation of the isomeric substances produced in the manufacture of dithio-salicyleic acid. August 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

13,892. H. H. Lake.—From C. L. T. Müller. Production of pure ethylic alcohol from crude spirits. August 21.

14,877. G. Christopher and R. W. Leftwich. Preparation and treatment of extract of tea. August 21.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATION.

12,309. J. Williams. Improvements in the treatment of paper or other fabrics, to render them suitable for photographic purposes. August 2.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

13,301. H. C. Bond. Process for truly reproducing the colours of nature in a compound photographic print. July 24.

16,537. W. Oldham. Method and materials for developing photographic pictures. August 7.

1889.

9921. H. Deveril and W. Gallagher. Photographic negatives and sensitised plates. July 24.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

11,500. P. Ward and E. M. Gregory. Improvements in fuses and detonators. July 18.

11,501. P. Ward and E. M. Gregory. Improvements in the construction of electric fuses and detonators, and in the method of and appliances employed for manufacturing the same. July 18.

11,664. Sir F. A. Abel and J. Dewar. Improvements in the manufacture of explosives. July 22.

11,665. W. Schücker. An improved manufacture of smokeless gunpowder. Complete Specification. July 22.

11,667. Sir F. A. Abel, J. Dewar, and W. Anderson. Process and apparatus for the manufacture of explosives in the form of wires or rods, and for forming the same into cartridges. July 22.

11,711. J. Altschul and R. H. Punshon. Improvements in the manufacture of safety fuse for blasting purposes. July 23.

11,748. J. Harper, R. Punshon, and F. Parker. Improvements in high explosives. July 23.

12,089. P. Giffard. Improvements in mining or blasting cartridges, and in shells or explosive projectiles. July 30.

12,249. J. C. Butterfield and T. C. Batchelor. Improvements in or relating to explosive cartridges. August 1.

12,307. A. V. Newton.—From A. Nobel, France. Improvements in the preparation and application of explosive compounds. August 2.

12,338. C. O. Lundholm and J. Sayers. Improvements in the manufacture of explosives. August 3.

12,427. W. E. Liardet. Improvements in the manufacture of explosive compounds. Complete Specification. August 6.

12,763. J. Lutz and L. Oltósy. Improvements in the manufacture of lucifer matches. August 13.

12,895. E. A. Trewinnard. Improvements in matches. August 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

13,308. J. M. T. Anderson and A. Anderson. Manufacture of explosives. July 24.

13,789. P. M. Justice.—From L. Fraenkel. Explosive compound. July 30.

14,027. C. O. Lundholm. Manufacture of dynamite. July 31.

14,814. W. Ellicott. Manufacture of cartridges. August 21.

15,028. F. J. Shand. Cartridges for blasting. August 21.

1889.

236. R. S. Lawrence. Methods of treating high explosives, such as dynamite, and for utilising, protecting, and firing such explosives, in projectiles, torpedoes, cartridges, &c. July 24.

THE JOURNAL

OF THE

Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 9.—VOL. VIII.]

SEPTEMBER 30, 1889.

[Non-Members 30/- per annum; Members 21/- per Set of extra or back numbers; Single Copies (Members only) 2 6.]

The Society of Chemical Industry.

Past Presidents:

Sir H. E. Roscoe, M.P., LL.D., V.P.R.S.	1881—1882.
Sir Frederick Abel, C.B., D.C.L., F.R.S.	1882—1883.
Walter Weldon, F.R.S.	1883—1884.
W. H. Perkin, Ph.D., F.R.S.	1884—1885.
E. K. Muspratt	1885—1886.
David Howard	1886—1887.
Prof. James Dewar, F.R.S.	1887—1888.
Ludwig Mond	1888—1889.

COUNCIL FOR YEAR ENDING JULY, 1890.

President: Sir Lowthian Bell, Bart., F.R.S.

Vice-Presidents:

R. Forbes Carpenter.	S. H. Johnson.
Prof. F. Clowes, D.Sc.	Ludwig Mond.
Sir J. Neilson Cuthbertson.	Dr. Hugo Muller, F.R.S.
Prof. James Dewar, F.R.S.	Dr. W. H. Perkin, F.R.S.
Jas. Duncan.	Dr. Edw. Schmuck, F.R.S.
Dr. John Evans, F.R.S.	Prof. W. A. Tilden, F.R.S.

Ordinary Members of Council:

L. Archbutt.	B. E. R. Newlands.
S. B. Boulton.	Jno. Pattinson.
Jno. Brock.	Jno. Spiller.
Jno. Calderwood.	E. C. C. Stanford.
Alexander M. Chance.	J. C. Stevenson, M.P.
A. E. Fletcher.	A. Norman Tate.

With the Chairmen and Secretaries of Sections.

Honorary Treasurer:

E. Rider Cook, East London Soapworks, Bow, E.

Honorary Foreign Secretary:

Dr. Ferdinand Hurter.

General Secretary: Charles G. Cresswell.

Offices:

Palace Chambers, 9, Bridge Street, Westminster, S.W.

THE JOURNAL.

Publication Committee:

The President.

Sir F. A. Abel, F.R.S.	Prof. A. K. Huntington.
A. H. Allen.	F. Hurter, Ph.D.
G. H. Bailey, D.Sc., Ph.D.	Ivan Levinstein.
Joseph Bernays, M.I.C.E.	Prof. R. Meldola, F.R.S.
H. Brunner.	Ludwig Mond.
W. Lant Carpenter.	E. K. Muspratt.
Prof. Frank Clowes, D.Sc.	B. E. R. Newlands.
W. Y. Dent.	C. O'Sullivan, F.R.S.
Prof. Jas. Dewar, F.R.S.	John Pattinson.
John Heron.	W. H. Perkin, Ph.D., F.R.S.
D. B. Hewitt, M.D.	Sir H. E. Roscoe, M.P., F.R.S.
David Howard.	John Spiller.
Prof. J. J. Hummel.	A. Norman Tate.
	Thomas Tyrer.

Editor:

Watson Smith, University College, London, W.C.

ASSISTED BY THE FOLLOWING STAFF OF

Abstractors:

T. L. Bailey, Ph.D.	F. S. Kipping, D.Sc.
G. H. Beckett.	Chas. A. Kohn, Ph.D.
D. Bendix.	F. W. T. Krohn.
E. Bentz.	T. A. Lawson, Ph.D.
Jos. Bernays, M. Inst., C.E.	J. Walter Leather, Ph.D.
E. E. Berry.	A. Liebmann, Ph.D.
E. J. Bevan.	D. A. Louis.
Bertram Blount.	W. Macnab.
Arthur G. Bloxam.	N. H. J. Miller, Ph.D.
C. H. Bothamley.	J. M. H. Munro, D.Sc.
W. Lant Carpenter.	H. S. Pattinson, Ph.D.
E. G. Clayton.	H. T. Penntermann.
Julius B. Cohen, Ph.D.	S. G. Rawson, D.Sc.
C. F. Cross.	A. Rée, Ph.D.
A. R. Davis.	F. W. Renaut.
W. W. Haldane Gee, B.Sc.	Edward Simpson.
C. Napier Hake.	A. J. Smith, B.Sc.
Oswald Hamilton.	Oscar J. Steinhart, Ph.D.
John Heron.	A. L. Stern, B.Sc.
Bertram Hunt.	D. A. Sutherland.
F. Hurter, Ph.D.	Bertram Thomas.
C. C. Hutchinson.	Eustace Thomas.
D. E. Jones, B.Sc.	V. H. Veley, M.A.
W. E. Kay.	R. Lloyd Whiteley.
A. J. King, B.Sc.	A. Wingham.

NOTICES.

On and after the 30th of September the Editor's address will be "University College, Gower Street, London, W.C.," instead of Owens College, Manchester, as heretofore.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January 1883, and January, February, and April 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once, stating price required, with Mr. Cresswell. The stock of all other numbers is at present sufficient for the Council's requirements.

Post Office Orders in payment of subscriptions should in all instances be made payable at the General Post Office, London.

CHANGES OF ADDRESS.

Allen, G. J., 1/o Tübingen; 27, Bolton Road, Pendleton, Manchester.
 Babington, F. W., 1/o Toronto; Inland Revenue Laboratory, Ottawa, Canada.
 Barlow, E. B.; Journals to Beta, Old Bromley Road, Beckenham, S.E.
 Best, T. T., 1/o Liverpool; c/o Messrs. Gamble & Son, St. Helens.
 Bevan, J. W., 1/o Bristol; Chemical Works, Temple Street, Dublin.
 Binks, Jas. B., 1/o Silloth; 117, Westmuir Street, Parkhead, Glasgow.
 Cawley, Geo., 1/o Manchester; 358, Strand, London, W.C.
 Chaney, H.; Journals to Mysore Gold Mining Co., Ltd., Kolar District, Mysore, India.
 Edmonds, H. R., 1/o New York; 7, King Henry's Road, London, N.W.
 Emmens, S. H., 1/o Harrison; New Stanton, Westmoreland Co., Pa., U.S.A.
 Hamilton, Oswald, 1/o Manchester; University College, Gower Street, London, W.C.
 Horn, Wm., 1/o Glasgow; Roxburgh Street Refinery, Greenock, N.B.
 Ikuta, Dr. M., 1/o Yotsuya; 25, Tomoyecho, Shiba, Tokio, Japan.
 Isherwood, Oswald; Journals to 4, Strong Street, Broughton, Manchester.
 Jackson, Val., 1/o West George Street; 7, Thornville Terrace, Hillhead, Glasgow.
 Japp, Dr. F. R., 1/o Bedford Park; 25, Woodville Road, Ealing, W.
 Krause, O. H., 1/o Box 217; Box 577, Jersey City, N.J., U.S.A.
 Lovett, W. Jesse, 1/o Thornes; Lamerfield Lane, Wakefield.
 MacMillan, T. O., 1/o Glengarnock; 28, Maxwell Road, Pollokshields, Glasgow.
 McRoberts, Geo., 1/o Stevenston; Bath House, Ardrossan, N.B.
 Newbury, Prof. Spencer B., 1/o Paris; Cornell University, Ithaca, N.Y., U.S.A.
 Orndorff, Dr. W. R., 1/o Paris; Cornell University, Ithaca, N.Y., U.S.A.
 Richardson, J. H., 1/o Church; Goole Alum Works, Goole, Glasgow.
 Robertson, R. A., 1/o Pollokshields; 8, Park Street East, Glasgow.
 Schad, J., 1/o 14, Charlotte Street; 15, Cooper Street, Manchester.
 Smith, Watson, 1/o Owens College, Manchester; University College, Gower Street, London, W.C.
 Tatters, J. G., 1/o South Shields; The Mause, Runcorn, Cheshire.
 Trechmann, A. O., 1/o Stockton; 7, Beaconsfield Street, Harthpool.
 Warne, Thos., 1/o Rainham; c/o Mason and Barry, Ltd., Wallend Works, near Newcastle-on-Tyne.
 Weir, Surg. Maj. P. A., 1/o Glasgow; September No. to c/o King, King, and Co., Bombay; and thenceforth to Opium Agency, Ghazipur, N.W.P. India.
 Wray, O. J. P., 1/o Silvertown; Fernleigh, Old Dover Road, Blackheath, S.E.
 Wyatt, J. W., 1/o Watford; St. Cuthbert's Mills, Wells, Somerset.

CHANGES OF ADDRESS REQUIRED.

Gibson, Jno., 1/o 29, Greenhill Gardens, Edinburgh.
 Rushton, H. F., 1/o 30, Juvenal Street, Liverpool.

Death.

Miest, Emile, Sté Marie d'Oignies, par Tamines, Belgium.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	R. Messel.
H. E. Armstrong.	B. E. R. Newlands.
W. Lant Carpenter.	B. Redwood.
W. Crowder.	T. Royle.
W. J. Dibdin.	John Spiller.
C. Graham.	Wm. Thorp.
S. Hall.	C. R. Alder Wright.
C. C. Hutcheon.	

Hon. Local Sec. and Treasurer:

Thos. Tyrer, Garden Wharf, Battersea, S.W.

SESSION 1889-90.

Nov. 4th.—Mr. C. Napier Hake, F.C.S. "An Account of a Borax Lake in California."

Dec. 2nd.—Mr. Watson Smith (Editor of the Society's Journal). "Some Notes on Variations in the Products of the Destructive Distillation of different Gas Coals, heated separately in the same retort and under similar conditions."

Jan. 13th (2nd Monday):—

Mr. A. H. Allen. "On the Properties and Applications of Metallic Compounds of the Phenols."

Mr. J. Hauff. "On Cresotinic Acid and its Applications."

Communications.

ON CHILIAN MANGANESE ORE.

A Paper read before the British Association (Chemical Section), Newcastle-on-Tyne.

BY JOHN PATTINSON, F.I.C., AND H. S. PATTINSON, PH.D.

PREVIOUS to the adoption of Weldon's manganese recovery process, nearly the whole of the rich manganese ore imported to this country, or mined in Devonshire and Cornwall, was used for generating chlorine in the manufacture of bleaching-powder. About 54,000 tons were used for this purpose in 1868, about the time that Weldon discovered his process. After the general adoption of this process, the demand for manganese ore for generating chlorine was restricted to what was needed to make up the relatively small loss of material incidental to the Weldon recovery process; for this, and for some other chemical purposes, such as the manufacture of manganates, there were used in Great Britain in 1888—20 years later—about 7,000 tons. But the use within recent years of the rich alloys of manganese and iron, known as "ferro-manganese," in steel making, has given rise to a new and large demand for rich manganese ores. The value of ores for this purpose depends upon the proportion of metallic manganese they contain, and not upon their yield of oxygen, as when used for generating chlorine.

Manganese ores are now imported from Spain, Portugal, Hungary, Greece, Canada, New Zealand, and Australia, but by far the greatest quantities come from Canea and from Chili. During the year 1888 about 85,000 tons of manganese ore were imported for making ferro-manganese, of which quantity about 25,000 tons came from Chili. The first shipments of these ores from Chili were in 1883, and so far as we are aware, no analyses of them have as yet been published. The three following analyses of Chilean manganese ores will therefore be of interest. They are made upon samples taken from cargoes of about 1,000 tons

each, and may be regarded as representing the nature of the Chilean ores heretofore imported.

	I.	II.	III.
	Per Cent.	Per Cent.	Per Cent.
Peroxide of manganese.....	69.23	57.06	66.03
Protoxide of manganese.....	11.92	23.05	10.39
Peroxide of iron	1.67	4.71	1.59
Oxide of lead	0.00	0.06	0.05
Oxide of copper.....	0.15	None.	0.14
Oxide of zinc	0.10	None.	None.
Nickel and cobalt.....	None.	None.	None.
Alumina	1.21	2.80	1.60
Baryta.....	None.	None.	3.58
Lime	1.13	2.33	5.36
Magnesia	0.24	0.56	0.13
Potash	2.86	0.46	0.15
Soda.....	0.08	0.26	0.11
Silica	1.17	7.30	4.75
Carbonic acid (CO ₂).....	None.	0.18	2.33
Sulphuric acid (SO ₃).....	0.05 (=0.02 S)	0.13 (=0.05 S)	1.57 (=0.63 S)
Phosphoric acid (P ₂ O ₅)	0.12 (=0.05 P)	0.14 (=0.06 P)	0.05 (=0.02 P)
Arsenic	Not determined.	0.15	0.04
Combined water	3.90	3.00	1.96
	99.92	100.19	99.94
Metallie manganese.....	53.00	52.63	49.79

The analyses were made on the samples dried at 100° C., at which temperature they lost, respectively, 2.47 per cent., 1.08 per cent., 0.98 per cent. of hygroscopic moisture.

No. I. comes from the neighbourhood of Santiago, and was shipped from Valparaiso; Nos. II. and III. are from the vicinity of Coquimbo and Carrizal, which are now the chief ports of shipment. Nos. I. and II. are very hard compact amorphous ores of a bluish-black colour, and often exhibit a conchoidal fracture; No. III., which contains more peroxide than the others, is softer and of rather a darker colour, and crystals of calcium carbonate are frequently found disseminated through it.

The ore is found in stratified beds varying in thickness from a few inches to six feet. These beds occur in the range of hills along the coast of Chili, known as the "Cordilleras de la Costa," and are found out-cropping in the sides of the hills, at varying distances one below the other, often to the number of four or five. These beds are much distorted and are interrupted by frequent faults.

A characteristic of Chilean manganese ores is the large percentage of protoxide of manganese they contain—a much larger percentage than is found in Caucasian or Spanish ores, which usually contain no more than from one to two per cent. of protoxide.

It is well known that manganese dioxide acts the part of a feeble acid, and, when precipitated, carries down with it as manganites, protoxide of manganese, baryta, lime, potash, and other bases with which it was in solution. It is probable, therefore, that in these ores the protoxide of manganese has been deposited in combination with the peroxide in the form of manganite of manganese. In No. I. there is an unusual amount of potash, and in No. III. the percentage of lime and baryta is high. A part of the baryta exists as sulphate, and a part of the lime as carbonate, but no doubt portions of these bases as well as the potash have been precipitated with the manganese

dioxide, and exist in these ores as manganites. Baryta is no uncommon constituent of manganese ores. In some Caucasian ore as much as 2.04 per cent. has been found. Potash, also, is found in other ores than Chilean, and we have met with one specimen which contained as much as 1.15 per cent. The silica in the Chilean manganese ores is sometimes in the form of quartz, but it also exists very frequently as a silicate of manganese. It is also to be observed that these Chilean ores contain a very low percentage of phosphorus, a matter of great importance to the steel maker. The amount of phosphorus varies to a slight extent, samples of some cargoes having had about 0.10 per cent. of this constituent. No. II. contains a small quantity of arsenic, which has been shown by Pattinson and Stead (Journal of the Iron and Steel Institute, 1888, Part I.) not to be so deleterious an ingredient of steel as phosphorus.

Enormous beds of manganese ore, containing between 30 and 40 per cent. of manganese and a large percentage of calcium carbonate, have been discovered in Chili. These deposits are practically inexhaustible, but as yet only the richer ores, containing about 50 per cent. of manganese and upwards, can be profitably exported. Perhaps in the future, should the means of transport become cheaper, these poorer ores may be brought into the market.

THE PRODUCTION OF THE ALLOYS OF ALUMINIUM AND SILICON IN THE ELECTRIC FURNACE (COWLES' PROCESS).

*Read before "B" section, British Association,
September 13, 1889.*

BY J. H. J. DAGGER, F.C.S., F.A.C.

Historical.—Although aluminium is one of the most widely distributed of the elements entering into the composition of nearly two hundred minerals, its oxide alumina was regarded as identical with lime until, in 1754, Margraff proved it to be a distinct substance.

In 1807, Davy, so successful with the oxides of the metals of the alkalis and alkaline earths, attempted to decompose alumina by the battery, but failed; and it was not until the year 1828 that Wöhler, by heating the chloride with metallic potassium, first obtained aluminium as a grey lustrous metallic powder, and 18 years later in globules not larger than pin heads; from these with extreme ingenuity he determined the principal properties of the metal. In 1854, Deville (at that time Professor of Chemistry in the École Normale, Paris), in course of some researches on the chloride, obtained a button of pure aluminium by the decomposition of the chloride with sodium, and on the 14th February that year read a paper describing his discovery before the Academy of Science. As a result a committee was formed to carry on experiments, 2,000 francs being granted to meet expenses. On August 14th he read a second paper before the Academy, exhibiting several bars of aluminium, and caused a medal of the metal to be struck and presented to the Emperor.

In March of the next year experiments on a large scale at the Imperial cost were instituted at Javel, and on June 18th, Deville presented to the Academy, through M. Dumas, large bars of pure aluminium. These experiments are said to have cost the Emperor 35,000 francs (1,158*l.*).

Devil's method, modified in details, is still the chief of the chemical methods of preparing aluminium on a commercial scale, and is dependent on the cost of the metallic sodium and the double chloride of aluminium and sodium, which is the compound used in the most important of the present day processes.

Pure aluminium is a highly lustrous metal, white with a faint tinge of blue in colour. It resists the action of air and moisture even at high temperatures, is not blackened by

exposure to the action of sulphuretted hydrogen or the alkaline sulphides, and is not attacked by fused nitre, nitric or dilute sulphuric acid. It dissolves readily in hydrochloric acid or in solutions of the alkalis.

Its density is but two and one half times that of water, compared with other metals its density is as follows:—

Metal.	Density.	Compared with Aluminium.
Platinum	21.5	8.6
Gold	19.3	7.7
Lead	11.4	4.8
Silver	10.5	4.2
Copper	8.9	3.6
Iron	7.8	2.9
Tin	7.3	2.8
Zinc	7.1	2.8
Aluminium	2.5*	1.0

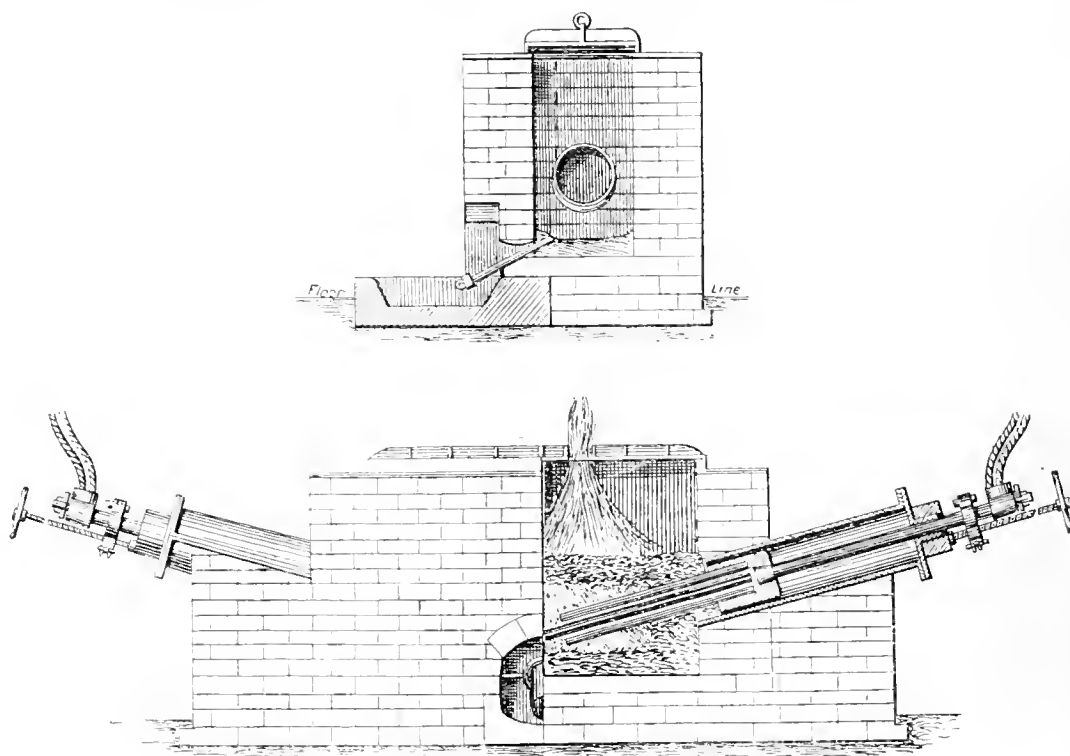
* Cast metal 2.56. Rolled or hammered metal 2.67.

In a paper read by Mr. W. H. Barlow before the British Association, 1882, its tenacity is given at 12 tons to the square inch, but weight for weight it would equal high class steel or 36 tons per square inch. Its elasticity is almost equal to that of silver. Is ductile, can be drawn into very fine wire, and is almost as malleable as gold. Its thermal conductivity is about two-thirds that of copper. Its electrical conductivity is given by Deville as eight times that of iron. Its specific heat is .22, it melts at 1300° F.,† but exhibits no tendency to volatilise even though heated in a carbon crucible in a blast furnace to high temperatures.

The extreme lightness of aluminium, its power of resisting the action of air, moisture, and sulphuretted hydrogen give it an advantage over silver which it equals in tenacity and elasticity as a material for jewellery, and for scientific and astronomical instruments.

The greatest value of aluminium is as yet in its alloys, and it is with their production in the electric furnace I propose to deal to-day, and I may remark that the successful application of the intense heat of the electric arc to the production of metals on a commercial scale, marks a new departure in electro-metallurgy of which we cannot over-estimate the importance, rendering it possible to produce rich alloys of aluminium at half the cost of any other process, and so widening the field of their application to an extent hitherto unknown.

TRANSVERSE AND LONGITUDINAL SECTION OF THE COWLES ELECTRICAL FURNACE.



Messrs. Cowles' first experiment was with a very refractory zinc ore containing silver, which they had failed to reduce in an ordinary furnace. A fireclay tube was taken filled with a mixture of the crushed ore and charcoal powder, a bundle of electric light carbons inserted in each end, and a current from a small dynamo sent through the mass; in a short time the ore was reduced, but the fireclay tube was partly melted, showing the necessity for a lining that would protect the furnace walls from the intense heat. Powdered charcoal, a very feeble conductor of heat and electricity, was tried, but it was found that after a time it became

converted into graphite, thus becoming a conductor, as the smelting proceeded changing gradually from the inside to the outside, and as the hot zone expanded causing loss of energy and eventually destroying the furnace. Mr. Alfred H. Cowles then suggested soaking the charcoal powder in milk of lime, and drying before use. This proved successful, each particle of charcoal being coated with a film of lime, which insulates it and prevents electrical conduction between neighbouring particles even after the charcoal is

† Bailey gives 700° C. = 1,484° F.

converted into graphite. Messrs. Cowles now found that they had a furnace that would enable them to conduct metallurgical operations at a temperature hitherto unknown outside the laboratory, and after some experiments with corundum, they, acting in conjunction with Professor Mabery, set up the first plant for the production of aluminium bronze, ferro-aluminium and silicon bronze at the works of the Brush Electric Company, Cleveland, Ohio, U.S.A., and on the 20th January 1886 Mr. E. H. Cowles read a paper before the Franklin Institute describing the electric furnace and a process of making aluminium bronze. The Institute thought so highly of the importance of the discovery that they awarded to Messrs. Cowles the "Elliott" gold medal, the highest honour in the gift of the Institute. The City of Philadelphia awarded them the "John Scott Legacy" medal, this being the only instance of the two awards falling to the same inventors.

In 1887 Mr. E. H. Cowles was elected a Fellow of the Royal Society.

The results obtained at Cleveland were so satisfactory though using only a dynamo of 300 ampères with E.M.F. of 60 volts, that in 1886 the Cowles Company commenced the works at Lockport, N.Y., U.S.A. The works at Lockport commenced operations with a Brush dynamo giving a current of 1,500 ampères with an E.M.F. of 45–60 volts; to this has been added two dynamos, each capable of supplying a current of 3,000 to 3,200 ampères with an E.M.F. of 55 to 60 volts. A fourth dynamo is now building of 3,000 ampères.

One striking feature of the Lockport works is the use of water-power, the dynamos being actuated by two powerful turbines, 30 inch diameter = 500 horse-power.

The number of furnaces in operation are 14, producing about 300 lb. of aluminium contained in alloys per 24 hours. Four additional furnaces are now building.

I will now describe the English works of the company at Milton, Staffordshire.

The Milton Works.—These, the first electro-metallurgical works established in Europe, are situated near Milton station, on the North Staffordshire railway, with which system they are connected by a siding, and also abut on a branch of the Trent and Mersey canal, thus affording facilities for cheap transit of raw material, coal, and finished products.

The experience at the Lockport works showed conclusively that great economies were to be expected from increasing the size of the furnaces, and the strength of the electric currents, but no current of more than 3,000 ampères had been used up to the time the Milton works were planned.

Mr. Cowles then prepared a specification for a dynamo to give a current of 5,000 ampères at 60 volts, and eventually Messrs. Crompton's designs were accepted.

Dynamo.—This dynamo is of 500 h.p., and furnishes a current of 5,000 to 6,000 ampères, with an E.M.F. of 50–60 volts. It is said to be the largest machine (at least in regard to quantity of current) in England, and probably in the world. I will not describe this magnificent machine more fully, as it was the subject of a very interesting paper read by Mr. Crompton before the "G" section of the Association last year.

Boilers.—The boilers supplying steam to the works are of the Babcock-Wilcox type, representing 600 h.p., and are fitted with mechanical stokers; by this means one man can easily attend to the generation of steam for the whole works.

Engine.—The main engine used for driving the dynamo only is a compound condensing horizontal tandem engine, made by Messrs. Pollitt and Wiggell, of Sowerby Bridge, and is well worthy noting for its beautiful workmanship. Its motion is indeed so silent that with your back to it at the moment of starting you cannot tell whether it is in motion or not. It is of 600 h.p., and is provided with automatic expansion gear, and the centrifugal governor maintains the speed at 76 revolutions. It is needless to say that work of this kind involves rapid fluctuations of load, and as an additional precaution against racing, the engine is fitted with Tate's electrical "stop-valve," which stops the engine automatically if the speed exceeds a certain limit. It

can also be stopped from various points in the engine and furnace rooms by means of push-buttons connected in parallel with the main circuit leading to the Tate's valve.

The engine has a 23-in. high-pressure and a 43-in. low-pressure cylinder. The stroke is 5 ft., the average steam pressure being 85 lb. The flywheel is 20 ft. in diameter, and weighs 20 tons; it is geared to the dynamo by 18 driving ropes, so that the dynamo makes five revolutions for each revolution of the engine.

The Current.—From the dynamo the current is led by copper bars to an enormous "cut out," calculated to fuse at 8,000 ampères. This is probably the largest ever designed, and consists of a framework carrying 12 lead plates, each $3\frac{1}{2}$ in. by $\frac{1}{16}$ in. thick. From this it passes into the furnace rooms. A current indicator is inserted in the circuit, consisting of a solenoid of nine turns. (This was cut out of a cylinder of cast copper by means of a parting tool in a screw-cutting lathe.) In the solenoid is an iron core suspended by a spring. The movement of this is communicated to two pointers, one dial being placed in the engine room, the other in the furnace room. The range of the indicator is such that the entire circle of $360^\circ = 8,000$ ampères.

Furnaces.—There are two furnace rooms, each containing six furnaces. The first room contains the bronze furnaces, in which is carried on the manufacture of aluminium copper and silicon copper. The second is devoted to the production of ferro-aluminium. The furnaces are rectangular in form, built of fire-brick, the internal dimensions being 60 in. by 20 in. by 36 in. Into each end is built a cast-iron tube, through which the carbon electrodes enter the furnace.

Electrodes.—Each electrode consists of a bundle of nine carbons, each $2\frac{1}{4}$ in. diameter, attached to a head of cast iron for ferro-aluminium, or cast copper when cupro-aluminium is made. Each carbon rod weighs 20 lb. Quite recently it has been possible to obtain carbons 3 in. diameter weighing 36 lb.; these are employed in bundles of five. The "head" of the electrode is screwed to the copper rods or "leads," which can be readily connected with or disconnected from the flexible cables supplying the current.

Each cable is secured to slides running on omnibus bars of copper overhead, so that it can be brought into position opposite the furnace to be used.

The electrodes are arranged so that it is possible, by means of a handle and screw, to advance or withdraw them from each other in the furnace.

Lining.—Lining the furnace is the first operation preparatory to smelting; this is done by covering the bottom of the trough with a layer of prepared charcoal.

Charcoal Lining.—Oak charcoal is used. This is ground under edge runners, treated with milk of lime and dried, first in a steam-jacketed revolving drum, and afterwards on a hot iron plate. Each particle of charcoal is thus coated with an insulating film of lime.

The electrodes are now arranged in the furnace, and a "former," consisting of two pieces of sheet iron connected by stirrups arched so as to fit over the electrodes, forming a box without top or bottom (the size being dependent on the charge used), is dropped over the electrodes. Prepared charcoal is then rammed into the space between the iron sheet and the fire-brick walls of the furnace. This done, the charge of ore mixed with coarse charcoal and the metal to be alloyed with the aluminium, in form of turnings or granules, is placed inside the iron box, after which this is carefully withdrawn. Some broken pieces of carbon are arranged so as to connect the electrodes and start the current. The charge is then covered with coarse charcoal, and the cast-iron cover, having a hole in the centre for the escape of gases, is lifted into place and luted so as to prevent the entrance of air.

The commencing current is about 3,000 ampères, gradually increasing to 5,000 ampères in the first half-hour. The time occupied by a "run" is about $1\frac{1}{2}$ hours. Soon after starting the gases escaping from the orifice in the cover take fire and burn with a white flame. This gas consists mainly of carbonic oxide, with small quantities of the hydrocarbons and nitrogen. On the conclusion of the run the furnace is allowed to cool, the melted alloy collecting in the bottom of

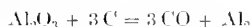
the furnace. The next furnace, ready charged, is connected, so that the process is a continuous one, the furnaces being successively charged and connected.

A form of furnace in which the metal is tapped from the bottom has given very satisfactory results.

The energy required to produce 1 lb. of contained aluminium depends of course upon the grade of alloy, the average being 18 h.p. per hour.

The crude metal from the furnace is then refined and remelted in a reverberatory furnace, each "run" is sampled, and the percentage of aluminium ascertained by analysis.

The nature of the reaction that takes place in the electric furnace is not very easy to ascertain. The reduction of the ore takes place in an air-tight box, and in presence of an enormous excess of carbon. It may be assumed that at the intense heat of the electric arc the ore melts and give up its oxygen to the carbon—



The presence of copper or iron is immaterial, as the reaction takes place with ore alone, but in absence of the alloying metal the liberated aluminium absorbs carbon and is converted into a carbide.

Professor Hampe, however, contends that the reaction is in two stages, the first being electrothermic, in which the ore melts; the second electrolytic, in which electrolysis of the molten oxide takes place, aluminium being liberated. Supposing an alternating current is used in the furnace instead of the continuous, and that we have a high number of alternations—from recent experiments with alternating currents we know that very slight or no electrolytic action occurs—if then we get equal results, it would go to prove that the action is thermic, and *not* electrolytic.

Alternate Current Experiment.—An experiment was made by the Cowles Company using an alternating current.

The furnace used was 48 in. by 12 in. by 24 in. with current of 900 ampères with E.M.F. of 50 volts, alternations per minute 11,000. At the end of 1½ hours we obtained 45 lb. of 4 per cent. aluminium bronze.

This investigation was purely of an experimental character, and it cannot be doubted that on the larger commercial scale the result would be more satisfactory.

The results obtained were identical with those given by the continuous current in every way, the resultant slags similar in composition.

The slag from the electric furnace is really only melted unrefined ore and not a slag in the proper sense of the word. Its approximate composition is Al_2O_3 90, SiO_2 2.00, Fe_2O_3 4.00, CaO 3.9, P 0.10.

The charcoal from the old linings which has been partially converted into graphite is re-crushed and treated with milk of lime, dried as before, and thus used many times over. The crude metal from the "runs" is remelted with a fluor-spar as a flux and tapped from the reverberatory furnace into ingots or plates, the refinery slag is put into a revolving drum for breaking into pieces, and then washed to remove carbon; the entangled particles of alloy are thus recovered and are worked up with other charges.

These operations are carried out in a separate building, the reclaiming house.

Production.—These works produce about 260 lb. of contained aluminium per 24 hours, the most valuable alloy being aluminium bronze, which is supplied in grades* containing 1½ to 11 per cent. aluminium. To obtain these the rich furnace product containing 15 to 20 per cent. aluminium is remelted and reduced to the desired percentage with metallic copper and cast in 12 lb. ingots.

I have now described the most important features of the electro-metallurgical industry as carried on at Milton, and will proceed to describe the chief properties of the alloys produced and some results obtained from them.

The Alloys of Aluminium.—With copper, aluminium forms a series of interesting and beautiful alloys varying in colour from bluish-white to red gold and pale yellow, and also differing widely in physical and mechanical properties.

Alloys containing 60 to 70 per cent. aluminium are very brittle, glass hard and beautifully crystalline. With 50 per cent. the alloy is quite soft, but under 30 per cent. the hardness returns. The 20 per cent. bronze has a whitish-yellow tint and somewhat resembles bismuth, it is very brittle and can be pulverised in a mortar.

The brittleness of alloys containing more than 11 per cent. prevents their use, but from 11 per cent. to 1½ they are of very great value, possessing great tensile strength, high resistance to compression, low specific gravity and greater resistance to corrosion than any alloy known.

The following gives the density of these alloys compared with other metals and alloys:—

Metal.	Density.
Aluminium bronze, 3 per cent.	8.69
" " 4 "	8.62
" " 5 "	8.37
" " 7.5 "	8.00
" " 10 "	7.69
" " 11 "	7.23
Brass.....	8.38
Cannon bronze	8.23
Cast bronze	7.20
Cast steel.....	7.71
Iron.....	7.80
Nickel.....	8.57
Silicon.....	2.67
Platinum.....	21.50
Gold.....	19.30
Lead	11.40
Silver.....	19.50
Copper	8.90
Tin.....	7.50
Zinc.....	7.10

Cu₉Al.—The standard "A" grade, containing 10 per cent. aluminium, behaves as a true alloy, that is will not liquefy out into different combinations. It resembles pale gold in colour. Its tensile strength in castings run from 75,000 lb. to 90,000 lb. to the square inch with from 4 to 14 per cent. elongation.

The following is the report of a test of 10 per cent. bronze produced by the Cowles process, made by Professor Unwin and alluded to in his work on the "Testing of Materials of Construction," p. 348.

The bar was 0.499 in diameter and was placed in shackles which have spherical bearing surfaces, so that the tension was extremely uniform on the section.

Breaking weight, 7.195 tons = 36.78 tons per square inch, 89,743 lb.

Elongation in 10 inches, 3.326 inches = 33.26 per cent.

Contraction of area, 0.078 inches = 39.87 per cent.

Elastic limit, 3.47 tons = 17.74 tons per square inch.

The elongation in different parts of the bar was much more uniform than with iron or steel.

One-inch lengths measured after fracture—

1.	2.	3.	4.	5.	6.
1.27	1.27	1.26	1.28	1.27	1.26
7.	8.	9.	10.	11.	12.
1.28	1.20	1.34	1.36	1.44	1.44

* "High grade" furnace, product 20–30 per cent. Al.

The high elastic limit in a material so plastic is noteworthy.

In *resistance to compression** this metal equals the best cast steel; its *transverse strength* or rigidity is about 40 times greater than ordinary brass; its limit of elasticity equals steel of the same tensile strength and elongation; forged, tempered, and annealed, its elongation equals the best grades of steel of the same strength.

The "Special" grade contains more aluminium than "A" grade; is higher in tensile, transverse, torsional strength and elastic limit, its elongation is less varying from nil to 8 per cent.

The following was a test made at Washington Navy Yard of metal of this grade supplied by the Cowles Company's works.

TEST AT WASHINGTON NAVY YARD OF COWLES COMPANY'S "SPECIAL GRADE" ALUMINIUM BRONZE.

Specimen.	Dimension of Specimens.		Weight Applied.	Elastic Limit per Square Inch on Original Cross Section.	Weight per Square Inch on Original Cross Section.	Elongation.	Reduction of Area.
	Length.	Diameter.					
No. 1†	Inches. 2.00	Inches. .500	Lb. 22,485	Lb.	Lb. 114,514	Per Cent. 0.45	Per Cent. 0.00
No. 3.....	2.00	.501	21,650	79,894	109,823	0.05	2.39

† Cu 89, Al 10, Si 1.0 = 100.

Ordnance Office, Navy Yard, Washington,
February 16th, 1886.

A. H. MCCORMICK,
Commander, U.S.N.,
Inspector of Ordnance.

TEST MADE IN LEEDS, ENGLAND.

The Leeds Forge Company, Limited. Testing Department.
Special Grade Aluminium Bronze.

November 10th, 1886.

Specimen.	Dimensions in Inches.		Tensile Strength in Tons.	
	Diameter.	Area.	Total.	Per Sq. In.
1 Round bar casting	.285	.0643	3.7	57.27 (128,400 lb.)

For the Leeds Forge Company,
(Signed) SAMRSON, FOX, MAY, & Co.

All grades of this bronze under 11 per cent. can be rolled, swaged, or drawn cold, and is the only bronze that is not "hot short," and can be worked at a bright red heat as easily as wrought iron. Under the hammer it can be drawn out to the fineness of a needle.

The rolling of sheets, rods, bars, and wire is done at bright heat, only the finishing being done cold. Rolling or working this metal in any way makes it stronger and tougher. A "rolled" rod "B," grade, tested at the Otis Iron and Steel Works, Cleveland, Ohio, showed tensile strength 83,000 lb. (37 tons) to the square inch with 39 per cent. elongation before breaking. In the casting this metal had but 60—65,000 lb. (26.7—29 tons) tensile strength, with 20 per cent. elongation.

The fracture of the special and "A" grades exhibit a crystalline structure; the lower grades are extremely fibrous.

The beautiful colour and power of resisting corrosive influences make aluminium bronze valuable in art metal work.

In the church of St. Germain, Paris, are 12 beautiful candlesticks, 6 ft. high, and a crucifix, 4 to 5 ft. in height, made of 5 per cent. aluminium bronze; these have been in position over 20 years, and their colour is still perfect. In Philadelphia, the statue of Wm. Penn, intended to surmount the dome of the new city hall, will be cast in aluminium bronze.

Aluminium brass is another valuable alloy made by combining aluminium bronze with zinc in different proportions. It is a close-grained, homogeneous, and tough metal.

The torpedo shell before you is cast from this metal (the No. 2 grade).

Aluminium Brass.	Tensile Strength in Castings per Sq. In.	Elongation.
No. 1	Tons. 23—27	Per Cent. 10—14
No. 2	30—34	6—11

This alloy forges hot, and its special casting properties, its resistance to corrosion, its low specific gravity, render it valuable as a material for ships' propellers, stern and rudder frames, pump plungers and rods, valves, wheels, and pinions, and for hydraulic and engineering work generally.

A number of tests were made by order of the Navy Department of the United States of aluminium bronze and brass as compared with United States gun bronze, with favourable results. A blade could be made of it at least one-third thinner than cast iron or any other bronze blade, and would be that much lighter (*see table of tests*).

For cartridge shells this alloy cannot be equalled: their strength would enable a thinner and lighter shell to be used

The B, C, D, and E grades, containing $7\frac{1}{2}$, 5, $2\frac{1}{2}$, and $1\frac{1}{4}$ per cent. aluminium respectively, decrease in tensile strength from about 65,000 per square inch in B, to 25,000 lb. in E grade. The transverse and torsional strength, elastic limit and resistance to compression decreasing as the aluminium is lowered, elongation increasing in the same proportion. The E grade metal will stretch nearly two-thirds of its length before rupture, which exceeds that of pure copper by about 100 per cent. A piece of C grade wire can be twisted through several hundred turns before breaking. A rolled bar of C grade (5 per cent.) tested at the Phoenix works, Rohort, Germany, gave—

Tensile strength 82,880 lb. to square inch, 37 tons.
Elongation..... 60 per cent.

AVERAGE STRENGTH IN CASTINGS.

Grade.	Tensile Strength per Sq. In.	Elongation.
	Lb.	Per Cent.
"A" special (11 per cent.)....	90—100,000	0—5.0
"A" bronze (10 ")....	75—90,000	4—14
"B" " ($7\frac{1}{2}$ ")....	55—65,000	20—40
"C" " ($5-5\frac{1}{2}$ ")....	75 45,000	50—40
"D" " ($2\frac{1}{2}$ ")....	50—35,000	40—50
"E" " ($1\frac{1}{4}$ ")....	25—30,000	40—55

* Compression test 156,000 Watertown Arsenal test.

with the advantage of not being corroded by the contained explosive. The use of aluminium bronze as a material for cannon was the subject of a paper read before the United States Naval Institute. As early as 1859 a mountain gun of this metal was cast and tested by the Committee of

Artillery of France with very favourable results—the high price of aluminium being then the only thing prohibitive of its widespread use for guns.

The following are some of the results of mechanical tests of aluminium bronze and brass:—

COMPRESSION TESTS MADE AT WATERTOWN ARSENAL, U.S.A.

Original Length.	Shortened to Inches.	Original Diameter.	Increased to Inches.	Ultimate Strength.	Ultimate Strength per Square Inch.	Specimen (Casting).
Inches. 2'00	Inches. 1'705	Inches. .798	Inches. .865	80,200	Lb. 160,400	"A" 1 Bronze.
2'00	1'525	.798	.914	76,800	153,600	"A" 2 Bronze.

TRANSVERSE STRENGTH.

Cross Section of Bar.	Length between Supports.	Breaking Load.	Aluminium Brass No. 2 cast in Sand. Tested at Milton.
Square Inches. 1	No. of Inches. 12	Lb. 8,100	—

Deflection with 5,000 lb. load was but .04 inch, and permanent set .01 inch, showing remarkably high transverse elastic limit, great rigidity, and elastic resilience.

TESTS MADE TO DETERMINE EFFECTS OF TEMPERATURE.

"A" Aluminium Bronze.	Diameter.	Length.	Tensile Strength.	Elongation. per Cent.
Cast in sand .....	.330	1	116,000	5. Not broken.
Duplicate.....	.330	1	108,000	4. "
Same bar heated to 450° F. ....	.330	1	108,000	1. "
Cooled to temperature of room.....	.330	1	109,000	"
Heated to 450° F., or possibly somewhat higher temperature	.330	1	86,900	5. Bar broke.

Showing that this bronze retains its strength through a range of temperature. Aluminium brass No. 2, subject to like test, broke at 29,000 and 35 per cent. elongation with very great contraction of area. When cold the same bar resisted 85,000 lb. without rupture.

TESTS OF ALUMINIUM BRONZE AND BRASS.—UNITED STATES NAVY DEPARTMENT TESTS.

Mark or No.	Approximate Composition.					Length between Reference Marks.	Diameter.	Area.	Tensile Strength Per Sq. Inch.	Elastic Limit Per Sq. Inch.	Elongation in 15 Inches.	Reduction of Area.	Diameter at Fracture.			
Aluminium Bronze or Brass.	1 C	Cu. 91.5	Al. 7.75	Si. 0.75	Zn. ..	Sn. ..	Inches. 15	Inches. 1.875	Sq. In. 2.7612	Lb. 60,700	Lb. 18,000	Per Cent. 23.200	Per Cent. 30.7	Inches. 1.56	Chill castings.	
	7 C	88.00	10	1.33	..	..	15	1.875	2.7612	66,000	27,000	3.800	7.8	1.80
	9 C	91.5	7.75	0.75	..	..	15	1.875	2.7612	67,600	24,000	13.00	21.62	1.66
	10 C	90	9	1	..	..	15	1.875	2.7612	72,830	33,000	2.40	5.78	1.82
	11 C	63	3.5	0.33	33.33	..	15	1.875	2.7612	82,200	60—73,000	2.33	0.88	1.78		
	11 D	63	3.33	0.33	33.33	..	15	1.900	2.840	70,400	55,000	0.40	4.33	1.86		
	13 C	92	7.5	0.5	15	1.875	2.7612	59,100	19,000	15.1	23.50	1.61	Dry sand castings.	
	9 D	91.5	7.75	0.75	..	..	15	1.900	2.840	53,000	19,000	6.2	15.53	1.75
	10 D	90	9	1.0	..	..	15	1.890	2.810	69,930	33,000	1.33	3.30	1.86
	13 D	92	7.5	0.5	..	..	15	1.930	2.930	46,550	17,000	7.80	19.19	1.73
	1	88	2	10	15	1.875	2.7612	18,000	10,000	2.50	4.70	1.83		Green sand castings.
	2	88	..	..	2	10	15	1.875	2.7612	24,500	11,000	8.20	6.80	1.81
	3	88	..	..	2	10	15	1.875	2.7612	22,500	11,000	5.80	10.89	1.77
4	88	..	..	2	10	15	1.880	2.7760	23,000	13,000	4.00	10.35	1.78	
5	88	..	..	2	10	15	1.880	2.7760	20,570	13,000	2.33	6.30	1.82	
6	88	..	..	2	10	15	1.880	2.7760	23,750	13,000	3.79	7.30	1.81	

TESTS OF ALUMINIUM BRONZE AND BRASS.—UNITED STATES NAVY DEPARTMENT TESTS—continued.

Tests of Hardness of Large Bars. (Aluminium Bronze or Brass.)

Hardness of Navy Yard Bronze.

Mark.	Hardness of Head.	Hardness of Stem.	Mark.	Hardness of Head.	Hardness of Stem.
1 C	9.39	13.75	No. 1	3.33	3.33
7 C	14.12	14.26	No. 5	3.67	6.56
9 C	11.18	13.59			
11 C	14.69	10.60			
10 D	17.08	16.07			

The Navy Yard Bronze was furnished by U.S. Government, and carefully cast at New York Navy Yard under inspection of an officer detailed for that purpose.

WM. H. HARRIS,
Chief Engineer, U.S.N.

TESTS MADE AT MILTON WORKS.

Description.	Original Diameter.	Final Diameter.	Original Area.	Final Area.	Original Length.	Final Length.	T.S. Original Section.	T.S. Final Section.	Elongation.	Reduction of Area.
Rolled No. 1 brass .....	.737	.620	.4266	.3049	3.812	4.562	37.7	53.3	Per Cent. 22	Per Cent. 29.2
Rolled No. 2 brass .....	.614	.539	.2965	.2200	5.165	5.625	37.8	50.9	9.7	25.6
Rolled "C" bronze .....	.731	.410	.4196	.1276	6	8	31.3	114.6	33.3	70
"Hercules" metal rolled hot to 1½ in. ...	.607	.485	.2893	.1847	2.56	3.47	31	53.6	35	36
"A" bronze .....	.509	..	.278	..	2.46	..	44.5	..	5.7	10
No. 2 brass, rolled hot from 3 sq. in. pillar to 1½ in. and cold to 1 in.	.570	..	..	..	2.40	..	39.0 (88,900 lbs.)	..	12.5	17.6

ALUMINIUM ALLOYS.

Shrinkage per Inch in 12 Inches.

ALUMINIUM BRONZE.

	Dry Sand.	Green Sand.
	Inch.	Inch.
A 1	$\frac{1}{16}$	$\frac{7}{16}$
A 2 .....	..	$\frac{1}{8}$
A 3	$\frac{3}{16}$	$\frac{9}{16}$
C 2 .....	..	$\frac{1}{4}$

ALUMINIUM BRASS.

No. 1	$\frac{1}{8}$	..
No. 2	$\frac{3}{8}$	$\frac{2}{8}$

ALUMINIUM HERCULES.

No. 3	$\frac{3}{8}$	$\frac{3}{8}$
No. 4	$\frac{3}{8}$	..

ALUMINIUM BEARING METAL.

No. 1 .....	..	$\frac{6}{16}$
No. 3 .....	..	$\frac{12}{16}$
Silicon .....	..	$\frac{1}{8}$

Ferro-Aluminium.—The alloys of aluminium and iron have long been known. They are referred to by Faraday, who found 0.013 to 0.69 per cent. aluminium in "Wootz" steel. Rogers, in an article in the "Moniteur Industriel," No. 2379, 1859, says a small per cent. of aluminium makes steel hard, strong and brittle, a larger quantity makes it very dense, without impairing its peculiar polish or detracting from its qualities.

The influence of aluminium in small quantity on cast iron is very marked, and was last year the subject of an interesting paper by Mr. W. J. Keep, in conjunction with Professor Mabery and L. D. Vorce, of the Case school of applied science, Cleveland, Ohio, U.S.A., read before the American Association for the Advancement of Science, August 1888.

Two bases were used—one a white iron, with composition Si 0.186, P 0.263, S 0.0307, Mn 0.092. The other, grey

Swedish iron, marked F.L.M., with Si 1.249, P 0.084, S 0.004, Mn 0.187. The ferro-aluminium used was made by the Cowles process, and contained Si 3.86, Al 11.42 per cent. Each base was experimented upon separately, and at the same time a series of blank trials were made, the metals in the two series being subjected to exactly the same conditions.

The following results were obtained:—

1st. Solidity of castings and prevention of blowholes. The aluminium castings were of a slightly finer grain and of increased solidity. With 0.1 per cent. Al present the resistance to dead weight was increased about 44 per cent. and to impact 6 per cent.

2nd. Does the aluminium remain in the iron after re-melting? The white base, after the addition of 0.25 per cent. of aluminium, was re-melted six times, fresh quantities of the white base being added each time. That the aluminium remains in and improves the iron is shown by the superior and stronger castings obtained in this series, even after the percentage of Al had become very low, than in those cases where no aluminium was added.

3rd. The effect of aluminium on the grain. Aluminium seems to enable iron to hold in solution all its carbon until just upon the point of solidification, when it is precipitated in a finely graphite form. The advantage of this is the uniformity of the mass and the absence of pockets of graphite, which are generally produced when ordinary grey iron has been cooled slowly. Hence the homogeneity and greater strength of the aluminium castings. The rapidity of cooling makes little or no difference, as the release of the carbon seems to be instantaneous and only at the moment of crystallisation.

A very little aluminium is sufficient to precipitate graphite from white iron, 0.25 per cent. rendering it perceptibly darker in colour, 0.5 per cent. more so, whilst 0.75 per cent. renders it quite grey with no signs of white. With increasing amounts up to 4 per cent., the maximum in all these experiments, the effect is the same, the castings becoming softer and greyer as the amount of aluminium increases. The presence of much silicon does not alter the matter, the grain being the same also in thin and rapidly cooled, as in thick castings.

4th. Aluminium castings are not affected by chilling. Graphite is liberated whether the casting is cooled rapidly or slowly, with the result that the grain is uniform and there is no chill.

5th. When sufficient aluminium is present to liberate the graphite, a coating is formed on the casting which resists the sand and the heat, and prevents the iron burning the sand into itself.

6th. The fineness of the grain causes them to be more easily cut than cast iron of coarser grain.

7th. The presence of aluminium increases the strength to sustain a constant load, but the strength does not increase uniformly with the percentage of aluminium.

8th. The increase in strength is much greater and more marked than in the preceding. Above a certain percentage the strength diminishes, due to larger amount of graphite liberated.

9th. Elasticity is improved.

10th. The fineness and compactness of iron containing aluminium gives less permanent set than iron equally as soft when that softness is produced by silicon.

11th. The shrinkage is slightly increased with a small quantity of aluminium, due probably to the elimination of blowholes, but with 0.75 per cent. and more it is much decreased, especially in case of the wrought iron.

12th. In case of the white iron fluidity is much increased. With grey base containing much silicon it is not so clear, though it is believed the fluidity is increased.

The fact that aluminium lowers the melting point of iron is utilised in the Mitis castings, the invention of Mr. Peter Ostberg, of Stockholm. In making Mitis castings, a very small quantity of aluminium, about 0.50 per cent. Al, in form of 7 or 8 per cent. ferro-aluminium is added to the charge (about 60 lb.) of wrought iron in the crucible the moment this has been melted. The fusing point is at once lowered about 500°, and the charge becomes very fluid and can be cast in the finest moulds, while the great difference between its temperature and its fusing point gives all the time necessary for its manufacture without danger of its solidifying.

The tensile strength of Mitis castings may be as high as 27 tons per square inch, with an elongation of 20 per cent. Another alloy made in the electric furnace is silicon bronze, which, owing to its great strength and tenacity, its resistance to corrosion, combined with high electrical conductivity, is perhaps the best metal extant for electric light, telephone, and telegraph wires.

In conclusion, may I direct your attention to the test bars, castings, and specimens of aluminium alloys made by the Cowles process, kindly lent for this paper by the Cowles Syndicate Company, Limited.

Specimens of Aluminium Alloys made in Cowles' Process. Exhibited in connexion with Paper read before "B" Section, British Association.

No. 1. Aluminium bronze cylinder (torpedo shell).—2 feet long, 14 inches diameter; cast in sand with core, outside finely polished; inside rough. Test bars taken from same pouring gave: Tensile strength, 105,000 lb. per square inch (46.87 tons); elongation, 6 per cent.

No. 2. Cylinder same as above, made from aluminium brass "No. 2" (one-third zinc) (33.3 per cent.).—Tensile strength, 90,000 lb. per square inch (40.17 tons); elastic limit, 66,000 lb. per square inch (29.46 tons); elongation, 6 per cent.

No. 3. Piece of calico-printing cylinder, 6 inch diameter and about 1 foot long. Cast by Messrs. Bolton and Sons, Oakamoor Mills, Cheadle, Staffordshire, in the same manner as they cast their copper cylinders.

No. 4. Dynamo hub of aluminium brass "No. 2."—This metal has a tensile strength of 93,000 lb. to the square inch, and 5 per cent. elongation. The German silver that has heretofore been used in the Brush hubs has but 44,000 lb. tensile strength, and 24 per cent. elongation, and costs much more than this brass.

No. 5. Billet of 10 per cent. aluminium bronze cast in chill.—One entire side polished to show perfect casting, colour, &c.

No. 6. Lathe turnings of aluminium bronze, showing no signs of oxidation after three years' exposure to the atmosphere.

No. 7. Aluminium "pig" casting (80 per cent. aluminium).—Produced directly by heat of electric furnace reduction of oxide of aluminium by carbon. (Believed to be the first reduction by carbon of this oxide.)

No. 8. North Metropolitan (London) Tramways Company's "car bearing" of ordinary gun-metal after a year's wear, and originally of same dimensions as No. 9.

No. 9. Same company's car bearing made from Cowles' aluminium bearing metal after a year's running on same route as No. 8, no wear being perceptible.

No. 10. Aluminium bronze bar, one end hammered hot, other end twisted cold.

No. 11. Five per cent. aluminium bronze bar.—Bending test, bent cold.

No. 12. Ten per cent. aluminium bronze rolled sheet.—Test, spring by bending.

No. 13. Five per cent. aluminium bronze rolled bar. Tested at Phoenix Works, Ruhort, Germany.—Tensile strength, 82,880 lb. to square inch (37 tons); elongation, 60 per cent.

No. 14. Five per cent. aluminium bronze cup drawn cold from a 9-inch disc.

No. 15. Sample of silicon copper product run direct from furnace. Silicon = 15.08 per cent.

No. 16. Bar of basic Siemens steel, tested at Phoenix Works, Ruhort, Germany, showing bending and fracture.

No. 17. Bar of 10 per cent. Cowles' aluminium bronze, tested at Phoenix Works, Ruhort, Germany, showing bending and fracture.

No. 18. One-inch round bar of aluminium bronze.

No. 19. Two-inch square bar of aluminium.

No. 20. Propeller blade of No. 2 aluminium brass.

No. 21. Ores, slags, and fragments of carbons from the electric furnace.

No. 22. Drawings and views of the furnace, engine, and dynamo.

No. 23. Photographs of the "Cowles'" aluminium works, Milton, Staffordshire.



A NOTE ON THE VOLATILISATION OF LEAD OXIDE, AND ITS ACTION UPON GLASS AT LOW TEMPERATURES.

A Paper read before the British Association, Newcastle-on-Tyne, September 1889.

BY T. W. HOGG.

LEAD oxide in a state of fusion attacks silica with great readiness, and by merely exposing a mixture of these substances to a red heat for some time combination will take place without the mixture having been in a state of fusion; it is therefore not surprising to find that glass should be acted upon by lead oxide at a comparatively speaking low temperature.

If a polished plate of glass be coated with oxide of lead and then heated up to a temperature of scarcely visible redness, or even slightly below this, it will be found, after cooling and removing the surplus oxide, that the surface has

been distinctly corroded, owing to the oxide having entered into combination with the constituents of the glass. The corroded parts produced by conducting the operation at this temperature possess quite a smooth surface, but if the corrosion be allowed to take place at a decided red heat the parts are rough and not unlike the effect produced by dry hydrofluoric acid. By soaking these corroded plates in a solution of ammonium sulphide the lead may be converted into sulphide of lead, and the corrosion may be so varied under different conditions that brilliant mirror-like films may be obtained of considerable durability and of sufficient thickness to be quite opaque, or so thin that light of a brownish hue is transmitted.

Upon examining these corroded parts under the microscope the limit of each mark was observed to possess a delicate fringe easily seen by very oblique light, and especially if the glass was observed from the reverse side, the appearance being similar to what might be produced by a slightly volatile substance. Whilst submitting this point to a more careful examination it was found that if a plate of glass was written upon, using lead oxide as a pigment, and another plate, preferably of some dark blue or ruby tinted glass, placed immediately over it but prevented from actual contact by suitable means—if these were then heated for about one hour to a temperature of scarcely visible redness, the upper glass always had its polish so altered that a distinct reverse of the writing appeared upon it, more or less sharp according to the distance between the two surfaces.

It was suspected at first that this result was produced by the mechanical transportation of particles of the oxide, as the expulsion of moisture from moist substances is often accompanied by the expulsion of part of the substance itself. This suspicion, however, was easily disposed of by previously heating the oxide before placing the upper glass over it; the effects were just as easily obtained with this precaution, and quite a conclusive experiment consists in

actually fusing the oxide upon a platinum support; if this is then covered by a plate of glass and prevented from actual contact in the usual way, and heated to the usual temperature, the polish of the glass will also be distinctly altered. The effects are also obtained if a little lead oxide be placed in a platinum crucible and this covered by a piece of dark blue glass; in this case it requires exposure to the low temperature for two or three hours before the glass is tarnished. It is generally understood that lead oxide is not sensibly volatile below its fusing point, and so far as the indications of the balance are concerned this may be quite true; it is therefore very interesting to know that by the experiments here described, it can be shown that lead oxide volatilises at a scarcely visible red heat in such quantities that fail to be recognised by the most sensitive balance.

ON SOME RESULTS OF ANALYSES OF OLIVE OIL FROM DIFFERENT SOURCES.

BY LEONARD ARCHBUTT.

THE examination at various times during the past seven or eight years of samples taken from large bulks of olive oil intended for lubricating has afforded an opportunity of making a comparison of the oil from several different sources; but as, unfortunately, only a fraction of the samples have been labelled with the port of shipment, the number available for purposes of comparison is not so large as it might have been.

The results are arranged in the following table, and the following conclusions may be drawn from them:—

Source of the Oils.	Total Number of Samples.	Number Examined for Adulteration as well as for Acidity.	Number found Genuine.	Per Cent. found Genuine.	Free Fatty Acid (= Oleic Acid).		
					Highest.	Lowest.	Average.
Seville.....	32	32	31	96·8	10·0	1·5	4·4
Malaga.....	35	35	27	77·1	25·1	2·0	6·7
Unknown.....	3	3	2	66·6	5·6	2·1	3·3
Spain (total).....	70	70	60	85·7	25·1	1·5	5·5
Gallipoli.....	19	18	17	94·4	16·9	·9	7·3
Gioja.....	12	8	8	100·0	25·2	4·1	10·9
Monopoli.....	3	3	3	100·0	8·6	4·1	6·3
Naples.....	2	1	1	100·0	9·4	9·2	9·3
Italy (total).....	36	30	29	96·7	25·2	·9	8·5
Sicily (Messina).....	28	22	9	40·9	16·6	·5	9·1
Greece (Zante).....	2	2	2	100·0	8·7	4·8	6·7
Candia.....	12	10	6	60·0	16·8	5·5	9·5
Levant.....	3	3	..	..	13·5	8·5	10·4

The Seville oils, both as regards their freedom from acidity and the high percentage of genuine samples among them, prove to be superior to the famed Gallipoli oils. The acidity of some of the samples of Malaga oil was very high, but the average acidity was less than that of any of the Italian oils, except those from Monopoli, of which only three samples were examined. Among the Malaga oils there was a large percentage of adulterated samples. Taking the Spanish oils generally, although they appear from these results to be more liable than the Italian oils to be adulterated, yet, on the other hand, they are as a

rule decidedly more neutral, which, as regards lubrication and burning, is a very important point.

Amongst the Italian oils those from Gioja are distinguished for their acidity. The small number of adulterated Italian oils is worthy of note.

My analyses of the oils from Sicily quite confirms their reputation for inferiority. They are very largely adulterated, and as a rule decidedly rancid.

A few single samples from sources not named in the table have also been examined. Thus, some oil from Mitylene proved to contain as much as 30 per cent. of free fatty acid,

A sample labelled "Sfax Fine Olive Oil" gave the following results:—

Sp. gr. at 60° F.	0.9169
Free fatty acid (= oleic)	13.5 per cent.
* Rise of temperature with sulphuric acid of 97 per cent. strength.	43.5° C.
Percentage of KOH required for saponification.	19.38 per cent.
Melting point of fatty acids by } 28° C. and capillary tube method	28.5° C.

* The Elaidin required 310 minutes to solidify at 19° C., and was dark lemon yellow and soft after standing 24 hours at 19° C.

The oil showed no unusual tendency to dry when tested side by side with olive oil of known purity.

By Renard's process no Arachis oil was found.

By the Millian-Stoeck test no cotton oil was found.

The melting point of the fatty acids is quite abnormally high, and so also is the specific gravity, considering the large percentage of free fatty acid in the sample. No conclusions can be drawn, however, from the results yielded by this single sample. Another African oil, from Saffi (Morocco) gave quite normal results.

* See this Journal, 1886, 303 et seq.

NOTE ON THE USE OF POTASSIUM CYANIDE IN THE ESTIMATION OF COPPER.

BY GEO. E. H. ELLIS, F.C.S.

ASSAYERS in this section of the United States (Butte City, Montana) are in a somewhat unenviable position, for they have to work accurately, expeditiously, and, at the same time, cheaply. A copper assay (wet method) costs but a dollar, a silver and gold determination the same amount, while the value of a lead ore or of a silver ore is determined for the pitiable sum of half a dollar. These are the usual charges, but some assayers "run" three silver samples for a dollar, and wait a month or longer for remuneration for

their labours. Add to this the fact that a copper assay is supposed to take four hours for execution, and a silver one two, and it will be readily seen that lengthy, elaborate, or expensive methods of analysis, *e.g.*, brown iodide of potassium method, the electrolytic method, &c., are useless so far as we are concerned. In the assay of copper ores, therefore, we are confined to the determination by means of a standard solution of potassium cyanide, and I regret to say that some of our assayers (?) (and Butte City is the second largest mining camp on the face of the globe), after getting the copper into solution, render the solution alkaline with ammonia, filter off the precipitate (if any), and then titrate with the cyanide solution, utterly ignoring the fact that the amount of potassium cyanide used is no indication of the percentage of copper present if the ore carries zinc, iron, or other foreign metals.

Much has been written about the interference of zinc, iron, &c., but believing from experience that these results, though probably correct in direction, were not correct in degree, I determined to obtain further information by appeal to experiment. The influence of zinc was first determined, for most of our copper ores obtained at moderate depths carry more than "traces" of this metal.

The following solutions were prepared:—

(A.) 7.3104 grms. of pure copper were dissolved in a little pure nitric acid, the solution heated to small bulk, and then diluted to 3,000 cc.; 30 cc. of the copper solution, therefore, contain 0.73104 gm. of copper.

(B.) 121.5 (approximately) grms. of potassium cyanide were dissolved in 1,000 cc. of water.

(C.) 6.5035 grms. of pure zinc were dissolved in a small quantity of nitric acid; the solution was then heated to a small bulk and diluted to 10 litres; 1 cc. of the zinc solution, therefore, contains 0.00065035 gm. of zinc.

The mode of procedure was as follows:—30 cc. of the copper solution (A.) were taken, 150 cc. of water were then added, then varying quantities of the zinc solution (C.). 15 cc. of strong ammonia was afterwards introduced, and the blue solution nitrated with the standard potassium cyanide solution. The solutions were measured with pipettes graduated to $\frac{1}{20}$ cc., and each set of experiments was made on the same day, so that the results obtained should not be affected by the alteration in the value of the cyanide solution.

A large number of experiments were performed, and no difficulty was experienced in obtaining concordant results. The following are offered as being the most reliable:—

Composition of Solution.	Weight of Zn and of Cu.	Percentage Composition.	KCy required in cc.	Difference in cc.
30 cc. of Cu solution + 0 cc. of Zn solution	*073104 Cu Nil Zn	Cu = 100 Zn = 0	23.94	..
30 cc. of Cu solution + 1 cc. of Zn solution	*073104 Cu *00065035 Zn	Cu = 99.118 Zn = 0.882	23.93	- 0.01
30 cc. of Cu solution + 2 cc. of Zn solution	*073104 Cu *0013007 Zn	Cu = 98.252 Zn = 1.748	23.94	0.00
30 cc. of Cu solution + 5 cc. of Zn solution	*073104 Cu *00325175 Zn	Cu = 95.741 Zn = 4.259	23.95	0.01
30 cc. of Cu solution + 7.5 cc. of Zn solution	*073104 Cu *004877625 Zn	Cu = 93.745 Zn = 6.255	24.06	0.12
30 cc. of Cu solution + 10 cc. of Zn solution	*073104 Cu *0065035 Zn	Cu = 91.831 Zn = 8.169	24.50	0.56
30 cc. of Cu solution + 15 cc. of Zn solution	*073104 Cu *00975525 Zn	Cu = 88.227 Zn = 11.773	24.96	1.02
30 cc. of Cu solution + 20 cc. of Zn solution	*073104 Cu *013007 Zn	Cu = 84.895 Zn = 15.105	25.31	1.37
30 cc. of Cu solution + 25 cc. of Zn solution	*073104 Cu *01625875 Zn	Cu = 81.809 Zn = 18.191	25.48	1.54
30 cc. of Cu solution + 30 cc. of Zn solution	*073104 Cu *0195105 Zn	Cu = 78.934 Zn = 21.066	25.64	1.70
30 cc. of Cu solution + 35 cc. of Zn solution	*073104 Cu *02276225 Zn	Cu = 76.256 Zn = 23.744	25.75	1.81
30 cc. of Cu solution + 40 cc. of Zn solution	*073104 Cu *026014 Zn	Cu = 73.755 Zn = 26.245	25.85	1.91

Composition of Solution.	Weight of Zn and of Cu.	Percentage Composition.	KCy required in cc.	Difference in cc.
30 cc. of Cu solution + 80 cc. of Zn solution.....	·073104 Cu ·052028 Zn	Cu = 58·122 Zn = 41·578	28·96	5·02
30 cc. of Cu solution + 120 cc. of Zn solution.....	·073104 Cu ·075042 Zn	Cu = 48·366 Zn = 51·634	32·84	8·90
30 cc. of Cu solution + 200 cc. of Zn solution.....	·073104 Cu ·130070 Zn	Cu = 35·981 Zn = 64·019	39·76	15·82
30 cc. of Cu solution + 320 cc. of Zn solution.....	·073104 Cu ·208112 Zn	Cu = 25·995 Zn = 74·004	47·12	23·18
30 cc. of Cu solution + 400 cc. of Zn solution.....	·073104 Cu ·260140 Zn	Cu = 21·937 Zn = 78·063	52·53	28·59
30 cc. of Cu solution + 600 cc. of Zn solution.....	·073104 Cu ·390216 Zn	Cu = 15·778 Zn = 84·222	64·20	40·26
30 cc. of Cu solution + 800 cc. of Zn solution.....	·073104 Cu ·520280 Zn	Cu = 12·330 Zn = 87·680	79·20	55·26
30 cc. of Cu solution + 1,000 cc. of Zn solution...	·073104 Cu ·650350 Zn	Cu = 10·105 Zn = 89·895	92·50	68·56
30 cc. of Cu solution + 1,200 cc. of Zn solution...	·073104 Cu ·780420 Zn	Cu = 8·565 Zn = 91·435	96·80	72·86
30 cc. of Cu solution + 2,000 cc. of Zn solution = 22 cc. of AmHO (instead of 15 cc. as in all the other cases).	·073104 Cu 1·30070 Zn	Cu = 1·839 Zn = 98·161	123·0	99·06

From these results it may be concluded that the presence of 4—5 per cent. of zinc in the copper solution does not practically affect the correctness of the indications afforded by the potassium cyanide solution; but that when the percentage of zinc exceeds that amount, the indications of the standard solution are perfectly untrustworthy, and that consequently the zinc must be removed before titration is effected. When the percentage of zinc present was considerable, it was noticed that the change of colour of the solution from light blue to faint violet took place very slowly indeed.

It seemed also a matter of interest to determine whether the "copper value" of the blue solution altered on being kept exposed to air and to light for a considerable time. All the experiments performed showed that the blue colour in the ammoniacal solution at the end of three weeks required for its discharge practically the same volume of potassium cyanide solution as it did when first produced. For instance:

On June 1st a solution (A.) was prepared containing 20 cc. of solution of copper nitrate, 100 cc. of water, and 10 cc. of ammonia solution. The blue solution, which did not fill the flask, was then exposed to light until the 22nd June, when it was titrated and required 17·5 cc. of cyanide solution for the discharge of the colour.

Solution (B.), prepared and titrated on the 22nd with the same solutions, containing 30 cc. of copper nitrate solution, 150 cc. of water, and 15 cc. of ammonia solution, required 26·3 cc. of cyanide solution.

26·3 cc. for 30 = 17·53 cc. for 20.

As regards the standardising of the potassium cyanide solution, my experience seems to indicate that standardising should be performed *at least* once a week; a certain weight of copper which on the 6th of June required 24·8 cc. of cyanide solution needed 26·3 cc. of the same solution on the 22nd of the same month—an increase of 0·1 cc. per day.

I hope soon to be able to present to the Society a series of determinations upon the influence of varying quantities of iron on the amount of potassium cyanide required for the titration of solutions containing equal weights of copper. Present results show that the percentages obtained are always low when a considerable percentage of iron is present, owing probably to the retention by the precipitated hydrate of a portion of the blue ammoniacal compound.

ASSAYING AND HALL-MARKING AT THE CHESTER ASSAY OFFICE.

BY W. F. LOWE, F.I.C., F.C.S.

(Associate of the Royal School of Mines.)

THERE seems to be little doubt that the Chester Assay Office is descended from the old Chester Mint that existed as far back as the reign of Athelstan, but the charter of the company only dates back to the reign of James II. An old minute book of the Chester Goldsmiths' Company, however, dates back as far as 1523, and from this it is seen that the officers of the company had the power of testing (by touch) all articles of gold or silver sold in the city of Chester.

The process of assay by cupellation is the removal by the aid of fused lead oxide of all the constituents of an alloy with the exception of the so-called noble metals, gold and silver (and also platinum, if present). It is carried out by the addition of a suitable quantity of lead to the alloy, which is then placed on a hot bone-ash cupel, and heated in a current of air. The lead and also the other metals, with the exception of the gold and silver, oxidise, and the fused lead oxide takes up the other oxides as fast as they form and carries them down into the porous cupel until a button of pure gold or silver only is left. The process of cupellation is one of the oldest metallurgical operations there is any record of, for it is frequently mentioned in the Old Testament as the "refiner's fire." There is also no doubt that the Romans carried out the process on a large scale, for numerous pigs of lead have been found in this country bearing the sign "EX ARGENT" (ex argentate) showing that they had been desilverised, and assays of the lead prove this to have been the case.

To come down to a more recent date, a very full and complete account of the method of assay by cupellation, &c. is given in Sir John Pettus' translation of Lazarus Erckern's Book on Assaying published in 1683.

The modern methods of bullion assay will be found very fully described in Watts' Dictionary of Chemistry, Phillip's Metallurgy, Percy's Silver and Gold, Makin's Elements of Metallurgy, and also in the last edition of Muspratt's Dictionary of Chemistry.

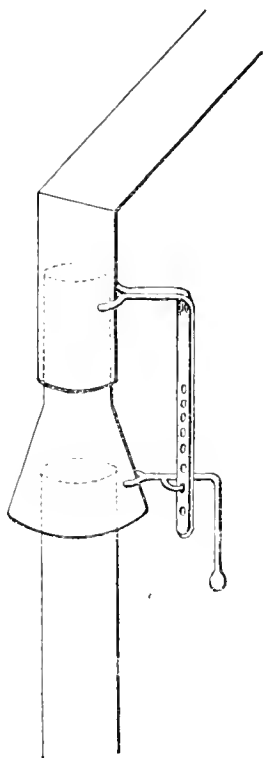
The furnace used for cupellation is a muffle furnace, and, after having worked with many forms, we find that no furnaces are to be compared both for accuracy in assaying and for ease and comfort in working with Fletcher's gas furnaces. At Chester Assay Office a pair of these furnaces have been used for the last eight years, and have been found most satisfactory. The muffles are 9 $\frac{3}{4}$ in. by 5 $\frac{1}{4}$ in., and

each muffle is capable of cupelling 32 gold assays at a batch (*i.e.*, of taking eight cupels, each cupel taking four assays). With gold assays, they burn 75 cubic feet of gas per hour, but with silver assays, where only 20 assays are cupelled in a batch, and the temperature is much lower, they burn from 50 to 55 cubic feet per hour, and with the price of gas at Chester (3s. 4d. per 1,000) they cost 3d. per hour for cupelling gold and about 2d. per hour for cupelling silver.

Formerly a furnace similar to that described in Makin's *Manual of Metallurgy* was used; later this was replaced by a pair of furnaces similar to those used in the metallurgical laboratory of the Royal School of Mines, a description of which is given in Percy's *Silver and Gold*.

The gas furnaces are placed under a hood and are connected with the chimney of the furnace room by means of a cone damper which can be brought right down upon the loose iron chimney supplied with the furnace, or can be raised above it; this damper is very useful in regulating

Fig. 1.



the draft. At first there was some difficulty with the grids or upper part of the burners; these used to get red hot, and in a few weeks the slits in them would be nearly closed up so that the grids required continually renewing.

To prevent this, the body of the furnace was raised about half an inch above the burner, being supported on strips of asbestos cardboard at the corners. If the body is raised only very slightly above the burner, this heating is prevented, but it is an advantage to raise it as much as half an inch, so that in case of the passage for the flame round the muffle getting choked with soot, a bent iron rod can be inserted without putting out the furnace and cooling down the muffle. This choking only very occasionally takes place, but it is capable of spoiling any assay that may be in the furnace if it cannot be removed at once, as the temperature is lowered so considerably by it. The heating of the burners took place only when the furnace was kept burning for several hours together, and especially when the temperature was changed several times, as in cooling down before taking out silver assays and then heating up again for the cupellation of another batch. Since raising the body of the

furnace the grids last for months, only requiring renewing about once or twice a year. Another little precaution to be taken with these furnaces is to tightly wire the connecting india-rubber tube to the burner of the furnace, for after a time it is apt to get slack where it fits on to the burner, and when this happens the gas flashes back and takes fire at the small nozzle through which it passes before entering the box below the gauze and grid.

The muffles used have only a few small holes at the end, moderately high up; in fact, the muffles are supplied without any holes, and a few are made in them before being used. Muffles with slits in the sides are decidedly objectionable, as they crack much sooner, and silver assays done in them are not so uniform. After a muffle has been in use for some time it frequently cracks along the bottom, and this, if not noticed, will often cause trouble, as the assays which are in the cupels just over the crack leap or spurt, and are thus rendered worthless. The cause of this appears to be the reducing action of the fine jet of gas which, passing through the crack, acts on the absorbed oxide of lead in the cupel, and disengages gases just below the bottom of the molten assay. The cracks can be stopped with fireclay, or a thin piece of iron can be laid on the bottom of the muffle; but neither remedy is satisfactory, and it is better to put in a new muffle at once.

For silver assays, 10 grains are taken, but a special set of weights is used, divided into ozs., dwts., $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$ dwts., the 10-grain weight, representing the assay pound of 12 troy ounces, and the standard weight of 9.25 grains, representing 11 oz. 2 dwt., that being the legal standard for silver.

The balances employed are made by Oertling, and will indicate distinctly $\frac{1}{10000}$ of a grain; in fact, on such a balance, one milligramme puts the pan right down upon its supports, and the needle completely off the scale.

The weighed assay is placed in a little bag of lead, made by taking very thin sheet lead (laminated lead) cut to the proper weight (the piece then measures about $3\frac{1}{2}$ by $2\frac{1}{2}$ in.), and rolling this up into a little conical bag, like the bags used by grocers for holding moist sugar, &c. It is needless to say that each batch of lead is assayed for silver. The commercial laminated lead is quite pure enough for this purpose, as on an average the amount used for each assay contains only sufficient silver to raise the amount by 0.08 per thousand. The bags are kept on a shelf by the side of the balance. After being placed in the lead bag, the latter is folded up and is squeezed up into a very little ball, which is then ready for cupelling. 20 to 24 silver assays are cupelled at a batch, and several check or trial assays are cupelled at the same time, to determine the loss of silver by absorption into the cupel. At a proper temperature the loss appears to be due entirely to absorption, for the amount lost by the assays can be recovered from the cupels. If the temperature is too high there is also a loss due to volatilisation, and at the temperature at which gold assays are cupelled, and which is much higher than that employed for silver, there is some loss of silver by volatilisation. Silver can always be found in the fine dust of these furnaces, and the dust from the inside of an old iron chimney yielded 0.073 per cent. of silver and 0.00033 per cent. of gold.

The pure silver for checks as also the pure gold for the same purpose, we always prepare ourselves, and before using them compare them with assays from the trial plates supplied by the Mint. These trial plates are portions of those prepared at the Mint. A full and very interesting account of their preparation is given in the fourth Annual Report of the Deputy Master of the Mint, 1873.

The loss of silver in cupellation varies with the temperature, and at the temperature usually employed by the writer the loss is not more than 1 to $1\frac{1}{2}$ dwt. on the assay pound or about 4 to 6 parts per thousand, on a batch of 20 assays. With a batch of 24 assays it is rather more, about 8 parts per thousand, but with only about a dozen assays it can be reduced to $\frac{1}{2}$ dwt. per assay pound or about 2 parts per thousand.

The great advantage of the gas furnace is, that not only is this loss less than in the coke furnace, but it is also much more uniform, the checks in the front losing almost identically the same as those in the centre and back rows,

whereas with a coke furnace the loss is usually very much greater at the back of the muffle.

Great care must be taken in cooling down silver assays before removing them from the muffle, for the pure molten silver left on the cupel absorbs oxygen and this oxygen is given off as the assay cools and sets; and if the assay is cooled quickly the surface sets before the oxygen has been given off, then what is called "spitting" of the assay takes place; that is, a kind of arborescence is thrown up.

There is a curious effect often to be noticed when pure silver checks have been used without the addition of any copper. If the furnace has been turned down too quickly so as to make the finished assays spit, the buttons from the standard silver (*i.e.* alloyed silver) will have spit, whilst the pure silver checks will not have done so.

The assays after removal from the furnace are squeezed with a pair of pliers, brushed, and then weighed.

Gold.—The oldest method of testing the quality of gold was by the touch. This consisted in making a streak on a black stone, called a touchstone, and comparing it with a streak from a piece of gold of known composition called a touch needle. Erskern says that by this method a difference of half a carat (*i.e.* about 2 per cent.) can be detected, but it has been shown that a difference of several carats very frequently cannot be detected even by those accustomed to use the touchstone.

The process for the bullion assay of gold depends on the solubility of silver and the insolubility of gold in nitric acid. It was formerly considered that 3 parts of silver should be added to 1 part of gold in order that all the silver might be removed, and hence the process received the name of inquartation. It is now found that gold will part on the addition of 2 parts of silver to 1 of gold, but in assaying it is usual to obtain the alloy in the proportion of $2\frac{1}{2}$ parts of silver to 1 of gold.

Erskern describes this process very fully, and his description is very similar to the method in which it is still carried out, and a considerable amount of accuracy seems to have been obtained (to about 0.1 per cent.).

There are three different methods of reporting the quality of gold: (1) decimally; (2) in carats; and (3) in parts of the assay pound of 12 oz. troy.

The following table by Professor Roberts Austen shows the relationship of the three methods. It is usual, however, in employing carats, to weigh to the $\frac{1}{16}$ th of a carat grain.

				Excess Grains.	Decimal Equivalent.
				1	1736
				7.5	13021
				60	107116
				240	4176
				5,760	1,00000
Assay Pound.	Carat.				
	1	4	8		
1	24	96	768		

At Chester the unit weight employed is five grains, this represents 24 carats, but the assay can readily be reported decimally if required. The writer would prefer to employ a larger quantity, but the difficulty lies in being able to obtain a sufficient amount for assay without damaging the articles sent to be hall-marked. Many of these, such as rings, brooches, chains, &c., are very small.

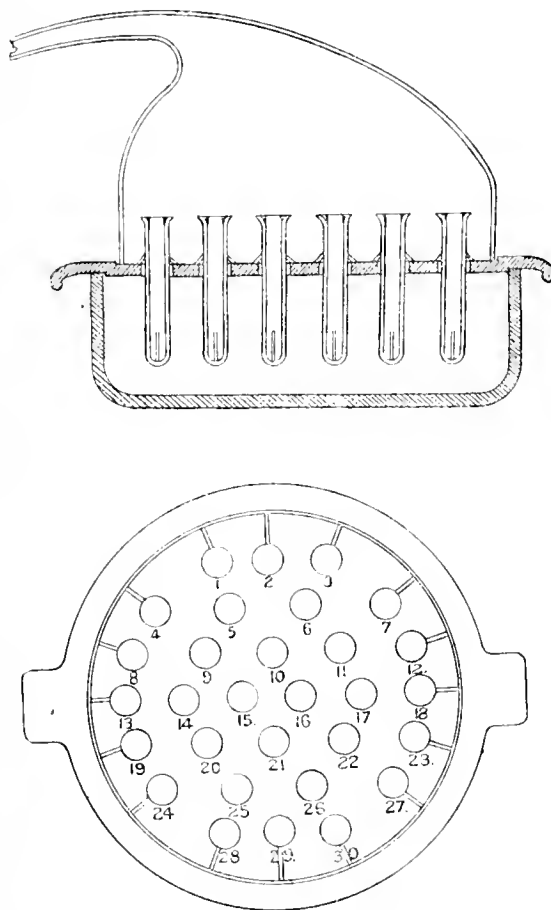
In taking the assays from the articles, if they are large enough they are scraped with a steel scraper, and if the article is made in several portions a separate assay is made from each part. The smaller articles have small pieces cut off, as they are sent up unfinished. Not less than two assays are made if possible from a single lot of work, and where there is a large number of articles in one lot, a dozen or more assays may be made from it.

The weighed assay is placed in what is called a silver lead, that is a small conical bag of lead into which has been weighed the requisite amount of fine silver to form an alloy of $2\frac{1}{2}$ parts of silver to 1 part of gold. When a batch of 30 assays is ready they are each squeezed up to the size of a small bullet, and cupelled. The buttons are taken from the cupel with a pair of pliers, squeezed and brushed

with a fine wire brush, then flattened or datted as it is called on an anvil with a heavy round-faced hammer, both hammer and anvil being kept bright and polished, and are then rolled out into a little strip about three inches long. Each assay, after rolling, is placed on a tray of wire gauze over a large, solid flame Fletcher burner, and in this way the whole batch of 30 are annealed at one time. After the strips are cool they are rolled up into little coils called cornets, and they are then ready for parting.

Formerly the parting was done in flasks, the ones exhibited being some of the patterns used; the oldest is one that has not been in use for 60 or 70 years at least. The best for this purpose are the long-necked parting flasks, but the labour of filling and emptying is very great when about 60 gold assays are made per diem, and in order to simplify the operation I designed the apparatus shown, which is described in the Chemical News, and also in the last edition of Mitchell's Manual of Assaying.

Fig. 2.



The apparatus consists of a porcelain basin $8\frac{1}{2}$ in. in diameter, having a capacity of 50 oz.; a porcelain cover perforated with 30 holes, each hole being numbered with black enamel; and a number of glass tubes. The tubes are made to slip loosely through the holes in the cover, and in order that they may not come against the bottom of the basin they are bulged out into a ring near the centre of the tube. The tubes we are using at present have three small holes in the bottom and another hole in the side, about 1 in. from the bottom; but I am having some tubes made with two fine slots at right angles to each other, and extending about 1 in. up.

I am also having a glass hood condenser made which will fit into a depression in the cover, the cover being made so [] to receive it.

The method of using the apparatus is this:—Two of the basins containing a sufficient quantity respectively of weak and strong nitric acid are heated over two of Fletcher's radial burners, the basin of weak acid being covered with the perforated plate carrying the tubes, and the strong acid being covered with an ordinary dinner plate. The assays, which are flattened, &c. whilst the acid is heating, are dropped into the tubes, and as soon as the action of the acid has ceased the cover is lifted off by means of a metal crutch covered with india-rubber, and the tubes are dipped

Fig. 3.



into a basin of distilled water. The whole 30 being thus washed at one operation, they are then transferred to the basin of strong acid (sp. gr. 1.28) and are boiled briskly for half an hour, the time being noted on a small slate hung at the side of the draught closet.

It is very necessary that the boiling should be brisk, as otherwise a much greater surcharge will be found, and it is curious to note that this was known at the time Erekern wrote, for he says, "Take notice also that you may cause the last aqua fort to work in great bubbles that the roles may become clean."

After boiling in the second acid, the tubes are lifted by the cover and are dipped into distilled water and allowed to drain. Each tube is then taken out in order and is plunged over head in a basin of distilled water, so as to completely fill the tube. The tube is then inserted over a small porous crucible and the assay allowed to fall through the water into the crucible. The crucibles are drained and are then annealed, *i.e.*, ignited in the muffle, when the assays are ready to weigh. The use of somewhat similar perforated tubes had been tried for this purpose some time ago, but was given up it is said from the difficulty which was found in transferring the assay to the crucible. In the method described above there is no difficulty whatever in doing this, and when the writer designed this apparatus he had no knowledge that tubes of this kind had been used before.

This apparatus has now been in use at the Chester Assay Office for the last 10 years, during which time at least 90,000 assays have been made with it, and has given every satisfaction. Its great advantages are that all the assays are under precisely the same conditions, it is a very great saving of labour and time, much less nitric acid is required, and it requires no attention until it is time to take off the assays; in fact it combines nearly all the advantages of the costly platinum cups and boilers used for a similar purpose with a very moderate cost.

The only special precautions to be taken with it are: (1) to have the first acid sufficiently dilute; (2) to see that the second acid boils properly; and (3) not to boil the second acid longer than about half an hour, as the best results are obtained under these conditions.

Pure gold check assays are employed with each batch of assays, for in parting gold and silver with nitric acid there is always a slight surcharge with the higher standards and a slight loss with the lower, and this has to be allowed for in weighing up the finished assays. In the process described

the surcharge on 22 carat or $\frac{916.6}{1,000}$ gold is usually from 0.06 to 0.07 per 1,000. On 15 carat or $\frac{625}{1,000}$ gold and on 18 carat or $\frac{750}{1,000}$ gold it is usually nil, but if the acid has not been boiling well, there will be a surcharge. With 9 carat or $\frac{325}{1,000}$ gold there is a slight loss, usually about 0.06 to 0.08 per 1,000. Under the proper conditions both surcharge and loss are very regular. The surcharge is due to the retention of silver in the cornets, and this was known as far back as the time of Erekern, for he recommends the use of check assays.

The pure gold used in check assays is prepared by dissolving fine gold (assay bits) in aqua regia, evaporating off the acid, and diluting very largely with water to allow all the silver chloride to settle. The clear solution is then siphoned off, and the gold precipitated with oxalic acid. The precipitated gold is boiled with hydrochloric acid, to free it from any traces of silver chloride. It is then washed with hot water, dried, and fused under bisulphate of potash.

In preparing some pure gold in this way from 5 oz. of assay bits, 3.858 grs. of AgCl were obtained. This is equal to 2.9 grs. of silver; so that the amount of silver present in the assay bits was equal to 1.23 parts per thousand.

In cupelling gold there is always a slight loss, due to absorption into the cupel. It is usually stated that this loss is greater with the lower than with the higher standards. This, however, does not appear to be the case, for the following table give the results of some assays made of cupels which had been used for different standards, and it will be seen that the absorption is almost identical.

Standard.	Weight of Gold obtained from 1 Cupel (= 4 Assays of 5 grs. each).	Absorption per Thousand.
9 carat, or $\frac{375}{1,000}$	0.014 grs.	0.7
Do. do.	0.014 "	0.7
15 carat, or $\frac{625}{1,000}$	0.014 "	0.7
Do. do.	0.015 "	0.75
18 carat, or $\frac{750}{1,000}$	0.014 "	0.7
Do. do.	0.015 "	0.75
22 carat, or $\frac{916.6}{1,000}$	0.014 "	0.7

The above were all cupelled on different days, so that the temperature of the furnace would not account for this regularity; but as the amount of lead used is the same for all standards, this, most probably, is the cause of the regularity.

The number of assays made last year at the Chester Assay Office, from articles sent to be hall-marked, was 25,100, of which more than half were gold.

PROPOSED UNIFICATION OF NOMENCLATURE IN ORGANIC CHEMISTRY. (PARIS.)

The following is the text of the resolutions adopted at the International Chemical Congress recently held in Paris (this Journal, 1889, 656).

Nomenclature of the Non-saturated Derivatives of the Fatty Series.—"The letters *a* and *b* shall designate the two atoms of carbon bound together by multiple links, in the case of bi-substituted derivatives; in the case of tri-substituted derivatives the designation may be omitted, provided the two radicals united to the same atom of carbon be named first."

The Design and Construction of Chimney Shafts.

EXAMPLES OF EXISTING

For whom Constructed.	External Form of Shaft.	Total Height, including Foundations.	Height from Ground Line.	Outside Dimensions of Foundations.	Outside Dimensions of Shaft at Ground Line.	Outside Dimension of Shaft at Top.	Inside Dimension of Flue at Ground Line.	Inside Dimension of Flue at Top.
Mr. Townsend, Chemical Works, Fort Dundas, Glasgow. <i>a</i>	Circular (brick).	468'	451'	50' (circular).	32'	13' 4"	17' 16"	11'
Messrs. Tennant and Co., St. Rollox, Glasgow. <i>b</i>	Circular (brick).	455' 6"	435' 6"	50' (circular).	16' diameter.	13' 6" diameter.	12'	11' 2"
Mechernich Lead Mining Co., near Cologne, Rhenish Prussia. <i>c</i>	Circular stalk on square pedestal, 32' 8" high (brick).	441' 18'	430'	39' 36' (square).	32' 8' (square).	11' 48'	11' 48'	9' 84'
Messrs. Johnson & Co., Cement Works, Greenhithe, Kent. <i>d</i>	Circular (brick).	391'	297'	30' (square).	25'	11'	17' 6"	8' 9"
Dowlais Iron Works, South Wales. <i>e</i>	Circular stalk on square pedestal, 45' high (brick).	284' 5"	268' 8'	42' (square).	32' (square).	17' 8"	13'	15' 4"
Amoskeag Manufacturing Co., Manchester, New Hampshire, U.S.A. <i>f</i>	Circular (brick).	265'	255'	25' 8"	25'	12' 6"	15' 8"	10'
West Cumberland Hematite Iron Works. <i>g</i>	Circular (brick).	267'	250'	34' 6" (square).	25' 7"	15' 3"	21' 10"	13'
Deptford Pumping Station, Metropolitan Main Drainage. <i>h</i>	Circular stalk on square pedestal, 3' high (brick).	160' to top of concrete bed.	156'	22' (square).	18' (square).	8' 3" diameter.	7' 6'	6'

EXAMPLES OF EXISTING

*Messrs. Cox Brothers, Camperdown Linen Works, Lochee, Dundee. <i>i</i>	Ornamental (brick), square for 230', remainder octagonal.	296'	282'	35' (square).	36'	13' (octagonal).	14' 6" diameter.	13' 8" diameter.
*Messrs. Lister & Co., Manningham Mills, Bradford. <i>j</i>	Square ornamental (stone).	262' 6"	256' 6"	40' (square).	21'	21'	16'	13'
Crossness Pumping Station, Metropolitan Main Drainage. <i>k</i>	Ornamental (brick) stalk, with curve base on square pedestal.	227' to top of iron cap, 201' to bottom of iron cap.	162'	30' 2" by 2' 6"	26' 6"	12' below cap.	8' 5" diameter.	8' 3" diameter.
Western Pumping Station, Metropolitan Main Drainage. <i>l</i>	Square (brick), no pedestal, ornamental cast-iron cap.	201' 5"	172' 9"	55' (square).	20' 5"	15' 2"	7' 3"	7'
Kent Brick and Tile Company, Pluckley. <i>m</i>	Square (brick).	..	170'	..	16' 6"	5' 6"	7' 6"	4' 6"
Messrs. Stansfield and Co., Waltham Green, London. <i>n</i>	Ornamental design, square stalk on pedestal 32' 6" high (brick).	152'	120'	25' (square).	15' 6"	5' 6"	4' (square).	4' (square).

EXAMPLES OF EXISTING

*Messrs. Wessmield's Chemical Factory, Barmen, Prussia. <i>a</i>	Octagonal stalk on square pedestal, 46' high (brick).	315'	331'	..	20'	11'	8'	8'
*Messrs. Crossley and Sons, Dean Clough Mills, Halifax. <i>b</i>	Octagonal (stone).	330'	306'	32'	30'	15' 6"	9'	9'
*Messrs. Storey Brothers, White Cross-street Mills, Lancaster. <i>c</i>	Octagonal (brick) stalk, with stone cap.	270'	250'	28' (square).	25'	10' 8"	8'	8' (octagonal); top 1' 2", 9' 2"
Abbey Mills Pumping Station, Metropolitan Main Drainage. <i>d</i>	Octagonal stalk on square (stone) pedestal, 30' high.	212'	191' Ground line to top of stone cap, 158' 3".	37' 6" (square).	30' 6"	16' 3" (under side of stone cap).	8'	8'

a Designed by Professor Rankine and R. Corbett. Largest shaft existing.*c* Designed by Mr. Martin.*f* Designed by Messrs. Stevens & Manning.*h* Designed by Professor Rankine and Messrs. Gordon.*g* Designed by Professor Rankine.*k* Designed by Sir J. Bazalgette. Brickwork in foundation and pedestal is built cellular.*m* Designed by Mr. Ward. Peculiarity of this shaft is that it is built of 4½ in. cellular brickwork.*p* Designed by Mr. Storey and Messrs. Paley and Austin.*q* Designed by Sir J. Bazalgette. Chief feature was

C. Molyneux and J. M. Wood. Industries, 7, 224.

ROUND CHIMNEY SHAFTS.

Ratio of Height to Width externally, immediately above the Footings.	Batter of Shaft.	Weight of Shaft.	Cost.	Maximum Pressure per Sq. Ft. on Brick-work and Foundations.	Thickness of Brick-work, and Number of Sections into which the Shaft is Divided.	Lining (internal).	Duty.
14 to 1	1 in 48½	8,000 tons.	8,000 <i>l</i> .	407 tons on foundations.	12 sections, 5' 7" thick at bottom, 1' 2" at top.	9" fire brick with 9" air space, 60' in height.	Gases from chemical works.
11 to 1	1 in 32·9	4,100 tons (about).	..	3 tons on top of concrete foundations.	5 sections, 2' 7½" thick at bottom, 1' 2" at top.	Inner lining, 26½" high, 1' 10½" at base, 1' 2" at top.	..
13·1 to 1	1 in 60½ (circular stalk).	5,450 tons.	..	Base of stalk 0·961 tons, 3·7 tons on foundations.	27 sections, 11' 48' thick in pedestal, 6' 56" at base, 0' 82" at top.	No lining.	Fumes from lead works.
11·9 to 1	1 in 41	2,500 tons (about).	2,500 <i>l</i> . (about).	9½ tons (about).	8 sections, 3' 2" thick at bottom, to 1' 2" at top.	No lining.	Steam and fumes from cement kilns.
8·5 to 1	1 in 38½ (circular stalk).	..	..	..	8 sections, 7' thick in pedestal, 1' 6" at base of stalk, 1' 2" at top.	No lining.	Waste gases from boilers, &c.
10·2 to 1	1 in 40·8	2,330 tons.	3,333 <i>l</i> .	1·5 tons on foundation.	2' 8" thick at bottom, 1' 3" at top.	Lining, 10' diameter throughout.	Fumes from 64 boilers = 8,400 h p. Designed to burn 18,000 lb. of anthracite per hour.
8·75 to 1	1 in 49	2,380 tons (about).	1,500 <i>l</i> , or 4 <i>l</i> . per cubic foot of the whole space occupied by the building.	At springing at flue arches 3 tons, 1·6 tons on foundation.	4 sections, 3' thick at bottom, 1' 10½" at ground line, 1' 2" at top.	Fire brick lining top to bottom. Upper 160' ½ brick thick, rest 1 brick.	Gases from four blast furnaces, stoves, and boilers. 10½ tons of fuel per hour.
8·6 to 1	1 in 56½ (circular stalk).	..	..	..	4 sections, 5' 3" thick at ground line, 1' 10½" at base of stalk.	1½" fire brick lining carried up 36" above ground line.	10 Cornish boilers, 30' long by 6' diam.

SQUARE CHIMNEY SHAFTS.

9·5 to 1	Vertical sides with external offsets.	..	..	..	12' thick at foundation, 6' at ground line, 3' 3" 17' from ground line, 1' 6" at top.	Inner flue, circular from top to bottom, 1' 6" thick at bottom, 9" at top.	58 furnaces, smiths' forges, &c.
12·2 to 1	Vertical sides.	8,000 tons (about).	10,000 <i>l</i> . (about).	5 tons (about) on foundation.	..	1½" fire brick, 50' in height, 4" air cavity.	..
7·8 to 1	Curved batter for 42' high, remainder of stalk vertical.	..	1,000 <i>l</i> . (about).	..	5' thick at base of stalk, 1' 10½" where curve ends, this thickness carried up throughout.	Fire brick lining, carried up 40'.	12 Cornish boilers, 6' diam. by 30' long.
8·4 to 1	1 in 62½	..	..	..	3' 5½" thick at ground line, 1' 2" at top.	Inner flue 14' thick from bottom to top, 1½" fire brick for 40'.	18 Lancashire boilers, 22' long by 6' 6" diam.
10·3 to 1	1 in 31	..	..	..	1½" thick throughout.	..	Gases from Hoffmann's brick kilns.
8 to 1	1 in 70 (square stalk).	..	1,000 <i>l</i> . (about).	..	5 sections, 5' 7" thick in pedestal, 1' 10½" at base of stalk, 9" at top.	1½" fire brick lining, 33' above ground line.	2 Lancashire boilers, 2 brewing coppers.

OCTAGONAL CHIMNEY SHAFTS.

10·5 to 1	1 in 97	..	..	9½ tons on lowest part of chimney.	5' 3" thick in pedestal, 3' 9" at base of octagon, 1' 6" at top.	..	Products from chemical factory.
10 to 1	1 in 41	5,200 tons.	9,000 <i>l</i> . to 10,000 <i>l</i> .	8 tons (about) on foundation.	..	Inner circular shaft of 11" fire brick, with a 3" air space.	Products from 15 boilers, &c.
10 to 1	1 in 54 (about).	3,300 tons.	2,800 <i>l</i> .	1½ tons (about) on foundation.	Outer shaft, 1' 6" at bottom, 1' 2" 20' from top, 9" at top.	Inner shaft 26½" high, 18" thick at base, 9" at top, built parallel.	Products from boilers.
..	1 in 100 for a height of 78' below cap.	Stone cap, 60 tons; iron cap, 27 tons.	Brickwork in stalk cost about 8 <i>l</i> . per rod (labour only).	..	3 sections: (1) First 40', 4' 1½" to 1' 10½"; (2) 1' 6"; (3) 1' 2" thick.	..	6 Lancashire boilers, 8' diam. 10' long.

and Hills. Second tallest shaft existing.

h Designed by Sir J. Bazalgette.

i Designed by Sir J. Bazalgette. Chief feature of this shaft is a stone spiral staircase, built in the space between the lining and outer shell.

n Designed by Mr. Bradford.

cast iron cap, which has since been removed owing to chimney being much cracked.

c Third tallest shaft existing.

i Designed by Mr. Maclaren.

j Designed by Messrs. Andrews & Pepper.

o Designed by Messrs. R. Ives & Sons. Chief feature, shaft entirely of stone.

* Authority, Baureroff.

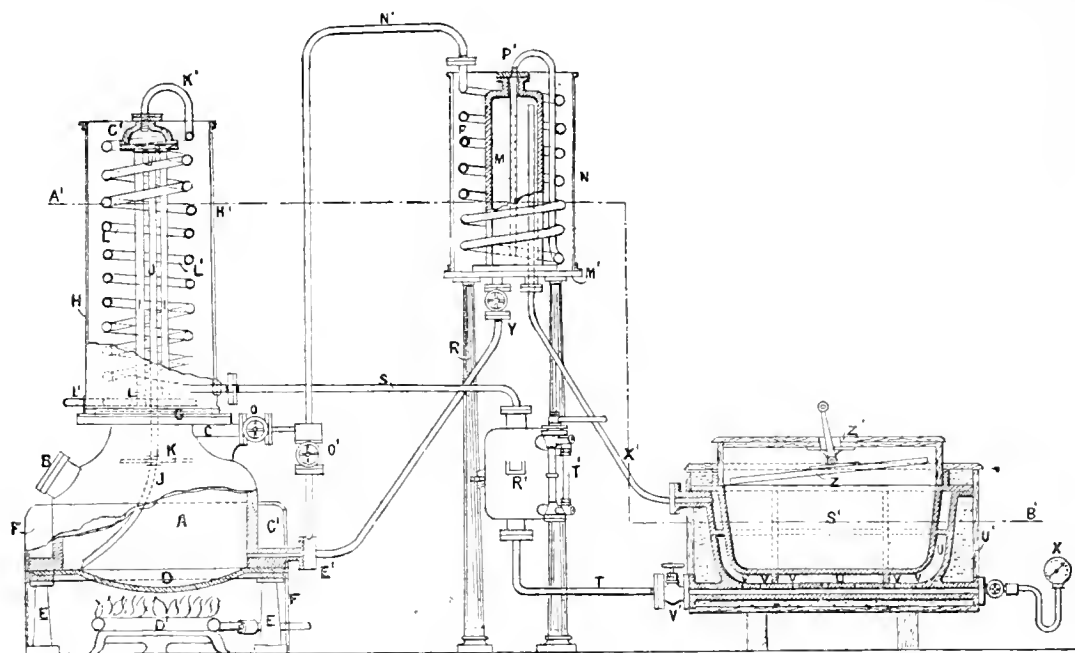
Improvements in Filters. M. Negro, London. Eng. Pat. 11,357, August 7, 1888. 8d.

Two annular tubes of perforated metal or wire-work enclose between them the filtering agent, which may be paper, asbestos, or other of the substances commonly used for such a purpose. The filter so formed is fitted by means of a screwed socket in the interior of a conical vessel forming the reservoir for the unfiltered substance, the lower end of which forms the outlet for the filtrate.

—C. C. H.

An Improved Apparatus for Ice-making and Refrigerating. A. Glasson, London. Eng. Pat. 12,008, August 20, 1888. 8d.

THE improved refrigerator belongs to the type generally known as "ammonia absorption" apparatus. A is the generator, heated preferably by gas, and vaporising the concentrated solution of ammonia it contains. The vapour rises through the rectifier tubes I into the bonnet G'; the water condensed returns through pipe J, and the vapour passes on, is condensed in worm L, and, by means of tube S, delivered into receiver R' supplying the freezing cell S'.



Vaporising again in jacket U, it abstracts heat from the water contained in S', kept in motion by stirrer Z, and, passing through pipe X' into absorber M, meets with a fine spray of weak liquor delivered from A through tube N', cooled in worm P, is absorbed and again let down into A when required to be re-distilled.—C. C. H.

Improved Method of and Apparatus for Centrifugally separating Solids and other Matters from Liquids. W. Hicks, London. Eng. Pat. 2528, February 13, 1888. 8d.

A NUMBER of arms or chambers radiating from a common centre, provided internally with partitions so as to form a zigzag passage from the upper to lower part, are fixed to a vertically revolving shaft. The outer extremities are fitted with sliding valves, so that the ends of the horizontal chambers formed by the partitions can be opened; the lower ends of all the chambers formed by the partitions communicate with a common overflow pipe next the rotating shaft. The action is as follows:—Liquid containing solid matter is introduced into the upper part of the chambers, the solid matter it contains by centrifugal force collects on the periphery and may be discharged from time to time through the sliding valves, whilst the liquid passes to and fro from centre to periphery and *vice versa*, and so on through the entire length of the passage in the chambers, and finally overflows in a clarified condition into the common outlet pipe. A modification is also shown, in which the liquid is forced in, and so urged filtration or separation secured.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

Experiments on the Manufacture of Oxygen in Gasworks, and the Result of its practical Application to the Purification of Coal Gas. W. A. Valon. The Gas World, 1889, 715—719.

IN a previous paper the author has given an account of experiments in the purification of gas by means of oxygen in conjunction with "oxide" or lime. When oxide alone is employed and a small quantity of oxygen is mixed with the crude gas, the oxide is revived *in situ*, the life of the purifier is lengthened, and the cost of labour is considerably diminished. The advantages of using oxygen are still more marked when lime, in quantity sufficient to remove the carbon dioxide, is employed in purification; not only the carbon dioxide but the whole of the sulphur (sulphuretted hydrogen) and some of the sulphur compounds are removed, the latter being abstracted with perfect certainty, and the lime having no unpleasant odour either when partially or completely spent.

The oxygen is made by Brin's process, and the necessary apparatus is fully described. The barium oxide is heated at a constant temperature in steel retorts placed in ordinary gas retorts, and by the aid of an automatic arrangement for reversing the valves, devised by Mr. Murray, the process may be described as practically automatic. The requisite quantity of oxygen is mixed with the gas by means of a proportional meter, devised by W. G. Hicks, which automatically and accurately regulates the percentage of oxygen necessary for purification, and is so arranged that the quantity added can be increased or decreased at will.

In experiments made at the Ramsgate works, a series of four purifiers (1, 2, 3, 4), 14 ft. × 14 ft., were each charged with 12 yds. of slacked chalk lime, not 60 per cent. of

which was caustic, and the gas, previously mixed with 0.6 per cent. of oxygen, passed through three of the boxes. The test for foulness is carbon dioxide in equal quantities at the inlet and outlet; with Sheard's apparatus a test can be made in a few minutes. The foul gas at the inlet of the first purifier contained on the average a trifle under 1 per cent. of carbon dioxide and 600 grains of sulphuretted hydrogen per 100 cubic feet. For the first six days the gas at the outlet of No. 1 was free from both sulphuretted hydrogen and carbon dioxide, and on the seventh day it contained only 98 grains of carbon dioxide and 110 grains of sulphuretted hydrogen; the inlet at the foul main showed at the same time 700 grains of carbon dioxide and 600 grains of sulphuretted hydrogen, and the sulphur (sulphur compounds) in the purified gas was under 6 grains. On the seventh day No. 2 commenced to work, and no carbon dioxide or sulphuretted hydrogen were present at the outlet until the 14th day. On the 14th day No. 3 commenced to work, and, 29 days after No. 1 was started, the gas at the outlet of No. 3 contained only 5 grains of sulphuretted hydrogen and not a measurable trace of carbon dioxide, No. 1 not yet being quite exhausted, although having passed more than 8 million cubic feet of gas. No. 1 was finally thrown out on the 40th day, 9 million cubic feet of gas having passed through it. The gas thus freed from sulphuretted hydrogen and carbon dioxide completely, and from sulphur compounds to a considerable extent, was, therefore, more than half a million cubic feet per yard of caustic lime, and the total sulphur in the purified gas did not at any time exceed 8 grains per 100 cubic feet.

These facts prove beyond doubt (1) the instantaneous action of oxygen; (2) the fixity of the sulphur in the lime; (3) that with oxygen a greatly reduced area is required; (4) economy in lime; (5) economy in labour; (6) simultaneous and perfect purification from sulphuretted hydrogen and carbon dioxide; (7) easy and absolute control of the sulphur compounds without trouble or anxiety; and (8) complete immunity from anything objectionable while carrying out the operation.

Experiments which were made to ascertain the effect of air on the illuminating power gave the following results:—The gas at Ramsgate has averaged for years past, with oxide purification and 1 per cent. of air, 13.5 candles, the coal used being Pelaw Main, and the make over 10,000 cubic feet per ton; 2½ per cent. of New Boghead or Tyne coal are added to bring the illuminating power up to 15.5 candles. Since lime and oxygen have been employed the illuminating power has ranged between 16.5 and 17.3 candles, and no coal whatever has been used, so that, allowing that the increase of one candle is due to the removal of 1 per cent. of carbon dioxide, the difference of 2½ candles may be credited to the use of 0.6 per cent. of oxygen and the discontinuance of 1 per cent. of air.

The effect of various quantities of air on the illuminating power was also carefully examined, and it was found that whilst with 0.6 per cent. of oxygen the illuminating power is 17 candles, when 2½, 3, and 5 per cent. of air are added instead, the illuminating power falls to 13.45, 13.04, and 10.09 candles respectively.

Comparative experiments with 3 per cent. of air in the one case and 0.6 per cent. of oxygen in the other, proved beyond doubt the value of oxygen over any possible system of air purification, in economy of space, lime, and labour, although an explanation of the cause of this difference cannot yet be given. Purifiers which, when pure oxygen was used, reduced the percentage of sulphur enormously, ceased to so reduce it directly air containing the same percentage of oxygen was used. And after a short time they actually let the gas issue more impregnated with sulphur compounds than it was when it entered the purifiers; and when the air was stopped and pure oxygen again admitted, the bad effect immediately ceased, and after an hour or so, when the oxygen had had time to spread through the material, the purifiers began to do good work again and to reduce the amount of sulphur.

With regard to the commercial and practical advantages accruing from the use of oxygen, the author asserts that, even where there is unlimited space for purification, or where the works are not under the operation of the Sulphur

Clauses Act, the avoidance of the use of cheap oxygen is an unjustifiable extravagance. The cost of providing, erecting, and maintaining the oxygen plant is discussed in some detail, and the saving from the employment of oxygen is estimated as follows:—The average cost of purification where companies are placed under the Sulphur Clauses Act is 3*l.* 15*s.* per 1,000,000 cubic feet (Field's analysis). The same work in conjunction with oxygen, but not including the cost of the oxygen, is 1*l.* 15*s.* The total cost, except the interest on plant, of 0.6 per cent., or 6,000 cubic feet of oxygen at the higher figure of 2*s.* 6*d.*, would be 15*s.* (a high estimate), and the interest on capital in providing oxygen plant at 10*l.* per million at 10 per cent., 1*l.* Balance in favour of oxygen, 5*s.* If to this sum the interest (3*l.* 15*s.*) on capital due to saving one-half the space and plant required under present system (*i.e.*, 50*l.* per million at 7½ per cent.), and the average cost (6*l.* 5*s.*) of 1½ candles in illuminating power at 1*l.* per candle, are added, the saving per million cubic feet is found to be 10*l.* 5*s.* Even if the interest (3*l.* 15*s.*) on capital saved is not taken into consideration, it still leaves 6*l.* 10*s.* per million to the credit of oxygen.

It is stated in conclusion that the economies of oxygen purification have been designedly understated, the saving claimed having been greatly exceeded at Ramsgate. It is sufficient for the author's purpose to make it clear that the system is self-supporting under all conditions where gas must be purified, and leaving such a margin as to recommend its adoption by all gas companies and corporations. (This Journal, 1889, 82.)—F. S. K.

PATENTS.

An Improvement in Fuel Gas Burners. The Gas Patents Syndicate, Limited. From J. B. Archer, Washington, U.S.A. Eng. Pat. 8560, June 11, 1888. 6*d.*

A HORIZONTAL pipe conveying air is terminated by an elbow piece, through the centre of which a smaller pipe is inserted to convey the fuel gas. A movable plug on the gas pipe serves to spread out the issuing gas, and a globular cap on the air pipe provides for a due admixture of gas and air before leaving the burner. A detailed drawing accompanies the specification.—G. H. B.

Improvements in Gas and Coke Producers and in the Apparatus for Collecting the By-Products therefrom. T. Nicholson, Hucknall Torkard. Eng. Pat. 9239, June 25, 1888. 6*d.*

ABOVE a coal or coke furnace is placed a generator or producer having a perforated bottom and sides. A blast of air is admitted to the furnace below, and the gaseous products from thence play through the perforations in the sides and bottom of the producer upon the charge of fuel within. The gaseous products from the furnace do not rise directly to the producer, but are first conducted to the rear of the apparatus, and are then, for their better distribution, led forward into a heat chamber immediately below the producer. The gas extracted from the charge of fuel in the producer is scrubbed with gas liquor in suitable scrubbers, and then led through a serpentine condenser. Lastly, the coke remaining in the producer is treated with wet steam, which is said to harden it and to remove its nitrogen and sulphur.—A. R. D.

The Generation of Gaseous Fuel and the Combustion thereof in Steam Generator Furnaces. The Gaseous and Liquid Fuel Supply Co., Limited, Manchester, and B. H. Thwaite, Liverpool. Eng. Pat. 10,224, July 14, 1888. 8*d.*

FROM an ordinary boiler flue the firebars are removed, and the fuel is allowed to rest upon a floor of refractory hollow bricks or pipes laid on the bottom of the flue. Below the ordinary door is placed another door for clinking and other purposes. Attached to the back of this, but at an interval of a few inches from it, is a refractory block through which a mixed blast of air and steam is supplied to the fuel lying on the floor, the few inches of space between the door and the block serving as a distributing chamber

for the said blast. The combustible gases produced by the decomposition of the fuel are met as they pass the furnace bridge by an independent air supply previously heated by traversing channels formed in the hollow floor supporting the fuel. For about 5 feet from its front end the flue is provided with a specially shaped refractory lining, which is raised to incandescence and prevents the deposition of carbon. A nest of open brickwork at the rear end of the flue also becomes highly heated and prevents any combustible gases from passing away unconsumed.—A. R. D.

Improvements in or relating to the Obtaining of Inert Gases.
L. Mond and G. Eschellman, Northwich. Eng. Pat. 11,294, August 4, 1888. 4d.

GASES containing oxidising or reducing constituents, or both, are deprived of these by being passed through oxide of iron or manganese of a suitable degree of oxidation heated to from 300° C. to 400° C. The oxide of iron or manganese that has been employed for eliminating an oxidising constituent may be revived for further use by being utilised to remove a reducing gas, or *vice versa*; or the process may be made a continuous one by taking care that gases of opposite tendencies are present in such proportions as to neutralise one another.—A. R. D.

Improvements in Gas-producing Apparatus in which the Carbonisation of Coal is continuously Effected. A. Elliott, Ludlow. Eng. Pat. 11,443, August 8, 1888. 11d.

AN open hopper kept filled with coal is connected by a vertical pipe with the horizontal retort which widens out towards the discharging end to allow for expansion of the coal during carbonisation. The gases are prevented from returning through the hopper by a sliding valve, which is only opened when a charge of coal is let down. The coal is moved forward in the retort by means of a scoop which can be moved forwards and backwards on an arm passing through the retort lid. The coke is received from the discharging end of the retort in a cylinder which revolves air-tight against a suitable face-plate on the retort, and is discharged by rotating the cylinder. The exit for the gas rises from the discharge end of the retort. Means for giving automatic motion to the various parts is described, and a number of retorts may be worked simultaneously. The specification is accompanied by drawings, which should be consulted for details.—G. H. B.

Obtaining Useful Products from Refuse or Residues of Gas Purifying, and Apparatus therefor. C. Dubois, Marseilles, France. Eng. Pat. 7653, May 7, 1889. 6d.

THE old or refuse materials which have been employed in the purification of lighting gas are heated in a rotary retort and at the same time treated with steam, superheated or otherwise. The sulphur is volatilised, and any cyanogen compounds present are decomposed with formation of ammonia. These products are separated and recovered by whatever means may be found most suitable.—A. R. D.

An Improved Apparatus for Manufacturing Carburetted Air Gas. G. P. Armstrong, London. From G. Jaunez, Paris, France. Eng. Pat. 7854, May 10, 1889. 6d.

THIS apparatus is to be worked on the same principle as that patented by Moussard in France, December 27, 1869, No. 88,263. It is claimed, however, to be less complicated, as all the parts are reduced to their simplest form. Liquid hydrocarbon is vaporised by heat and caused to pass through a Giffard's injector, where its expansive force is employed to draw in the air to be carburetted. A gas holder forms part of the apparatus, and the lower portion of this is utilised as a supply cistern for the hydrocarbon. It is situated below the injector or carburetter, so that any condensed liquid may flow back to the cistern. From the body of the holder a pipe passes downwards conducting gas to a burner, over which is placed a lenticular vaporiser. The

hydrocarbon flowing by gravity from the supply cistern above, is here brought to a state of vapour, and passes upwards as such to the carburetter. Leaving this latter mingled with air it goes forward to the holder, and thence through a suitable pressure regulator to be distributed as required.—A. R. D.

Process for Generating Gases known as Water-Gas and Producer-Gas. J. von Langer and L. Cooper, Leeds. Eng. Pat. 8192, May 16, 1889. 4d.

IN the usual process of making water-gas a mass of fuel in a generator is alternately submitted to the action of a blast of hot air from the bottom, and of a blast of steam from the top. The present improved process differs from the above by admitting both blasts at the top of the generator. It is claimed that a much higher proportion of water-gas is obtained and cheaper kinds of fuel can be employed. The same principle of downward direction only is also applicable when producer-gas alone is required, but in this case a reduced quantity of steam is admitted at the top, and a supplementary supply of heated air is introduced half-way down the mass of fuel.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

New Occurrences of Ozokerite. B. Lach. Chem. Zeit. 13, 831.

OZOKERITE for the cerasin industry is still obtained from Galicia, but new deposits are always being sought for. Ozokerite is known to be found in the Caucasus, and there are reports more or less fanciful from North America of deposits of white ozokerite miles in length being found.

The author having had samples submitted to him, has examined them by his process (Chem. Zeit. 9, 905; this Journal, 1885, 488) with the following results:—

Caucasian ozokerite resembles an inferior Galician variety. Melting point of crude substance 68° C. Treated with 20 per cent. of fuming sulphuric acid it yields 58.1 per cent. of second quality. Cerasin: melting point = 68.5° C. Volatile portion, 1.8 per cent.

The crude substance has a repulsive odour, is worked with difficulty in quantity, becomes stiff in the basin, and presses extremely badly. The price is at present too high, and until greater demand arises and the transportation be accomplished, the Galician ozokerite production will make very strong competition.

North American ozokerite, Colorado. Here extensive mines of an ozokerite-like substance are found, the supply of which is hindered only by the transport difficulty. On being tested, however, it proves useless for the production of cerasin. The material is supplied in cakes 36 × 20 × 6 cm. in dimensions. It is a dull black hard substance, smelling of catechu, and proving brittle and pulverisable. Care must be taken in melting it at 95° C., or violent frothing may occur from the presence of traces of water.

The analysis shows—

Melting point of crude substance 76.4° C.
" " treated " 76.5° C.

Treated by the aforementioned process no cerasin is obtained. Even when heated to 300° C. it will not filter in the slightest through filter-paper, although it is quite a thin fluid. Subjected to distillation it gives the undernoted results:—

	Per Cent. (by difference).
Paraffin and oil.....	90.60
Loss in gas	2.12
Loss in water.....	2.69
Residue	5.28

It commences to distil at 360° C., when nearly 3 per cent. of oil setting at 30° C. comes over. At a much higher temperature it runs over and distils steadily, giving a very fair crude product for paraffin extraction.

Consequently this substance is suitable for paraffin making and is absolutely useless for the cerasin industry.

The price is at present disproportionately high.—D. A. S.

Recovery of Tar and Ammonia in the Manufacture of Coke.
Stahl u. Eisen, 1889, 9, 482.

GREAT progress has been made in plant for condensing the tar and ammonia formed in the manufacture of coke, and it has been found that by condensing it the quality of the coke has not deteriorated. The Hoffmann-Otto ovens have proved excellent, and bee-hive ovens have also been used. In the water condensers not only the fluid tar but also much viscid tar is deposited, so it is advisable to make use first of air condensers which consist of large chambers with sheet-metal partitions between which the gases have to travel zig-zag, and thus deposit most of the tar and coal dust. After leaving the water-condensers the gases are passed through washers to remove the remainder of the tarry products. Since only 11 to 14 per cent. of the nitrogen in the coal are converted into ammonia, numerous attempts have been made to increase the yield. It has been proved in practice that instead of being diminished, as hitherto supposed, the yield is increased by employing a higher temperature, and the introduction of hydrogen into the coke ovens still further increases the yield. As hydrogen is too expensive, dissociation of water in the ovens has been tried, but the loss of coke in consequence is too great. The use of lime is also unsatisfactory, as the quality of the coke is deteriorated.

A greater yield of tar can be obtained by keeping the upper part of the ovens cool, but its quality is deteriorated owing to the decrease in the light oils. The tar is sent away for distillation, but the ammonia liquors are almost always worked up at the coke factories, generally into ammonium sulphate.—E. E. B.

Discovery of New Petroleum Wells near Baku.

A REPORT, dated the 22nd August last, has been received at the Foreign Office from P. Stephens, British Vice-Consul at Batoum, stating that news had been received in Batoum on the previous day to the effect that eight new fountains had been discovered in the naphtha-producing territory of that district, the combined output of which, at the present rate of supply, could approximately be estimated at 16,000 tons per diem, in consequence of which the price of crude oil at Baku had decreased from $\frac{1}{2}d.$ to $\frac{3}{4}d.$ per gallon, and a further fall was expected.

"Peat" Candles in South America.

"PEAT" candles are not made of peat, but of the paraffin that is distilled from peat in Brazil, where it is more plentiful even than in Ireland. According to *The Commercio des Amazonas*, John Grant and Co. are now having machinery installed at their works capable of producing 80 tons of peat paraffin a month. They are also extracting from the turf a valuable lubricating oil. They employ 300 workmen, and have 33 boilers with purifiers, stills, refrigerators in their plant.—*Engineering and Mining Journal*.

Petroleum in the Canadian North West.

THE *Canadian Gazette*, in its issue of August 8th, publishes the following:—

Interesting particulars of the rich find of oil in the North-West reached Ottawa on July 23rd in a letter received by Alfred Patrick, late clerk of the Dominion House of Commons, from his son, Major Allan Poyntz Patrick, Dominion Topographical Surveyor, of Calgary. The letter says:—"For 11 weeks we have been prospecting among the mountains for coal-oil deposits. I am happy to say we have been eminently successful. We have located a

considerable quantity of oil land, some on the eastern slope, and some on the British Columbia side. So soon as we felt perfectly certain as to the importance of our find we had several samples assayed. The result gave 91 per cent. lubricating oil, 5 per cent. heavy oil, 1 per cent. water, and 3 per cent. foreign matter. This is the best oil ever discovered, and far ahead of the Pennsylvanian oil-fields. There is plenty of head, the flow being about 4,500 feet above the sea level, and the crude oil can be run off in pipes any distance. It is the greatest find ever known. All the oil lands are within easy distance from the railway." The letter further states that arrangements are being made for developing the find, which, if correctly reported, adds immensely to the treasure to be expected from the North-West.

PATENTS.

Improvements in and Relating to the Manufacture of Acetic Acid and its By-products. R. Weiss, Zossen, Germany. Eng. Pat. 9835, July 6, 1888. 6d.

THESE improvements refer to the distillation of wood, peat, brown coal, or other organic substances, for obtaining carbon and various volatile products, notably acetic acid. It is proposed to introduce into the retorts a current of heated water or generator gas, or in fact any gas free from oxygen and containing carbonic oxide. This materially aids the evolution of the volatile products, and is said to largely increase their yield by removing them quickly from contact with the residual heated carbon, which is apt to promote their decomposition.—A. R. D.

Improvements in Vertical or Inclined Retorts for Distilling Shale, Coal, and other Analogous Substances. J. Jones, Dabuneny. Eng. Pat. 9893, July 7, 1888. 8d.

IN order to facilitate the discharge of the contents of the retort, the lower part is built so as to incline downwards to the discharge orifice, which may be closed by a sliding door as well as by an ordinary retort door. A suitable motion of a shovel applied at the bottom of a retort of this construction will cause the whole contents to descend evenly through the retort. A further claim refers to the employment of fireclay blocks having a feather and groove joint all round the block, of which the retort is to be constructed. The specification is accompanied by drawings.—G. H. B.

Improved Coating of Preservative Material for Iron, Steel, and other Structures, or for Coating the Bottoms of Iron and Steel Ships or other Vessels, and Process of Manufacturing the same and other Products from Gas Tar. J. H. Eastman, Liverpool. Eng. Pat. 10,192, July 13, 1888. 4d.

See under XIII., page 715.

IV.—COLOURING MATTERS AND DYES.

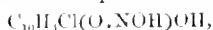
On Mononitroso- and Dinitrosomaphthoresorcinol. S. v. Kostanecki. Ber. 22, 1342—1347.

NEITHER the resorcinol of the naphthalene series nor its derivatives have been hitherto known. The author describes some compounds obtained from hydroxynaphthoquinone, $C_{10}H_5O_2$, $OH(O : O : OH = 1 : 4 : 2)$, belonging to this class of bodies.

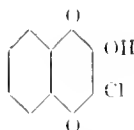
Hydroxynaphthoquinonemonoxime, $C_{10}H_5(O.NOH)OH$, *Mononitrosomaphthoresorcinol* is obtained by treating hydroxynaphthoquinone (1 mol.) dissolved in caustic soda (2 mols.) with a solution of hydroxylamine hydrochloride (1 mol.). The yellowish-red solution turns to an olive-green, and on addition of acid a light yellow precipitate is formed, possessing all the properties of a nitrosophenol. Recrystallised from glacial acetic acid it forms yellowish

needles, decomposing at 180° C. with evolution of gas. To obtain a pure product it is essential to work with reagents free from iron. This body is practically insoluble in cold or hot water and ether, easily soluble in alcohol, caustic soda and carbonate of soda. Ferrous salts produce in its alcoholic solution a green lake, ferric salts a dark brown one. Cobalt salts produce a dark yellow; nickel salts a scarlet red precipitate. The mononitrosophthaloresorcinol dyes mordanted fibres. Olive-green colours are obtained with iron mordants and scarlets with nickel mordants. The latter are, however, not fast to boiling soap solutions.

Monochloromononitrosophthaloresorcinol—

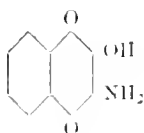


Chloronaphthalenic acid—



is acted upon by hydroxylamine in the same way as hydroxynaphthoquinone, yielding finally a chlorinated product which, after recrystallisation from glacial acetic acid, forms yellow needles, decomposing at 178° C. It dyes mordanted fibre.

Dinitrosophthaloresorcinol, $C_{10}H_4(O.NO)_2$.—If one molecule of the mononitroso-compound and one molecule of sodium nitrite be dissolved in dilute caustic alkali and poured into dilute acid, a light yellow crystalline precipitate is formed, which after recrystallisation from alcohol, forms long plates nearly white and decomposing at 165°. It crystallises with one molecule of water and dyes mordanted fibre darker than the mononitroso-compound. On oxidation with nitric acid phthalic acid is formed. On reduction with tin and hydrochloric acid Merz and Weith's naphthalenic acid—

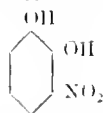


was obtained.—A. L.

On Colouring Matters which Dye Mordanted Fibres.

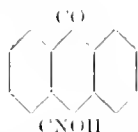
St. v. Kostanecki. Ber. 22, 1317—1333.

COLOURING matters having the character of phenols dye fibres mordanted with oxides, if two hydroxyl-groups are in the ortho-position. As a further instance that this theory is correct, the volatile nitropyrocatechin (nitrocatechol)—



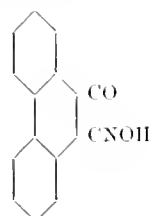
was examined, the result being that one more proof for this theory was obtained. It produces orange shades with aluminium mordants, whilst its non-volatile isomeride yields a light yellow under the same conditions. Nitrosophenols act in the same way if they are orthoquinone-oximes. Several similar compounds were examined.

Anthraquinone-oxime—



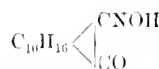
can be considered a para-nitrosophenol, and does not form dyes with metallic oxides.

Phenanthrenequinone-oxime—



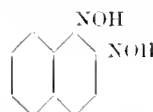
is an ortho-compound, and acts as a dye towards fibres mordanted with oxides.

Retenequinone-oxime—



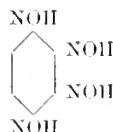
produces green shades with iron mordants.

Orthoquinonedioximes form dyes with oxide mordants.
—*Orthonaphthalenedioxime—*



produces brown shades with iron or cobalt mordants.

Orthobenzenetetroxime—



forms dark browns with iron mordants.

The isomeric para-compounds, as *p*-naphthalenedioxime—



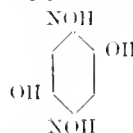
and

p-benzenedioxime—



do not form dyes with oxide mordants.

Orthohydroxyquinones form dyes with oxide mordants.
The dioxime of dihydroxyquinone—

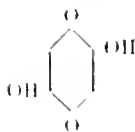


was proved to be a colouring matter in that sense as well as the hydroxynaphthoquinone-oxime, whilst the isomeride of juglonmonoxime, which is not an ortho-compound, does not act as a dye.

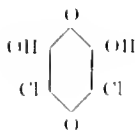
Orthohydroxyquinones are not all dyestuffs. Experiments with hydroxythymoquinone proved a failure, whilst the tests with *o*-hydroxynaphthoquinone were successful,

as well as those made with Mylius' hydroxyjuglone. Far stronger colours are, however, obtained with such bodies, which contain this complex of atoms twice.

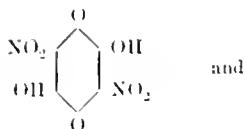
Dihydroxyquinone—



Chloranilic acid—

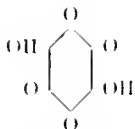


Nitraulic acid—



and

Rhodizonic acid



are all capable of dyeing upon oxide mordants.—A. L.

On Para-Diamidodiphenylpiperazine and the Formation of Colouring Matters from it. E. Tellmann and C. Schleich. Ber. 22, 1387—1389.

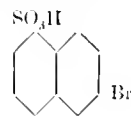
PARAMIDOPHENYLPYPERIDINE forms colouring matters, analogous to those obtained from paramidodimethylaniline. The authors examined the *p*-diamidodiphenylpiperazine in the same direction. It was prepared by heating 100 grms. of aniline with 100 grms. of ethylene bromide on the water-bath; a violent reaction sets in and the whole mass solidifies. Then 110 grms. of ethylenebromide were added and the mass heated to 130°—140° C. in the air-bath, whilst as much caustic potash was gradually added as would saturate the whole of the bromine. After several hours' boiling the organic compounds solidify. After washing with water they are distilled with steam to remove the excess of ethylene bromide and then treated with hot alcohol, by which the impurities are dissolved. The yield from 100 grms. of aniline was 90—100 of pure base. The nitrosation was performed in the same way as Morley describes, and the nitroso product without further purification was reduced with stannous chloride and hydrochloric acid. After precipitating the tin by sulphuretted hydrogen the hydrochloride of the diamido base was obtained in colourless prisms, crystallising with 4 mols. of water, $C_{16}H_{20}N_4(HCl)_4 \cdot 4H_2O$. On oxidation with 2 mols. of phenol or naphthol by ferric chloride, blue colouring matters of the indophenol group were obtained. If the phenol be replaced by the hydrochloride of an amine and the oxidation be performed by potassium bichromate, indamines are formed, of which the one prepared from aniline can be converted after addition of two more molecules of aniline hydrochloride in acetic acid solution, into a safranine. With metatolylendiamine a difficultly soluble blue colouring matter is formed, which is analogous to Toluylene blue, and is changed into a red colouring matter on boiling its hydrochloric acid solution. Dyestuffs similar to Methylene blue could not be prepared. On oxidation with sulphuretted hydrogen and ferric chloride a red colour was obtained, but no blue.—A. L.

On two β -Bromonaphthalenesulphonic Acids. S. Forsling. Ber. 22, 1400—1403.

THE author obtained these two acids by converting Brömer's β -naphthylaminesulphonic acid and Dahl's β -naphthylaminesulphonic acid into the corresponding diazo-compounds and treating these with fuming hydrobromic acid and cuprous bromide. The concentrated solutions were neutralised with potassium carbonate, when the potassium salts were precipitated.

$\beta_1 = \beta_2$ -Bromonaphthalenesulphonic acid obtained from Brömer's naphthylaminesulphonic acid is very soluble in water. Its salts are, however, very difficultly soluble in it. The potassium, ammonium, and barium salts are described. The bromide of this acid was prepared in the usual way with phosphorus pentabromide. It is easily soluble in benzene and chloroform, with difficulty in petroleum spirit and ether. It forms prisms melting at 110° C. By boiling it with alcoholic ammonia the amide is formed, crystallising in fine long needles, melting at 207° C. On distilling the bromide with the calculated amount of phosphorus pentabromide, dibromonaphthalene is obtained, which, after recrystallisation from alcohol and distillation with steam, was obtained from its solution in ether and chloroform, in colourless square plates, melting at 158° C.

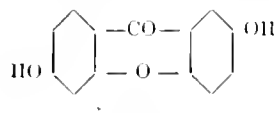
$\beta_1 = \alpha_2$ -bromonaphthalenesulphonic acid was obtained from Dahl's naphthylaminesulphonic acid; its bromide, prepared in the usual way, forms broad needles, melting at 151° C. It was converted into dibromonaphthalene, crystallising in white needles, melting at 75° C. It is identical with the compound obtained by Meldola and Darmstädter, and Wichelhaus, and its constitution is therefore—



—A. L.

Synthesis of Euxanthone. C. Gräbe. Ber. 22, 1405—1406.

ALL attempts at a synthesis of euxanthone have hitherto failed, only isomeric compounds having been obtained. The author has, however, at last succeeded in preparing this body by the action of anhydrous acetic acid on a mixture of β -resorcylic acid and hydroquinone carbonic acid, and by distillation of the product thus obtained. It is in every respect identical with euxanthone; its acetyl compounds have the same properties, and its constitution is therefore—



—A. L.

Studies on Brazilin. C. Schall and C. Dralle. Ber. 22, 1547—1564.

NITRIC acid produces with brazilin tetramethylether first a blood-red, then a brownish-red, and finally an olive-green colouration. An estimation of the molecular weight by Raoult's method proved that the formula $C_{16}H_{10}O(OMe)_4$ is consistent therewith. By the action of bromine, derivatives are obtained, which do not lose any bromine on treatment with dilute ammonia, and which can be crystallised, whilst others losing bromine under the same treatment, crystallise from acetic acid. The analysis of the latter bodies was carried out in the following manner:—

The material was dried over zinc chloride or calcium hydrate until no further loss of weight was observed. The bromine was estimated by treatment with dilute ammonia. Bromine escaping with acetic acid was absorbed in dilute ammonia.

Method of Decomposition.—The weighed substance was decomposed at 40 to 50° C. by standard ammonia, and the excess titrated back with dilute nitric acid, the body to be

analysed itself serving as indicator. It was dried at 192° C. in a stream of dry hydrogen or carbonic acid, the escaping bromine being again absorbed in ammonia, and after deducting its weight from the total loss of weight, the amount of acetic acid was obtained. Finally the total amount of bromine was estimated and a combustion was made.

A.—Derivatives not yielding up Bromine to dilute Ammonia.

Monobromobrazilin was obtained by Buchka and Erk by the action of bromine on tetracetylbraziln and by removing the acetyl groups afterwards. The authors prepared a monobromo product from the tetramethylether. After converting Buchka and Erk's substance into the tetramethylether, its melting point was observed to be 2°—3° C. lower than the one prepared by the authors. A further examination will decide whether the compounds are isomerides or not.

Dibromobrazilin was prepared by the action of 3 mols. of bromine on 1 mol. of brazilin in glacial acetic acid for several days at the ordinary temperature, until the cherry-red solution turns light brown and tribromobrazilin crystallises out. From the mother-liquors dibromobrazilin is obtained in light red plates, which for further purification were recrystallised from water with addition of sulphurous acid. White plates, melting between 170°—180° C. to a ruby-red mass, were obtained. With anhydrous acetic acid a tetracetyl compound is formed, melting after several recrystallisations at 185° C.

Tribromobrazilin.—3 mols. of bromine dissolved in glacial acetic acid are allowed to act for one hour on 1 mol. of brazilin in glacial acetic acid solution. The mixture is poured into cold water and the orange precipitate recrystallised from dilute alcohol with addition of sulphurous acid. It turns brown at 197°—200° C. without melting. Its tri-acetyl compound melts at 195° C. and its tetracetyl compound at 263° C.

B.—Derivatives losing Bromine on treatment with dilute Ammonia.

Tetrabromobrazilin (tribromobrazilinmonobromide) is obtained by boiling 2 or 3 mols. of bromine with 1 mol. of brazilin in glacial acetic acid solution. The yield is from 14 to 15 per cent. It loses one atom of bromine on treatment with dilute ammonia. The complete analysis leaves it undecided whether $C_{16}H_6Br_4O_3 + 1\frac{1}{2} \text{ aq.}$ or $C_{16}H_8Br_4O_3 + 2 \text{ aq.}$ represents the correct formula.

Hexabromobrazilin (tribromobrazilintribromide).—5 grms. of brazilin dissolved in 100 grms. of glacial acetic acid are filtered through glass wool, and a solution of 25 grms. of bromine in 25 grms. of glacial acetic acid is quickly added. The mixture is boiled for half a minute, and on cooling an abundant crystallisation sets in—large brownish-red crystals—losing bromine at 170°—180° C. The substance crystallised from perchloro-ethylene; water or alcohol decomposed it, hydrobromic acid being formed. Its formula is $C_{16}H_6Br_6O_3 + 2 \text{ aq.}$

Octobromobrazilin (tetrabromobrazilintetrabromide) is obtained like the hexa-compound, only the amount of bromine used is doubled. It loses bromine between 130°—140° C. Formula $C_{20}H_{12}Br_8O_3 + 2 \text{ aq.}$

Nonobromobrazilin (tetrabromobrazilinpentabromide) is obtained like the former compound, if the mixture of bromine and brazilin be boiled for 15 minutes instead of one minute. Formula $C_{16}H_5Br_9O_3 + 2 \text{ aq.}$

It is a remarkable fact that on drying the bodies of this series bromine always escapes as hydrobromic acid and not as free bromine.

Among the oxidation products the authors discovered a resorcinol carbonic acid. The authors further studied the properties of brazilin obtained according to Erdmann and Schulze's method and according to Buchka and Erk's method. They prepared the reduction products, the acetyl derivatives produced by acetyl chloride and anhydrous acetic acid.

The brazilin tetramethyl ether, as also the new trimethyl ether demonstrates, along with the acetyl compounds, the phenolic nature of the four brazilin oxygen atoms. Two monobromobrazilins have been in all probability identified, besides the two dibromo-compounds, and a new tribromobrazilin. All these are colourless substances. *But so soon as bromine is introduced in an unstable position, from which it is readily eliminated again, then derivatives possessing tinctorial powers arise.*—A. L.

PATENTS.

Manufacture of Sulpho-Acids, and Colouring Matters therefrom. F. Wirth, Frankfort-on-the-Maine, Germany. From "The Farbenfabrik vormals Brönnner," Frankfort-on-the-Maine, Germany. Eng. Pat. 3724, August 4, 1882. (Second Edition.) 6d.

WHEN naphthol sulphonic acids or their salts are treated with ammonia at a high temperature they are converted into the corresponding naphthylamine sulphonic acids. If β -naphthol be heated with twice its weight of concentrated sulphuric acid of 66° B. for several hours on a water-bath, it is converted into β -naphthol mono-sulphonic acid. 60 kilos. of the neutral or acid ammonium salt of this acid are heated for 24 hours to 150°—180° C., together with 60 kilos. of water and 12 kilos. of calcium hydrate under pressure. The melt is dissolved in hot water, filtered, diluted with about 500 litres of water and made acid. The β -naphthylamine sulphonic acid at once separates, and can be purified by redissolving in an alkali and precipitating with an acid. The acid is slightly soluble in hot water, and almost insoluble in cold, and separates in glistening flakey crystals. Its barium salt crystallises in needles containing 5 molecules of water. The diazo-compound forms colouring matters with the phenols and their derivatives, giving yellows to brownish reds. The combination with resorcinol yields a golden yellow dyestuff, and α -naphthol or its sulphonic acid yields a blood-red dye. The mono- and disulphonic acids of both naphthols can be converted in a similar manner. According to the patent, another β -naphthylamine sulphonic acid is obtained by heating under pressure, at about 180°, 50 kilos. of ammonium β -naphthol sulphonate, 25 kilos. of calcined sodium carbonate of 98°, together with water. The acid formed is almost insoluble in alcohol, but easily soluble in water, whereas the sodium salt is readily soluble in alcohol. The diazo-compound combined with α -naphthol produces a bluish-red dyestuff.—T. A. L.

The Production of New Azo-Colours. M. Hoffmann and A. Weinberg, Mainkur, Germany. Eng. Pat. 9214, July 31, 1885. (Amended, June 15, 1889.) 4d.

THE diazo-compounds of the sulphonic acids of α - and β -naphthylamine combine with α -naphthylamine to form azo-compounds, and these bodies may be again diazotised and recombined with the naphthols or naphthol sulphonic acids in an alkaline solution. The following is the method employed for working the invention:—35 kilos. of sodium α -naphthylamine disulphonate are dissolved in 300 litres of water and 30 kilos. of hydrochloric acid of 21° B., and diazotised by means of 7 kilos. of sodium nitrite dissolved in water. 18 kilos. of α -naphthylamine hydrochloride dissolved in 500 litres of water are then added under constant stirring. A dark violet precipitate separates, and the whole, after standing 12 hours, is treated with 12 kilos. of hydrochloric acid and 7 kilos. of sodium nitrite. The diazo-azo-compound thus formed is added to a solution of 36 kilos. of sodium β -naphthol- α -disulphonate, which is kept alkaline by the addition of 20 kilos. of ammonia of 25 per cent. The colouring matter which is immediately formed is salted out, filter-pressed and dried. Other α - or β -naphthylamine sulphonic acids may be used in place of the α -naphthylamine disulphonic acid mentioned above, but no claim is made to the use of Piria's naphthionic acid or to other amido-mono-sulphonic acids (*i.e.*, those which are not naphthalene derivatives). Other mono- and disulphonic acids of the naphthols, or the naphthols themselves, may be employed in place of

the β -naphthol- α -disulphonic acid mentioned in the second stage of the process described above. The shades given by the various combinations vary from reddish-violet to dark blue.—T. A. L.

Process for the Production of Mixed Azo-Colours. P. Jensen, London. From the "Actiengesellschaft für Anilinfabrikation," Berlin, Germany. Eng. Pat. 15,296, December 12, 1885. (Second Edition.) 6d.

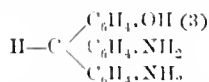
ALREADY described in this Journal, 1886, 595.—T. A. L.

Improvements in the Production of Mixed Azo-Colours. C. A. Martius, Berlin, Germany. Eng. Pat. 2213, February 15, 1886. (Second Edition.) 6d.

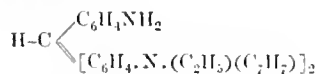
THIS patent is an extension of the preceding one (this Journal 1887, 138), and enumerates a number of amines and phenols together with their sulphonic and carboxylic acids with which tetrazo-diphenyl and tetrazo-ditolyl may be combined, producing mixed azo-colours. Examples are also given relating to the employment of benzylic carboxylic acid and benzidine disulphonic acid, together with their homologues, in the formation of colouring matters.—T. A. L.

Improvements in the Production of Green and Bluish-Green Colouring Matters. O. Imray, London. From the "Farbwerke vormals Meister, Lucius und Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 12,796, September 4, 1888. 8d.

THIS invention describes the production of green and bluish-green colouring matters which are to be considered as derivatives of *m*-hydroxydiamidodiphenylmethane—



The leuco-bases of these colouring matters are produced either by condensing *m*-nitrobenzaldehyde with tertiary aromatic amines (Ber. 12, 802), reducing and converting the amines into the corresponding hydroxy-compounds by the action of nitrous acid, or by condensing directly *m*-hydroxybenzaldehyde with tertiary aromatic amines. Colouring matters are produced from these leuco-bases by suitable oxidising agents, and are then converted into sulphonic acids, or the leuco-bases are sulphonated and the leucosulphonic acids subsequently oxidised. The patent also describes the compounds obtained from the methoxy- and ethoxy-derivatives. It is said that the sulphonic acids of the colouring matters when dyed are specially fast to light and washing. The formation of the oxy-compounds from the amido-compounds is illustrated by the following example: 50 parts by weight of *m*-amidotetraethyldiamidodiphenylmethane are dissolved in 35 parts by weight of hydrochloric acid of 33 per cent., and 5,000 parts by weight of water, the whole cooled to 0° and a solution of 8.9 parts of sodium nitrite of 96.5 per cent. slowly added. The whole is then warmed to 60° C. for some time, and finally boiled until nitrogen is no longer evolved. Soda lye is then added till alkaline, when the *m*-hydroxy-leuco-base is precipitated as a crystalline powder which is filtered off, boiled, and dried. In the case of bodies having less basic properties the method is slightly modified. Thirty-five parts by weight of *m*-amidodibenzylidethyldiamidodiphenylmethane—



are dissolved in 30 parts by weight of concentrated sulphuric acid and 4,000 parts of water, cooled to 0° and diazotised with 4.7 parts of sodium nitrite of 96.6 per cent. dissolved in water, the decomposition of the diazo-compound being carried out as described above. These hydroxy-compounds may also be obtained by direct condensation. Twenty

parts of diethylaniline, eight parts of concentrated sulphuric acid, and nine parts of *m*-hydroxybenzaldehyde are heated in a lead-lined boiler fitted with an agitator to 130° C. for 72 hours, the mass made alkaline with soda lye, the unaltered diethylaniline distilled off with steam, and the hydroxy-leuco-base remaining repeatedly boiled with water and dried. The *m*-hydroxy-leuco-bases prepared according to either of the preceding processes may be oxidised as follows into the corresponding colouring matters. Ten parts of *m*-hydroxytetra-ethyldiamidodiphenylmethane are dissolved in 8.8 parts of hydrochloric acid of 30.8 per cent. and the calculated quantity of manganese or lead peroxide suspended in water is added. The colouring matter is precipitated from the filtered solution by the addition of salt and purified by recrystallisation. The hydrochloride of the base thus obtained forms brilliant needles of the colour of cantharides and dyes wool, silk, and tanned cotton a yellowish-green shade. These bodies may be converted into "acid colouring matters" by heating them with six times their weight of fuming sulphuric acid to 50—60° C. until a test dissolves in dilute ammonia with a blue colour. The products are identical with those obtained by sulphonating the hydroxy-leuco-bases and subsequent oxidation as follows: 30 parts of *m*-hydroxytetraethyldiamidodiphenylmethane are dissolved in 150 parts of fuming sulphuric acid containing 10 per cent. SO₃, and the solution allowed to stand until a sample gives a clear solution with dilute ammonia. In the case of some of the compounds it may be necessary to use a stronger sulphuric acid, and to complete the reaction by heating to 70° C. In either case the product of the reaction is poured into water and converted into the calcium salt. To prepare colouring matters from these; 10 parts of the calcium sulphonate from *m*-hydroxytetra-ethyldiamidodiphenylmethane are dissolved in 300 parts of water and oxidised by adding the calculated amounts of dilute sulphuric acid and lead peroxide filtered, and the blue solution of the colouring matter evaporated to dryness. These colouring matters form copper-red powders of a metallic lustre, dissolving easily in water with a blue colour. Excess of a mineral acid turns the aqueous solution green, but the solution is unaffected even when boiled with ammonia or soda, and turns violet only when boiled with soda lye. They dye wool and silk very even bluish-green tints. Colouring matters belonging to the same series are obtained in a manner similar to the processes described above, either by condensing *m*-methoxy- or ethoxybenzaldehyde with tertiary amines or by methylating or ethylating the hydroxy-leuco-bases or the calcium salts of their sulphonic acids mentioned above, and sulphonating and oxidising the compounds so formed in the manner already described. These ethers are said to give better and bluer tints, and are quite as fast as the now substituted hydroxy-derivatives.—T. A. L.

Production of New Colouring Matters. T. R. Shillito, London. From J. R. Griggy, Basle, Switzerland. Eng. Pat. 13,767, September 24, 1888. 6d.

AZOXY and azo-compounds are formed by heating aromatic nitro-compounds with aromatic amines in presence of caustic alkalis. 10 kilos. of *o*-toluidine are heated with 10 kilos. of caustic alkali, and 10 kilos. of nitrobenzene are gradually added. A reddish-brown paste results and the reaction is complete so soon as the mass no longer smells of nitrobenzene. It is then diluted with water, boiled with zinc dust until decolorised, filtered and poured into concentrated hydrochloric acid, boiled and the diamidophenyltolyl formed is precipitated by adding sodium sulphate. The new *p*-diamine formed closely resembles benzidine and tolidine, and is the next higher homologue of benzidine and the next lower one to tolidine. Its sulphate is sparingly soluble. When diazotised it can be combined with amines and phenols similar to benzidine and the colouring matters thus formed when rendered soluble by sulphonation dye unmoderated cotton yellow and red to violet shades.

—T. A. L.

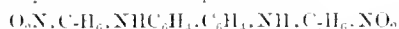
Production of Yellow, Orange, and Brown Colours of Alizarin-like Properties. T. R. Shillito, London. From J. R. Geigy, Basle, Switzerland. Eng. Pat. 13,920, September 27, 1888. 4d.

THESE colouring matters are produced by the action of nitric acid on the bodies obtained by combining diazo-compounds with aromatic hydroxy-acids. 12 kilos. of aniline or a corresponding quantity of toluidine or naphthylamine are dissolved in 36 kilos. of hydrochloric acid and 300 litres of water and diazotised with 9 kilos. of sodium nitrite at 5° C. The solution of the diazo-chloride thus obtained is poured into an alkaline solution of 17 kilos. of salicylic acid or the corresponding quantity of any other oxycarboxylic acid, and the dyestuff precipitated with salt or an acid, filter-pressed and dried. 45 kilos. of the dry compound are dissolved in 135 kilos. of sulphuric acid and a mixture of 20 kilos. of nitric acid and 15 kilos. of sulphuric acid is slowly added. After some time the whole is poured into water, filtered, washed, and brought to the form of a paste.

—T. A. L.

The Production of Dinitrodibenzylbenzidine and Dinitrodibenzyltolidine and Transformation of the same into Diamidodibenzylbenzidine and Diamidodibenzyltolidine respectively. A. Bang, Leeds. From Dahl and Co., Barmen, Germany. Eng. Pat. 3628, March 1, 1889. 6d.

By heating 1 molecule of benzidine with 2 molecules of *p*-nitrobenzylchloride the compound—



is obtained, which on reduction yields the corresponding amido-compound. This by the action of nitrous acid gives tetrazo-compounds, which when combined with amines and phenols or their sulphonic acids yield new colouring matters dyeing cotton yellower shades than those derived from benzidine or tolidine. 18·4 kilos. of benzidine are heated for 3—4 days to 100° C. with 34 kilos. of *p*-nitrobenzylchloride (according to the claim "in water suspension") in an enamelled boiler provided with an agitator and condenser. The dinitrobenzylbenzidine separates as a fine powder, and after filtering off is boiled twice with dilute hydrochloric acid in order to remove unaltered benzidine, after which it is reduced with 35 kilos. of tin and 15 kilos. of hydrochloric acid. The whole is then diluted with water, filtered, and the tin precipitated by means of zinc. The solution containing diamidodibenzylbenzidine and zinc chloride may then be directly diazotised and used for the production of dyestuffs. Diamidodibenzylbenzidine is an amorphous powder scarcely soluble in water but tolerably soluble in alcohol. Its chloride is very easily soluble in water, and the solution is not precipitated by sulphuric acid. Sulphuric acid, however, gives a precipitate when added to an alcoholic solution of the base. The tolidine derivative has similar properties.—T. A. L.

Improvements in the Production of Colouring Matter from Coal-Tar Products. H. D. Kendall, Lowell, Massachusetts, U.S.A. Eng. Pat. 9384, June 6, 1889. 4d.

This invention describes the production of a new fast brown colouring matter called "Essacine," by the action of sodium hydrosulphite on dinitrosoresorcinol or its homologues. 22 lb. of zinc are digested for some time with 17 gallons of sodium bisulphite solution of 35 B., and 1 part by weight of this solution is added to 3 parts by weight of commercial dinitrosoresorcinol containing about 25 per cent. of water. The mixture is constantly agitated when the temperature rises to about 57° C. and the reaction is completed in about one hour. The resulting liquid contains the essacine and may be diluted as desired. Cotton requires to be mordanted, preferably with chromium, the shades produced being, according to the patent, absolutely fast to soap, light, and acids. It can also be dyed together with alizarin and when mixed with Coeruleine, Viridine, &c. to produce different shades, gives colours which are said to be faster than when the Essacine is omitted.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Black Spots on Cellulose. W. Herzberg. Mith. Königl. techn. Versuchs. 1889, 62—64.

A SAMPLE of cellulose prepared by the Ritter-Kellner process was disfigured by numerous black spots varying in size from that of a pin head to that of a medium-sized pea.

The appearance was quite different from that occurring in straw cellulose which has been stored in damp places. Microscopical examination demonstrated the existence of a fungoid growth, twining round the cellulose fibres as ivy does round a tree. The brown colour of its mycelium caused the patches of it to be visible to the naked eye as dark specks. It was thought that the germs had been derived from the river water used in the manufacture, spring water not being available, but it is more likely that they came from the air, finding a good soil on the moist cellulose.

Calcium sulphite was recognised on the spots by Frank's method with iodine solution (*Papier-Zeitung*, 1888, 10), and if this be viewed as the cause of the growth the obvious remedy is to avoid its presence in the finished product; on the other hand the acid juices of the growth itself will tend to liberate sulphurous acid from the calcium sulphite and arrest its development. Thorough drying is an effective preventative, and where this is impracticable zinc chloride in the proportion of 1 litre at 40° B. to 100 litres of water proves a reliable antiseptic, 40 kilos. of such a solution sufficing for 100,000 kilos. of cellulose. So small a quantity interferes with neither the sizing nor the colouring processes.

The author recapitulates a few facts bearing on this subject that have appeared from time to time in the "*Papier-Zeitung*."

It was observed that a paper made from pure rags and highly sized with rosin developed a fungoid growth when kept in a warm damp place; there is no direct evidence to show whether the germs are derived from the water or air. Adequate nutriment for the mould is supplied by size of animal origin, and even when rosin is used the accompanying starch may prove sufficient.—B. B.

PATENTS.

Improvements in the Treatment of Flax and other Fibrous Plants for obtaining the Fibre therefrom for Spinning and other Manufacturing Purposes. L. Dekien, Courtrai, Belgium. Eng. Pat. 11,397, August 7, 1888. 6d.

By this invention the costly and troublesome process of retting is entirely done away with and the flax as cut is taken direct from the field to the scutching machine.

—E. J. B.

An Improved Method or Process of Freeing Rhea and other Vegetable Fibres from Cementitious Matter, and Apparatus therefor. G. F. Redfern, London. From E. F. Spence, Rotterdam, Holland. Eng. Pat. 11,973, August 18, 1888. 8d.

THE fibre to be treated is made into a coarse tissue with strong yarn, the latter forming the warp and the former the woof. Two boilers are then filled with this tissue. The boilers are connected together with suitable pipes, so that the liquid used for treating the fibre may be transferred from one to the other at will. In its passage from one boiler to another the liquid passes through a filter-press. A great saving in chemicals is claimed.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

The Substantive Cotton-Dyes. E. Noelting. Chem. Zeit. 13, 777—778.

ROSENSTIEHL and Noelting have recently discovered that dimeta-amido-derivatives of azoxy-compounds, such as azoxyaniline (dimeta-amidoaz-oxylbenzene), the two azoxytoluidines, and az-oxymetaxylidine, are bases from which a new class of substantive cotton-dyes may be obtained. The most important of these new dyes is one known as St. Denis red, which is produced by acting with α -naphthol- α -sulphonic acid on diazotised *o*-toluidine. It is distinguished by its fastness and perfect resistance to acids. It is not fixed on the fibre from an alkaline bath so easily as benzopurpurin and Congo-red, but full shades can be produced by modifying the ordinary conditions of dyeing. Rosenstiehl gives the following method of dyeing 10 kilos. of cotton, either yarn or cloth: 200 grms. of St. Denis red are dissolved, by the aid of heat, in 6 litres of caustic soda of 7° B, this solution being poured into a warm bath containing 200 litres of water, 48 kilos. of common salt, and 5 litres of caustic soda of 40° B. The bath is heated to 85°, the cotton entered, the heat raised to 90°—95° and kept at this temperature for half-an-hour. At the end of this time the goods are taken out, squeezed or wrung, and passed for 5—10 minutes into a 1 per cent. solution of sulphuric or hydrochloric acid, then well rinsed and dried. The dye-bath is not exhausted and should be preserved, being made up for use again by the addition of 165 grms. of dyestuff, dissolved in 5·7 litres of caustic soda of 7° B, and 0·5 litre of caustic soda of 40° B. for each 10 kilos. of cotton. A very deep red is obtained by taking, for the same weight of cotton, 300 grms. of dyestuff and 9 litres of caustic soda of 7° B. for the first bath, and 250 grms. of dyestuff with 8½ litres of caustic soda for subsequent baths. The dye-bath should be heated with closed steam and the volume of water evaporated must be replaced. Excellent results are obtained by strictly following the directions.

H. Koechlin recommends, more particularly for piece dyeing, a method based on the fact that the alumina-zinc-magnesia lake of St. Denis red is exceedingly bright and fast to soap. The cloth is mordanted by a passage through a solution containing, per litre of water, either 0·5 litre of acetate of magnesia of 30° B. and 0·5 litre of acetate of alumina, or 150 grms. of sulphate of magnesia and 50 grms. of alum. It is then dried and passed for two minutes into a bath, consisting of 50 grms. of sulphate of zinc and 100 cc. of caustic soda of 38° B. per litre of water, after which the pieces are rinsed and dyed per metre of cloth with 2—3 grms. of dyestuff dissolved in 2½ litres of water along with 400—500 grms. of common salt and 5 grms. of lime, the temperature of the bath being raised to 80° in the course of an hour, maintained at this temperature half an hour, and the cloth then rinsed and dried.

C. Schoen communicates a simpler and quicker method: 35 grms. of dyestuff are dissolved in each litre of water, with the addition of 20 grms. of aluminat of soda of 15° B. and 5 grms. of caustic soda of 38° B. To each litre of this solution there may further be added 100 cc. of a solution prepared by dissolving 100 grms. of sulphate of magnesia per litre of water and adding 200 grms. of caustic soda of 38° B. The pieces are padded with this solution, left rolled up for an hour, then passed through a bath of 50 grms. of alum per litre of water, rolled up again for two hours, and finally washed and dried. Ammonium chloride or sodium bisulphite may be used instead of alum in the fixing-bath.

Discharge effects may be obtained on the new red by means of stannous salts as with benzopurpurin, &c.—E. B.

Dyeing with Resorcinol Green and Cobalt Nitrate.

E. Kopp. Bull. Soc. Ind. de Rouen, 1889, 17, 139.

THE material is printed with a mixture of cobalt nitrate and sodium acetate in the usual manner, passed through a bath of sodium aluminate or sodium silicate, and then dyed with

resorcinol green (dinitrosoresorcinol), calcium chloride being subsequently added to the bath. Sodium aluminate gives better results than silicate. Dinitrosoresorcinol combines so readily with cobalt oxide that the brown colour, due to the union of these two substances, is produced almost instantaneously.—E. E. B.

PATENTS.

An Improved Process or Method of Dyeing or Painting on Fabrics and other Materials, and Apparatus employed therefor. C. and H. Dratz, Brussels, Belgium. Eng. Pat. 9044, June 20, 1888. 11d.

THE materials, consisting of textile materials spun, woven, or in fibre, wood, leather, paper, &c., are impregnated with mordants or colours in the form of a spray. Patterns in several colours may be obtained by protecting portions of the material by means of stencil plates or open-work patterns. The mechanical arrangements are described with the aid of drawings.—E. B.

Improvements in Bleaching, Dyeing, &c. J. C. Mewburn. From La Société Leblois, Piceni, et Cie., Paris, France. Eng. Pat. 11,452, August 8, 1888. 8d.

THIS invention has reference to Eng. Pat. 11,637 of 1885 (this Journal, 1886, 533). For bleaching or dyeing without deteriorating or felting the materials, two vessels are employed, one being a vessel which can be hermetically sealed, and in which a vacuum can be produced, the other a vessel in which a wheel revolves. In the vacuum chamber, which is preferably employed for steeping operations, there are placed at the top and bottom perforated pipes for the inlet and discharge of air and liquids, also a rack mounted on wheels, and divided into compartments for the reception of small portable boxes made of perforated sheet metal or formed of hollow rods with jointed sides, which serve to hold the materials to be operated upon. When working, a vacuum is created in the vessel by the upper pipes, and the steeping liquor, which has been prepared in an adjoining vessel, is drawn into the vessel by the pipes at the bottom until the boxes are entirely submerged. The formation of a vacuum is repeated several times, alternating with admissions of air through the lower pipes, which produce an agitation of the bath. The steeping-bath is then emptied, the vessel opened, and the boxes transferred to the compartments of the revolving wheel for the final operations of bleaching or dyeing. The wheel having been charged, the bleaching or dyeing is effected by turning the wheel alternately to the right and left whilst submerged in the bath. The steeping is best done at a temperature of 50 to 30° C. for materials which have to be bleached, and 10° to 80° C. for materials which have to be dyed. In steeping for bleaching, either water alone is used or an alkaline solution, or preferably a solution containing three-tenths per cent. of neutral hypochlorite of soda, made by double decomposition between caustic soda and bleaching powder solution, and known as "chlorogene." The steeping-bath preceding the dyeing may be formed of water or alkaline solution, but preferably contains a little dye, which can serve as a ground for the shade to be afterwards obtained. For certain dyes the preparatory steeping of vegetable fibres may be omitted.

Materials composed of animal fibres, which have already been scoured, are placed in the wheel and bleached or dyed at once, instead of undergoing a preliminary steeping.

—E. B.

Improvements in Dyeing Aniline Black. E. and G. E. Sutcliffe, Halifax. Eng. Pat. 11,806, August 16, 1888. 6d.

IN the dyeing of aniline black there is a formation of precipitate in the bath, not only representing a loss of material, but in the process of dyeing wherein the liquors are caused to circulate, interfering with the dyeing by preventing the flow of liquor. In the method given below, the whole of the dye-liquor employed is absorbed, and relatively less acid and oxidising agent require to be used.

The goods are saturated with a liquor composed of materials in the following proportion :—

- 120 gallons of a 5 per cent. solution of aniline hydrochloride,
- 20 gallons of a 5 per cent. solution of potassium chlorate,
- 15 gallons of a 6 per cent. solution of ferrous sulphate,
- 4 gallons of commercial hydrochloric acid.

The saturated goods are allowed to rest in a warm room or suitable ageing place for about 24 hours, and then treated according to the stage of development of the black. If the goods at the end of this time are of a green colour they are treated with an oxidising agent, such as bichromate of potassium; if, however, the black has completely developed, they are simply rinsed. Other oxidising agents may be used, such as potassium or sodium bichromate, alkaline chlorates or hypochlorites, bleaching liquor, or any agent ordinarily used for, or which will produce, the desired effect.
—E. B.

Improvements in Apparatus for Dyeing, Scouring, &c. W. Brown, Selkirk. Eng. Pat. 12,485, August 30, 1888. 6d.

A VESSEL, serving for the reception of the material to be operated upon, is fitted inside a double-jacketed vessel of similar shape. The inner shell is perforated at the bottom and round the sides near the top. When the apparatus is filled with water, &c. the application of heat causes the liquor to flow through the upper perforations and out at the bottom of the inner shell. In this way the felting of the fibres is avoided. Dyewoods, from which the colouring matter has to be extracted, are, by preference, placed below the inner shell. A drawing is given.—E. B.

Improvement in Blueing Preparations for Laundry and Similar Purposes. H. E. Hounsell, London. From G. A. Conant, Acton, Mass., U.S.A. Eng. Pat. 12,670, September 3, 1888. 6d.

SHEETS of Manila paper are dipped into a filtered solution of Prussian blue in oxalic acid and dried. Sugar is added to the solution to cause the blue to adhere to the dried paper.—E. B.

An Improved Blue for Laundry Purposes in the Form of Crystals. G. R. B. Kempton, West Ham. Eng. Pat. 5380, March 29, 1889. 4d.

A BLUE aniline or other dye is dissolved in water, and potash alum and common salt mixed with the solution, which is then concentrated and set aside for crystallisation. Blue crystals are thus obtained. It is claimed, as an improvement, for this preparation, that it has an attraction for all fibres, inasmuch as the potash alum acts as a mordant for the same; goods are more readily blueed, and an even colour is produced, as the crystals are perfectly soluble.—E. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Boracite from Douglasshall. C. Oehsenius. *Nen. Jahrb. f. Mineralogie*, 1889, 1, 271.

CRYSTALS of boracite and iron boracite have been obtained from carnallite at Douglasshall. The more recent layers of carnallite are richer than the older, but the yield is very variable. Pseudomorphs of boracite have been found there, and also in blondeite, a mineral similar to glaserite in composition.—E. E. B.

Discoveries at the Saline Deposits at Douglasshall. C. Oehsenius. *Nen. Jahrb. f. Mineralogie*, 1889, 1, 272.

A. NAUFERT has found the following minerals in carnallite at Douglasshall:—Crystallised iron-boracite, pyrites, red rock crystal, dark specular iron ore, Löwigite (?) sulphur, Bischofite, and tachyhydrite.

The so-called "Hartsalze" have also been found associated both with carnallite and kieserite, containing 46 to 58 per cent. magnesium sulphate and about 23 per cent. potassium chloride.

In the kainite is found blædite, krugite (associated with polyhalite), Reichardite, and blue rock salt.

Another interesting find is a crystallised sulphate of sodium and potassium (glaserite?), which occurs with astrakanite, and contains 59 to 66 per cent. potassium sulphate and 18 to 22 per cent. sodium sulphate.—E. E. B.

Action of Magnesium Chloride on Lead Oxide. A. Voigt. *Chem. Zeit.* 13, 695.

ANDRÉ has previously described the formation of oxychloride of lead by the action of chlorides of calcium, strontium, and barium on lead plaster, but considered that magnesium chloride had no action. The author, however, finds that upon boiling lead plaster with a concentrated solution of magnesium chloride, filtering, and adding cold water to the filtrate, a precipitate is obtained, which when dried at 100° C. has the formula $3\text{PbO} \cdot \text{PbCl}_2 \cdot \text{H}_2\text{O}$. Lead carbonate is also soluble in magnesium sodium, though not to the same extent as lead oxide.—E. E. B.

The Removal of Arsenic from Chamber-Acid. Le Roy W. McCay. *Chem. Zeit.* 13, 725—726.

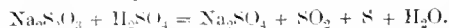
THE author proposes to remove arsenic from chamber-acid by treating the acid with hydrogen sulphide, whilst it is contained in air-tight leaden cylinders, which are heated by a steam-coil or jacket. The cylinders should also be provided with stirring-gear, to cause the precipitated arsenic pentasulphide to collect together and settle.—E. B.

The Action of Acids, especially of Sulphuric and Hydrochloric Acids, upon Sodium Thiosulphate. W. Vaubel. *Ber.* 22, 1686—1694.

It is generally assumed that sodium thiosulphate is decomposed by acids with the liberation of sulphur dioxide, the separation of sulphur and the formation of water and of the sodium salt of the acid employed. This is the case with the following acids: formic, acetic, succinic, citric, hydrochloric, hydrobromic, hydriodic, hydrofluoric, nitric, sulphurous, dithionic, dilute sulphuric, and dilute phosphoric. Other acids, however, give rise to the formation of sulphuretted hydrogen. Of these, concentrated sulphuric acid produces the largest proportion of sulphuretted hydrogen, and the quantity increases with the strength of the acid. Aqueous hydrocyanic acid gives, when heated with the solid thiosulphate, a considerable evolution of sulphuretted hydrogen; butyric, oxalic, and tartaric acids cause a slight production of sulphuretted hydrogen, as do hydrofluosilic acid and carbon dioxide. In most of these cases the application of heat favours the formation of the hydrogen sulphide. The author has specially examined the action of sulphuric and of hydrochloric acids.

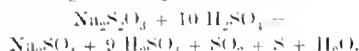
1.—*Decomposition of Sodium Thiosulphate by Sulphuric Acid.*

The decomposition as represented by the following equation is not complete :—



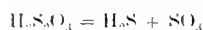
The degree of decomposition varies with the strength of the acid, and in order to obtain concordant results when employing acids of the same strength it is necessary to use 8—10 times as much acid as is required according to the equation. In carrying out the experiments, 10 grms. of the solid thiosulphate were decomposed by the acid in a suitable flask. The decomposition, which was conducted in the cold, was allowed to extend over two hours, when the sulphur dioxide (together with the sulphuretted hydrogen) was determined by absorption with water and titration with iodine. The separated sulphur was collected and weighed, and the total amount of sulphuric acid remaining at the end of the experiment determined volumetrically. The

following table contains the results of the experiments, the percentages being taken on the quantities which should have resulted according to the equation—



Per Cent. of H_2SO_4 in Acid employed.	SO_2 obtained.	S obtained.	Free H_2SO_4 .
	Per Cent.	Per Cent.	Per Cent.
20	73.9	100.11	98.17
30	82.6	92.21	98.87
40	..	96.71	105.97
50	85.7	101.34	136.01
60	85.3	102.99	197.15
70	84.8	109.60	110.50
80	85.2	95.86	109.60
90	92.0	99.40	109.20
100	45.4	9.15	119.69

In the two last cases sulphuretted hydrogen was formed, which was determined with the sulphur dioxide. In no case does the quantity of sulphur dioxide reach the required amount, whilst that of sulphur exceeds the 100 in four cases, and a steady rise in the percentage of sulphuric acid occurs as the strength of the acid employed in the decomposition increases. It is concluded from this that the thiosulphuric acid at the moment of its liberation decomposes thus :—



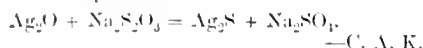
and then that these products mutually react as follows :—



11.—Decomposition of Sodium Thiosulphate by Hydrochloric Acid.

The decomposition in this case supports the above idea as to the decomposition products of thiosulphuric acid. Using 10 times the theoretical amount of 20 per cent. hydrochloric acid under similar conditions to those described above, the quantity of sulphur dioxide was always found to be less, that of sulphur more than should be formed according to theory, and further the production of sulphuric acid was observed in every case.

The action of silver oxide on sodium thiosulphate also confirms the author's view as to the decomposition of thiosulphuric acid. Geuther (Ann. Chem. Pharm. 1884, 226, 232) has shown that silver sulphide and sodium sulphate result, and this decomposition is shown to be a complete one, the total sulphur being in the form of sulphide and sulphate, whilst no sulphurous acid is formed. The following equation represents this decomposition :—



—C. A. K.

Sulphites and Thiosulphates. A. Schwicker. Ber. 22, 1728—1737.

A SERIES of experiments are described with the view of proving the asymmetric nature of the sulphites and thiosulphates of the alkali metals.

Regarding sulphurous acid as H_2SO_2 , OH two isomeric sodium potassium sulphites $\text{K} \cdot \text{SO}_2 \cdot \text{ONa}$, and $\text{Na} \cdot \text{SO}_2 \cdot \text{OK}$ are possible. By the addition of the requisite quantity of sodium carbonate to a concentrated solution of acid potassium sulphite hard yellowish crystals of the double salt containing two molecules of water of crystallisation result, No. I. Potassium carbonate and acid sodium sulphite give indistinct crystals also of a yellowish colour which contain one molecule of water of crystallisation, No. II.

Heated with ethyl iodide in a sealed tube to 140° , the former gives the double salt $4 \text{C}_2\text{H}_5 \cdot \text{SO}_2 \cdot \text{OK} + \text{NaI}$, the latter $4 \text{C}_2\text{H}_5 \cdot \text{SO}_2 \cdot \text{ONa} + \text{KI}$.

The analytical data agree fairly well with the above composition of these double salts, and it is suggested by the author that in both cases the metal attached to the sulphur has been replaced by the alkyl group according to the equations—



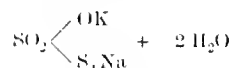
Sodium potassium sulphites corresponding to the above have also been prepared by Röhrig (J. Prakt. Chem. 37, 250; this Journal, 1888, 322).

Neither acid sodium nor potassium sulphite yield double salts with the corresponding normal sulphites. Either of the above sodium potassium sulphites give a double salt with acid sodium sulphite having the composition $\text{HKNa}_2(\text{SO}_3)_2 + 4 \text{H}_2\text{O}$. This salt is also obtained by treating acid sodium sulphite with potassium carbonate, or by evaporating a mixture of the acid sodium and potassium sulphites, or finally by passing sulphur dioxide into a solution of either of the sodium potassium sulphites. In all these cases the products appear to be identical.

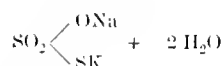
The double salt is stable, and only evolves sulphur dioxide on long standing; it is readily soluble in water, and the concentrated solution combines with acetone, pointing to the presence of an acid sulphite. The double salts $\text{HNaK}_2(\text{SO}_3)_2 + 3 \text{H}_2\text{O}$, and $\text{H(NH}_4\text{)Na}_2(\text{SO}_3)_2 + 4 \text{H}_2\text{O}$ are also described; they resemble the above in properties, and the latter is obtained by passing ammonia gas into a concentrated solution of acid sodium sulphite.

The sodium potassium sulphites can be converted into the corresponding thiosulphates by treatment with a freshly prepared concentrated solution of ammonium pentasulphide, and then boiling off the excess of ammonia. Salt No. I. yields tabular crystals, having the formula $\text{NaKS}_2\text{O}_3 + 2 \text{H}_2\text{O}$; these are readily soluble in water, melt at 57°C ., and have a specific gravity of 1.970 at 15° . Salt No. II. yields a similar thiosulphate also containing two molecules of water of crystallisation, but they melt at 62° , and have a specific gravity of 1.930 at 15° . When heated with ethyl bromide for some hours the former is converted into potassium ethyl thiosulphate, the latter into sodium ethyl thiosulphate, both crystalline compounds; the sodium and the potassium have been respectively replaced by the ethyl group, and since the ethyl group would in all probability attach itself to the sulphur atom united directly to the metal, the constitutional formulae for the two thiosulphates would be—

No. I.



No. II.



Both these thiosulphates treated with iodine are converted into potassium tetrathionate; salt No. II. should give sodium tetrathionate, but potassium iodide is formed in the reaction which decomposes the sodium tetrathionate with formation of the potassium salt as was proved by direct experiment. For a similar reason both the thiosulphates yield a potassium silver thiosulphate having the formula $\text{KAgS}_2\text{O}_3 + \text{NH}_3$ when treated with an ammoniacal solution of silver nitrate. This compound loses its ammonia at 100° , and leaves a brown powder; the aqueous solution readily decomposes with separation of silver sulphide. Sodium silver thiosulphate ($\text{NaAgS}_2\text{O}_3 + \text{H}_2\text{O}$) previously obtained by Lenz (Ann. Chem. Pharm. 40, 91) is also described.

The author draws the conclusions that the above facts point to the asymmetric constitution of the sulphites and thiosulphates.—C. A. K.

Nitrous Vitriol, and its Purification for the Manufacture of Aerated Waters. Pharm. Conference, Newcastle-on-Tyne. Pharm. J. 1889, 204.

At the *Pharmaceutical Conference* just recently held at Newcastle-on-Tyne, J. Pattinson read a paper upon the above subject. He had observed that when nitrous vitriol is employed to generate carbonic acid for charging ginger ale, the beverage obtained was more or less turbid. J. Pattinson found that the amount of nitrous compounds required to cause this turbidity was almost infinitesimal, 0.026 per cent. of N_2O , in the objectionable vitriol being sufficient to give rise to turbidity, whilst with the pure article a perfectly clear ginger ale resulted. Naylor pointed out that the pungency of the ginger essence, as well as that of the capsicin, were destroyed by the nitrous compound. T. H. Williams had also experienced the same troubles, but he added that, though ginger essence lost pungency and flavour, he had observed a similar effect on all kinds of aerated waters, and he found it was due to the nitrous fumes carried over in the carbonic acid gas. He had remedied this defect by passing the carbonic acid gas through a scrubber down which an alkaline solution of permanganate of potassium was allowed to trickle. The effect was all that could be desired. Pattinson proposed as a remedy to heat the vitriol with a little ammonium sulphate, which entirely destroys nitrous compounds. The presence or absence of these compounds can then be ascertained by adding a drop or two of permanganate to 20 cc. of the oil of vitriol, to which water is then added. If free from nitrous compounds, the pink colour is retained. The diphenylamine reaction might also be applied, and is still more delicate.—W. S.

PATENTS.

Improvements in obtaining Chlorine from Hydrochloric Acid or Chlorides, and in Regenerating Peroxide of Manganese which is used in the Process. A. Campbell, London, and W. Boyd, Glasgow. Eng. Pat. 10,187, July 13, 1888. 61.

MANGANESE chloride (obtained by acting upon manganese peroxide with hydrochloric acid for the production of chlorine) is heated with sulphuric acid and a further quantity of manganese peroxide. The whole, or nearly the whole, of the chlorine is obtained in the free state, sulphate of manganese being formed at the same time. This latter is dissolved in water and treated with carbonate of ammonia. The precipitated carbonate of manganese is separated, and converted into peroxide by any suitable means; the sulphate of ammonia is recovered by concentration and fishing in the usual way. Three modifications of the process are described.—A. R. D.

Improvements in the Manufacture of Permanganates and Chlorates. G. H. Bolton, J. R. Wyde, and H. Auer, Widnes. Eng. Pat. 10,193, July 13, 1888. 6d.

A SOLUTION of mangenate of soda which has been treated with chlorine, as described in Eng. Pat. 8217 of 1887 (this Journal, 1888, 437), and which contains sodium chloride and chlorate, as well as permanganate, is evaporated to about 90° Tw. During this process about two-thirds of the chloride present separates out and is removed by fishing. Potassium chloride is now added, in quantity rather less than sufficient to convert all the sodium permanganate into the potassium salt, and the solution, standing at about 80° Tw., is allowed to cool. The bulk of the permanganate crystallises out, and a second crop of crystals may be obtained by a further concentration to 130° with occasional removal of sodium chloride by fishing. The strong mother-liquor is freed from the remaining small quantity of manganese in solution by treatment with sulphuretted hydrogen or a soluble sulphide, after which it contains only the chlorate and chloride of sodium in about equivalent proportions. Further concentration to 100°—120° Tw., and fishing, removes a portion of the sodium chloride; the settled

liquor deposits on cooling chlorate of soda of great purity. If chlorate of potash be required, the necessary amount of potassium chloride should be previously added.—A. R. D.

Improvements in the Treatment of Sulphuretted Hydrogen to obtain Sulphur, and in Apparatus employed therein. J. Hargreaves, Ditton. Eng. Pat. 10,322, July 17, 1888. 6d.

SULPHURETTED HYDROGEN is intimately mixed with a volume of air just sufficient for the combustion of its hydrogen, and then caused to pass through a number of perforated blocks preferably built up of spiral-shaped pieces of earthenware or metal similar to those employed in the regenerator of the Hargreaves thermo-motor. These blocks are preferably placed one behind the other in a closed chamber, the intervening spaces being occupied by gauze-like material, to prevent the return of the flame. This end is better attained by making one of the blocks of metal, and keeping it cool by circulation of water. After passing the blocks the gaseous mixture is injected at a tangent into a tubular-shaped combustion chamber, made so long as to avoid sudden cooling before complete decomposition of the sulphuretted hydrogen. In order to recover as free sulphur any sulphur oxidised during the decomposition, the residual gases are passed through the solution of some suitable chloride, or they are scrubbed in any ordinary method for the recovery of the sulphur acids, and these, when concentrated, are injected into the hot end of the combustion chamber.—A. R. D.

Improvements in the Manufacture of Nitrate of Ammonia. C. N. Hake, London. Eng. Pat. 11,731, August 14, 1888. 4d.

It is proposed to produce solid nitrate of ammonium by bringing together nitric acid vapour and ammonia gas in a suitable mixing chamber, or by spraying liquid nitric acid into a chamber into which a current of ammonia gas is caused to flow. In the first case the nitrate is obtained as a fine powder; in the second as a supersaturated solution, solidifying on cooling. Care must be taken that the heat of combination be not allowed to raise the temperature in the mixing chamber above 120° C.—A. R. D.

Improvements in the Manufacture of Chloride of Aluminium with other Chlorides. W. White, Cheshunt. Eng. Pat. 12,543, August 31, 1888. 4d.

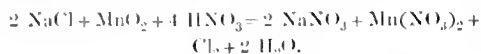
SODA or potash alum is dried, powdered, and intimately mixed with enough sodium or potassium chloride to convert the aluminium of the alum into aluminium chloride and to form with the same a double chloride. When the mixture is fused at a red heat the double chloride sublimes, leaving potassium or sodium sulphate behind in the retort or crucible.—A. R. D.

Improvements in the Manufacture of Soda Alum. E. Augé, Montpellier, France. Eng. Pat. 6443, April 15, 1889. 4d.

SOLUTIONS of sulphate of soda and sulphate of alumina when mixed together in the proper proportions cannot well be evaporated in the ordinary way to the density necessary for crystallisation without employing a temperature of at least 70°—80° C., and the soda alum solution when heated to this degree is rendered incapable of crystallising. The inventor obviates this difficulty by conducting the evaporation under reduced pressure, and obtains the required specific gravity (1.38 to 1.46) at a temperature of about 45° C.—in no case exceeding 60° C.—A. R. D.

Improvements in the Process of Manufacturing Caustic Soda or Caustic Potash. W. P. Thompson, Liverpool. From J. A. Bradburn, Syracuse, U.S.A. Eng. Pat. 6710, April 20, 1889. 4d.

To two molecules of sodium chloride are added four of nitric acid and one of peroxide of manganese. The mixture is heated by steam in a stoneware retort, the following reaction taking place:—



The chlorine thus produced is used in the ordinary way for making bleaching powder. The manganese in the residual liquors is precipitated with caustic soda, and then oxidised by a current of air, which renders it again available for use in the first stage of the process. The nitrate of soda left in solution is recovered by evaporation, mixed with ferric oxide, and heated in a current of air. The mixture of nitrous gases is passed over some oxidising manganese compound and treated for the recovery of the nitric acid. The mass remaining in the furnace yields on lixiviation a solution of caustic soda. The remaining ferric oxide can be used over again. Instead of manganese peroxide a manganate or permanganate may be used in the first operation. The process is equally applicable for the production of caustic potash.—A. R. D.

A New or Improved Process for making Metallic Sulphates in Solution. H. E. Newton, London. From L. O'Brien, Sydney, New South Wales. Eng. Pat. 8045, May 14, 1889. 4d.

The ores or minerals to be dissolved are placed in water in a vat provided at the bottom with a chamber into which are pumped under pressure sulphurous acid and steam. The mingled gases escape from this chamber by slits in its sides, and bubbling up through the contents of the vat, effect the "sulphating" of the ore therein. The boiling temperature requisite for speedy solution is maintained by the steam with which the sulphurous acid gas is mixed. In certain cases the action may be accelerated by the help of an oxidising agent such as nitrous acid or oxide of manganese.—A. R. D.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

The Solubility of Glass Bottles. R. Reynolds. Pharm. Conference, Newcastle-on-Tyne.

REUTER (*Pharm. J.*, Aug. 31, 1889) showed that chloral hydrate (cryst.) which had been kept some time in a blue glass bottle, acquired a blue tint, the colour being proved to be due to pigment derived from the glass of the bottle. Glass is known to be affected by alkaline solutions, and the glass windows of stables even become gradually attacked by the ammoniacal emanations from decomposed and decomposing urine. It was also pointed out that glass that has lain in mud becomes disintegrated, and hydrocyanic acid kept in white flint glass bottles becomes decomposed, owing apparently to the action of the glass. As a matter of personal experience, Reynolds mentioned that a solution of 1 in 10,000 of hydrochloric acid in water, which when freshly made gave a distinct reaction with congo-paper, failed to do so after being kept a day in a flint glass bottle. This result he was inclined to refer to the chemical interference of the bottle with its contents. The observation was confirmed in a similar one by Thresh, who, in testing the action of acid fumes in the

smoke of a neighbourhood on vegetation, found that whilst the rain collected directly on litmus papers was acid, that collected first in glass bottles showed either a neutral or an alkaline reaction. He tried all kinds of bottles, with a similar result. Some of the rain water was then collected in platinum dishes, and the water collected in bottles gave him 5 grains per gallon more solid residue than that collected directly in platinum. This residue was chiefly silica, pointing to the fact that a decomposition of the silicates of soda or lime, or both, had probably taken place.

Linford stated that hydrochloric acid acted very considerably on bottles, but sulphuric acid did not. The action of hydrochloric acid, however, soon ceased, and the bottle was no longer acted upon. Martindale had observed that *osmic acid* very much affects white glass bottles. The English-made bottles were chiefly affected. Nearly all foreign glass bottles stood the action of the acid exceedingly well. Where the grinding of the stopper occurred the action was only slightly noticeable. This result was considered to be due to the fact that English bottle glass contains more lead than the foreign glass. Bottles made of glass containing no lead would be found to stand the osmic acid very well. Weddell confirmed the statement that English bottle glass contains a considerable percentage of lead, whilst the French and German glasses are free from that metal.—W. S.

Mexican Pottery Glaze.

IN the current number of *Harper's Monthly Magazine* is an interesting announcement of a discovery of a band of Mexican Indians who manufacture a pottery glaze, which, in an introduction to the article, the expert in potteries, W. C. Prime, compares to the wondrous old glazes of Gubbio and the Florentine potters. "The fact stands," he says, "that to-day in San Felipe unskilled Indians are producing and selling for daily use in Mexico wares decorated with a lustre incomparably finer than any metallic lustre produced in Europe, and which, if potters can by experiment learn so to use it that different colours can be produced as desired, will practically restore to modern uses the lost Saracen and Italian lustres."

As much of the secret as the San Felipe Indians possessed is out, for at some risk Miss Y. H. Addis has penetrated to where the pottery was made, and has secured the entire process of firing, &c., adopted by the makers of these beautiful wares. She thus describes it: "The vessels once moulded, are fired, and when thoroughly cold are glazed with a mixture of (1) oxide of lead; (2) broken glass, which they buy from the refuse of shops; (3) 'peacock copper'; and (4) a very fine sand found near San Felipe. It was impossible to obtain even an approximately accurate idea of the proportions employed, because the potters have so long worked by the rule of thumb that they are really incapable of describing the quantities. Therefore, this point would have to be determined by examination during their practical working. After application of the glaze comes a second firing—the one in progress at the time of the visit. The ware emerged from the kiln at this stage dull and clouded, of a thick muddy brown or greenish colour. As rapidly as possible the potter buried the pieces in a great heap of stable manure, and after from one to hours they were disinterred, transformed by the ammoniacal fumes to a lustrous brilliance, with the shifting, varying hues that gleam on the breast of a peacock. The secret, if secret there be, seems to lie in two of the elements of the glaze, in combination with the ammonia treatment, for I am sceptical as to the potter's assertion that the effect is due to peculiar properties in the clay of San Felipe."—*Engineering and Mining Journal*.

PATENT.

Improvements in the Manufacture of Red Glass. H. J. Haddon, London. From the Josephine Glass Works of Count Schaffgotsch, Schreiberhan, Germany. Eng. Pat. 11,016, July 30, 1888. 6d.

The following mixture is prepared and melted in an open pot:—

	Parts.
Pine sand	2,000
Minium	400
Potashes	600
Lime	100
Phosphate of lime	20
Tartar (bitartrate of potash)	20
Borax	20
Red oxide of copper	9
Binoxide of tin (putty powder)	13

This gives at one melting a homogeneous glass of a transparent red colour, from which articles may be made direct without flashing, and without the necessity for a second heating to bring out the colour.—A. R. D.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Natural Cements. A. Cluss. Eng. and Min. J. 47, 516.

LIMESTONE, with intimate fine-grained admixtures of silica, alumina, magnesia, &c., in quantities of 35 to 60 per cent., are called cement stones. The high percentage of silicates causes a separation of the alumina from the silica during calcination at a red heat just sufficient to expel the carbonic acid. Oxides of iron and chloride of potash are generally present in small quantities. The burned lumps must be pulverised before they will combine with water, when they form hydrated silicate of lime, while the alumina remains practically inert. These cements set quickly, but harden slowly under water without shrinking, and attain gradually great strength, with well developed adhesive force. They bear doses of sand of double their own volume or over. From 30 to 40 per cent. of water must be added. Many American cements of this class contain large percentages of carbonate of magnesia. The tests of strength, in pure state as well as mixed with sand, compare well with the cements which do not contain these combinations. De Smeth found for Virginia cements in the pure state, after 30 days' exposure, 170—250 pounds tensile strength per square inch, which increases in 11 months to 316—381 pounds. Gilmore states the adhesion of Rosendale cement to the front bricks, after 28 days, when pure, to be 30 pounds, and mixed with one and two parts of sand, 16 and 12 pounds.

Clarke reports the tensile strength of Rosendale cements, pure:—

	Pounds.
After 1 and 12 months, as.....	115 to 290
And mixed 1:1 after 1 and 12 months.....	116 to 256
1:2 after 1 and 12 months.....	50 to 180
1:3 after 1 and 12 months.....	35 to 121
One cubic foot of Rosendale cement weighs.....	49 to 50

The proportion of tensile to compressive strength averages probably after one month 1:4, and rises probably, after two years, to about 1:6.—A. J. S.

Proceedings of the Austrian Society of Chemical Industry. Meeting of June 1, 1889. Chem. Zeit. 13, 781.

K. ZULKOWSKI criticised the work of Knapp on blast-furnace slag and Portland cement, in which the latter referred to the similar behaviour of the two materials when treated with dilute hydrochloric acid, ammonium chloride, magnesium chloride, or sugar, which dissolve lime freely from

them without bringing the corresponding amount of silica into solution. From this fact Knapp concluded that the lime so extracted is not in either material combined with silica. Zulkowski differs from this view. Twenty-six years ago he found that lime could be easily extracted, even by weak reagents, from basic aluminosilicate of lime which had been formed by heat, only inconsiderable amounts of silica dissolving at the same time. Again, Mylius and Foerster have shown that alkalis are dissolved out of glass by pure water, and that very little silica accompanies the alkali so dissolved. Water, further, dissolves lime from hydraulic lime, without it being thereby proved that the lime was present in the free state, a fact which can only be proved by a synthetical experiment. Zulkowski maintains the correctness of his theory, which is as follows:—

- (1.) That, in the burning of natural or artificial hydraulic lime, the clay is decomposed, with the formation of a basic silicate.
- (2.) When this basic silicate is fused, as in the case of blast-furnace slag, the whole of the lime becomes combined and the hydraulic property is lost.
- (3.) When the mixture is heated beyond fusion, there results a mixture of finely-divided lime and a fused or endry basic silicate, which, in presence of water, can again combine with the excess of lime.—E. B.

X.—METALLURGY.

Treatment of Quicksilver Ore Finest at Almaden, Spain. Eng. and Min. J. 47, 544—545.

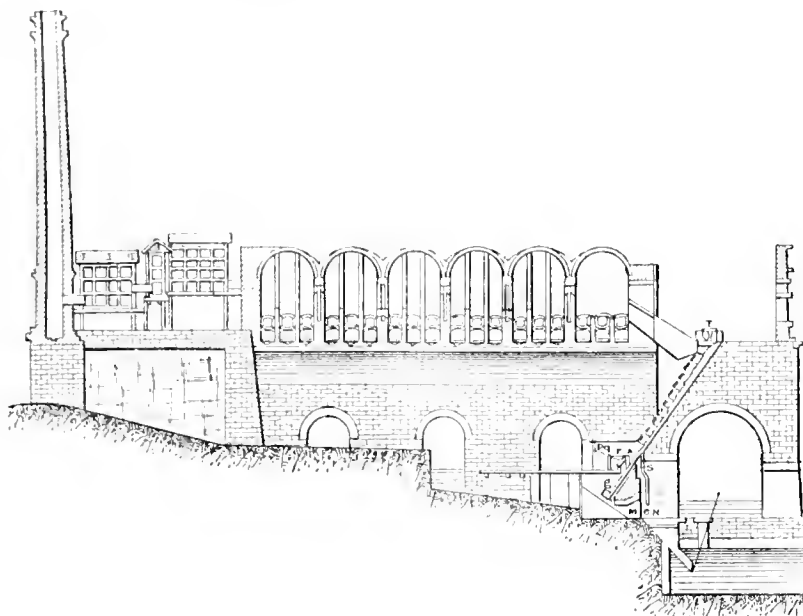
CHANEL furnaces are employed for the treatment of fines rich in quicksilver at Almaden. The size of the fines for these furnaces must not exceed 10 cubic centimetres. The furnaces mentioned have the great advantage of being continuous in their operation, to such an extent that in seven months not the slightest interruption occurred.

The hearth is an inclined plane constructed of fire-brick, 2·50 metres in width by about 8 metres in length, the grade of which is equal to, or a little steeper than the natural slope of the fines. Every 40 centimetres this floor has a rise of 2 centimetres, as can be seen in the illustration. It is divided by partitions, formed of fire-brick, 30 centimetres high, into 12 channels, 12 centimetres wide, in which the ore runs. Transversely in the channels, and supported on their partitions, there are placed bricks, called "taws" ("stoppers"), which are above the floor of the hearth 4 centimetres, this being the thickness of ore in each channel. Arranged in the same way there are others, called "petacos" ("trunks"), situated immediately at the bottom of the rises and at the same distance from the hearth as the "stoppers," which serve to break up the fine ore on them so as not to present invariably the same surface to the action of the heat. On the lower part of the hearth there is another inclined plane, M, perpendicular to it. This is also divided into 13 channels, but there are no "stoppers" nor "trunks" on it. The ore, already calcined on the first plane, travels to the second, at the end of which, M, a boy is placed, whose duty is to make it run over the hearth. A little above the second plane, and facing the first, but separated from it by the bridge *x*, is placed the fire-place, the grate of which is divided into two equal parts by a partition, which rises to the arched roof of the fire-place. The fire-grate is formed of two systems of bars, *p, q* and *r, s*, the first placed lengthwise and irregular in height, and the second crosswise. The air for combustion passes in by the ash-pit to the fire-place, having traversed certain passages *e, f, g*, where its temperature has been raised by the heat taken from the walls of the furnace. By means of the hopper "T" the channels are filled with ore, and when it has been sufficiently exposed to the heating and reducing action of the gases, the boy placed at M withdraws

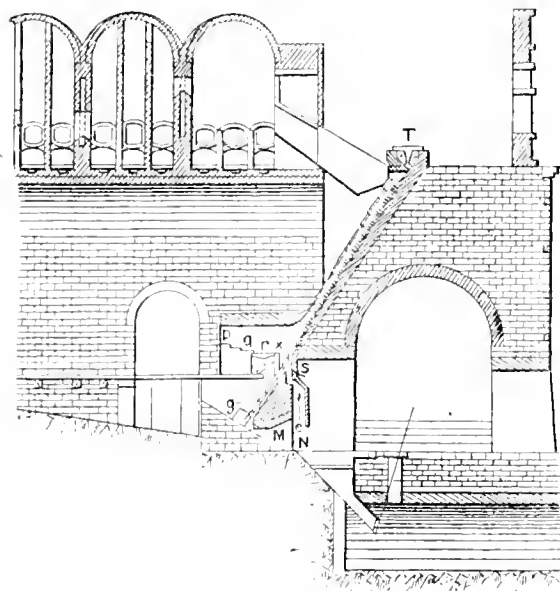
a portion of the ore placed on the lower edge of the second inclined plane. The ore remains subjected to the action of the heat about four hours. The calcined fines are ejected by a hopper to the passage G, whence they are taken out in

cars. They do not now contain more than two to four hundredths per cent. of quicksilver. The condenser is formed by two series of chambers, the first of which communicates with the furnace by a throat in the shape of a

FURNACE FOR CINNABAR FINES AT ALMADEN.



ENLARGED SECTION OF THE ABOVE.



truncated pyramid of iron plate protected with brick. The six chambers which constitute this first series are of brick, with thin walls, and are divided into partitions, which have openings arranged for the passage of the fumes, so as to run in double zigzag. The bottom of each division is formed of two inclined planes, whose intersection has a small incline towards a channel common to all the chambers in which is collected the quicksilver condensed in them. The bottoms are of iron plate in the three chambers nearest to the furnace, and of slate in those furthest away, this arrangement being in consequence of the iron being attacked

by the quicksilver in the latter. The last part of the condenser is formed of wooden chambers with glass, divided into four parts by vertical partitions. These chambers are arranged so that the air can circulate below and around the sides, and allow of observation in case of any filtration of quicksilver through the bottoms.

Coal was first employed as fuel, but coke is now found to give better results in regard to the smaller quantity of soot which is produced.—A. J. S.

The Platinum Metals. Eng. and Min. J. 47, 586—583.

Platinum.—Usually found in the form of small rounded and flattened grains. Platinum alloyed with other members of this group is found in small quantities in the beach sands and gold placers of the Pacific coast, and also associated with placer gold in Virginia, North Carolina, Georgia, and other southern States. In 1887 a nugget, weighing 104·1 grains, was described as found near Plattsburg, N.Y. Sperryite, a mineral containing platinum and arsenic, was discovered in the autumn of 1888, at the Vermillion mine, near Sudbury, Ontario, Canada. It was found to contain upwards of 7·52 per cent. of platinum. The greater part of the platinum that finds its way into commerce is derived from placer deposits in the districts of Soroblogodar and Nishni-Fagikk, in the Ural Mountains. Its refining is largely accomplished by the house of Johnson and Matthey, of London, where Deville's process is used, and the French corporation in Paris, formerly known as Quenessen, Le Brun, and Dessuontis. The method of mining is analogous to that of placer gold, with the exception that the apparatus for saving platinum depends upon gravity alone, and not upon gravity and amalgamation. From the material thus accumulated platinum is derived in the following method: The platinum is precipitated as a platinum-chloride of either potassium or ammonium in the nitro-hydrochloric acid solution of the crude metal. This substance washed with a little cold water, dried and heated to redness, or reduced in a current of hydrogen, leaves metallic platinum in a spongy state. The spongy platinum is made into a thin uniform paste with water, introduced into a slightly curved mould of brass, and subjected to a gradual pressure, by which the water is squeezed out, and the mass rendered at length sufficiently solid to bear handling. It is then dried, very carefully heated to whiteness, and hammered or subjected to powerful pressure, when the platinum will be in a state to bear forging into a bar. Deville and Delbray's method of refining consists in heating the crude metal in a crucible of lime by the oxy-hydrogen flame. All the impurities are separated in this way.

Palladium.—This metal is separated from the other members of the group by neutralising the acid solution, from which the platinum has been precipitated with sodium carbonate, and mixing with a solution of mercuric cyanide. Palladium cyanide separates out, and on being washed, dried, and heated to redness, yields metallic palladium in a spongy state. There has recently been described an alloy consisting of from 60 to 75 parts of palladium, 15 to 25 parts of copper, and one to five parts of iron, and its use recommended as suitable for the manufacture of watches owing to its non-magnetisable qualities. Other palladium alloys were described containing varying proportions of silver, gold, platinum, and nickel.

Rhodium.—From time to time it has been reported that rhodium occurs in small quantity in the amygdaloid rocks of Keweenaw Point, Lake Superior; but it is believed that its presence has not been authoritatively established. This metal remains in the solution after the platinum and palladium have been removed, and is separated in the following manner: The solution is mixed with hydrochloric acid and evaporated to dryness, when the residue is treated with alcohol of 0·837 density, which dissolves everything except the double chloride of rhodium and sodium. This is well washed with alcohol, dried, heated to whiteness, and then boiled with water, by means of which the sodium chloride is dissolved out, and metallic rhodium remains. It is a white coherent, spongy mass, less fusible and less capable of being welded than platinum. A small quantity of it in steel is said to impart most valuable qualities.

Iridium.—Its principal source is the mineral iridosmine, which, in America, is found chiefly in the placer washings of California and Oregon, where it accumulates with the gold on account of its weight, and is easily recovered and saved. When the crude platinum is dissolved in nitro-hydrochloric acid, a small quantity of a grey scaly metallic substance usually remains behind, having altogether resisted the action of the acid. This is the native alloy of iridium and osmium. It has been found in Cincinnati that by heating iridium or any of its ores in a sand crucible to a

white heat, and then adding phosphorus, the latter rapidly combined with the iridium, and in a few seconds the contents of the crucible were in a perfect state of fusion, capable of being poured and cast into an ingot. This material proved to be as hard as iridium, and seemed to have all the properties of the metal itself. The standard meter of Paris was made of an alloy consisting of 90 parts platinum and 10 parts iridium. Iridium has been used by the American Iridium Company, of Cincinnati, for the so-called diamond points upon gold pens, for the points of stylographic pens, for the knife edges of fine balances, for the tips of rubber turnery tools, for wire draw-plates in electric lighting, for the electric contact points of telegraphic apparatus, and, indeed, for any purposes where an exceedingly hard metal is required. Deposited electrolytically on base metals, it has been found to be exceedingly tough and susceptible of a high polish.

Ruthenium.—To obtain ruthenium, scaly osmiridium is heated to bright redness in a porcelain tube, through which a current of air (freed from carbonic acid and from organic matter) is drawn by means of an aspirator. The osmium and ruthenium are thereby oxidised, the former being carried forward as tetroxide and condensed in solution of potassium hydroxide, while the ruthenium oxide remains behind, together with iridium, and by fusing this residue with potassium hydroxide, treating the mass with water, and leaving the liquid in a corked bottle for about two hours to clarify, a solution of potassium ruthenate is obtained, which, when neutralised with nitric acid, deposits velvet-black ruthenium sesquioxide, and this, when washed, dried, and ignited in hydrogen, yields the metal.

Osmium.—When ruthenium and osmium are oxidised, the latter as tetroxide is passed in the form of a vapour into a solution of potassium hydroxide. This solution is mixed with an excess of hydrochloric acid and digested with mercury in a well closed bottle at 40° C. The osmium is then reduced by the mercury and an amalgam is formed, which, when distilled in a stream of hydrogen till all the mercury and calomel are expelled, leaves the metallic osmium in the form of a powder. Deville and Debray, by igniting precipitated osmium sulphide in a crucible of gas coke, at the melting heat of nickel, obtained it in bluish-black, easily divisible lumps.—A. J. S.

Note on the Influence of Temperature on the Mechanical Properties of Iron and Steel. A. Le Chatelier. Compt. Rend. 109, 58—61.

THE author has observed a noticeable change in the properties of iron and steel at a temperature above 80° and again a further one at about 240°. The change is permanent. There is an increase of elasticity and a notable reduction in the elongation. Thus three iron wires 2 metres long were loaded with 30 kilos. per square mm. at 15°, which gives an elongation of 9 per cent. No. 1 was now heated to 74°, No. 2 to 92°, No. 3 to 190°, each for 10 minutes. After cooling the following results were obtained:—

	Limit of Elasticity.	Load.	Elongation.
	Kilos.	Kilos.	Per Cent.
No. 1.....(74°)	33·5	38·2	21
No. 2.....(92°)	36·6	37·4	2
No. 3.....(190°)	40·0	41·6	4

Ordinary puddled iron drawn into thin wires was experimented upon and gave very irregular results, owing to minute particles of slag contained in the metal. The irons and steels used for the experiments referred to were of great purity. They contained 0·35 to 0·40 per cent. of manganese, and whilst the irons contained 0·05 per cent. of carbon, the steels contained 0·80 per cent. of that element.

—A. R.

Distilled Lead. R. Roosing. Chem. Zeit. 695—696.

The lead ores from Upper Silesia are specially suitable for the manufacture of pure lead, as they contain no bismuth or copper and only minute quantities of gold, antimony, arsenic, and nickel. Silver, zinc, and iron are present, but can be removed without difficulty. A sample of the lead produced by the distillation process at the Kgl. Friedrichshütte specially for chemical purposes, and from these ores, contained: Copper, 0.0007; antimony, 0.0006; arsenic, 0.0013; iron, 0.0010; traces of zinc, silver, bismuth, and nickel, lead (by difference), 99.9964 per cent.—E. E. B.

On the Nature of Cobalt and Nickel. Fleitmann. Chem. Zeit. 13, 757.

The author has repeated the experiments of Krüss and Schmidt with different kinds of commercial nickel and cobalt oxides, using as much as 50 grms., without obtaining a weighable quantity of the new metal. He has unsuccessfully endeavoured to obtain a sample from Krüss and consequently considers "Gnomium" as a phantasy. His own researches lead to the following conclusions:—(1.) If a new metal really exists as a general constituent of nickel and cobalt it cannot be present to the amount of 2 per cent. (2.) That this small quantity can have no real influence on the malleability of nickel, which in its usual purity is as weldable and malleable as the softest iron. (3.) That the patented process of Krüss is worthless, while it is not new and is partly impracticable.

If commercial nickel and cobalt in the form of hydroxides be treated with large quantities of caustic soda one obtains varying amounts of impurities which are usually present, together with small quantities of nickelous and cobaltous oxides. These impurities vary according to the source of the metal, but may consist of mixtures of lead oxide, zinc oxide, arsenious acid, manganic acid, molybdic acid, silica, alumina, cerium oxide, chromic acid, &c. The simultaneously dissolved nickel and cobalt oxides do not, as a rule, represent more than one-twentieth per cent. of the oxides taken. If they are separated from the remaining impurities which are dissolved by the alkali, and converted into nickelous and cobaltous oxides, they are found to be insoluble in caustic soda, by which it appears that their original solubility is due to the presence of some of the impurities, such as arsenious acid, silica, and alumina. If the original alkaline extract is treated with hydrochloric acid until the precipitate formed is redissolved, and then with ammonium carbonate, a complex mixture of different oxides and acids is obtained, which might confuse and mislead anyone not acquainted with such a mixture. It seems probable that Krüss and Schmidt had to deal with a similar mixture. The precaution taken by them to precipitate at a temperature below 10° C. strengthens Fleitmann's conclusion, since on warming precipitates are frequently formed, due to the manganic acid and the dissolved lead oxide being converted into manganic oxide and lead peroxide.—A. W.

Relative Merits of Different Lead-Tin Alloys for Soldering. J. Rothe. Mitth. Königl. techn. Versuchs. 1889, 86—87.

Two alloys were prepared from pure lead and Banca tin. A consisted of 10 per cent. of lead and 90 of tin, and melted at 210° C.; B was composed of 30 per cent. of lead and 70 of tin, and fused at 188° C. A was harder and less malleable than B, but behaved like it when subjected to bending tests; it gave the "cry" of tin, while in the case of B this property could scarcely be perceived.

Mechanical tests showed that A was as efficient a solder as B. Experiments with cast plates of the alloys exposed to the action of acetic acid indicated that at first B was more strongly attacked, and yielded more lead absolutely and relatively to the acid; after 24 hours tin was still freely dissolved from both alloys, but the amount of lead removed decreased considerably and became approximately constant and equal for both. It therefore appears that the lead

dissolved at the outset is reprecipitated by the more electro-positive metal, and is protected fairly completely by it subsequently.—E. B.

Servian Quicksilver.

The attention called to the new Servian quicksilver industry by the floating of the Avala Quicksilver Mines Company (Limited) in London recently, gave a recent visit made by us to the Servian section of the Paris Exhibition a more than passing interest. The Avala mines are situated fifteen miles south of Belgrade, and about two from the main railway line which connects that city with Paris and Constantinople. The mines are to be found at the foot of the mountain from which it takes its name, itself deriving its present name from an ancient castle, now in ruins, dating its origin to a century or two B.C., and with which many interesting legends are connected. The mines were discovered in 1883, the intervening five years having been spent in experimental working.

At the present time there are five veins of quartz in which the quicksilver is found, the largest of these being about 60 yards in width and 700 yards in length, the first mine having reached a depth of 100 yards. Nor is this all, for in the same mineral is found a considerable amount of sulphate of nickel, besides a certain quantity of the natural metal. One hundred and fifty thousand tons of mineral have been raised, giving an average yield of 27 lb. of quicksilver per ton, the whole of which is said to equal the best qualities found in the cinnabar mines of Almaden, Spain, and the New Almaden mines of California. Sixty miners and an engineer are constantly at work, the operations going on both day and night, now showing a daily raising of 15 tons. Four kilns and 10 retorts, with a powerful steam-engine, seem at present to constitute the principal working plant of the mine. At Avala the extraction of the metal from its ore is effected by oxidation and reduction, a process which appears to differ from that in use at Almaden, where great waste occurs, owing to an imperfect method of condensation, while at the Servian mines a loss of 6.6 per cent. only is sustained. Twenty-five bottles of quicksilver are produced weekly, each bottle containing 70 lb. net weight of the metal. These bottles have a similar form and style to those used in England for the nitrous oxide gas. Five hundred of them recently found a ready sale on the London market, while 200 have been despatched to China. At present, however, the company seems disposed to limit its sales to Vienna, where prices range somewhat higher than elsewhere, besides the great economy obtained in the matter of carriage, as compared with London, &c. It is not to be supposed that the company in question has been without competitors, but these, it would seem, from some unexplained reason, have not been successful. The principal one was the Kipanj syndicate. A former English concern, too, which worked the copper mines at Meidenpeck some years ago, came to grief; this was the first, and up to now the only, attempt by capitalists from this country to develop the mineral resources of Servia. We have searched in the United States and Spanish courts, consulted the officials, and perused the catalogues, but can hear of no other quicksilver exhibit. This is a matter of regret, as it would undoubtedly have been interesting to give some information from other sources.—*Chemist and Druggist.*

PATENTS.

Improvements in the Manufacture of Metallic Alloys. G. A. Dick, London. Eng. Pat. 2481, May 25, 1882. (Second Edition.) 6d.

See this Journal, 1883, 285.—H. S. P.

Improvements in or Relating to the Treatment of Ores for Facilitating the Extraction and Recovery therefrom of Gold and Silver, and in Apparatus therefor. W. P. Thompson, Liverpool. From H. F. Julian, Johannesburg, South Africa. Eng. Pat. 8332, June 7, 1888. 8d.

The finely pulverised ore is rotated in an air-tight barrel with water and chlorine, under a pressure of 60 to 80 lb. per square inch, produced by "air, steam, or other fluid."

Mercury is then introduced into the same or another barrel with the mud, and the whole again revolved under pressure. The contents are then run over copper plates to retain the amalgam, and, finally, the tailings are washed through a series of electrolytic cells in which the cathodes are mercury and the anodes carbon or other suitable material. These cells are arranged at different levels and overflow into each other. They are said to remove the last traces of gold, and catch any floured mercury or amalgam. Drawings are given.—A. W.

Improvements in Carburising and Coating Iron and Steel in the Form of Sheets, Hoops, Wrought or Cast Plates, Bars, or Manufactured Articles. J. Summerhill, St. Georges. Eng. Pat. 9848, July 6, 1888. 6d.

THE steel or iron articles are heated in an annealing furnace or muffle to as high a temperature as it is possible to attain without occasioning oxidation of the metal, and are then withdrawn and dipped into a bath of carbonaceous material, such as tar, pitch, or oil. The metal thereby becomes carburised and likewise coated with an adherent carbonaceous protective coating, which has a glazed appearance similar to Japan black when dried in the ordinary atmosphere, or a dull surface when artificially dried by heat. The most suitable bath is composed of approximately pure tar, containing 1 per cent. of Val de Travers rock. The time of immersion varies with the thickness of the material, and also with the desirability of carburisation with or without the production of the carbonaceous coating.

—A. W.

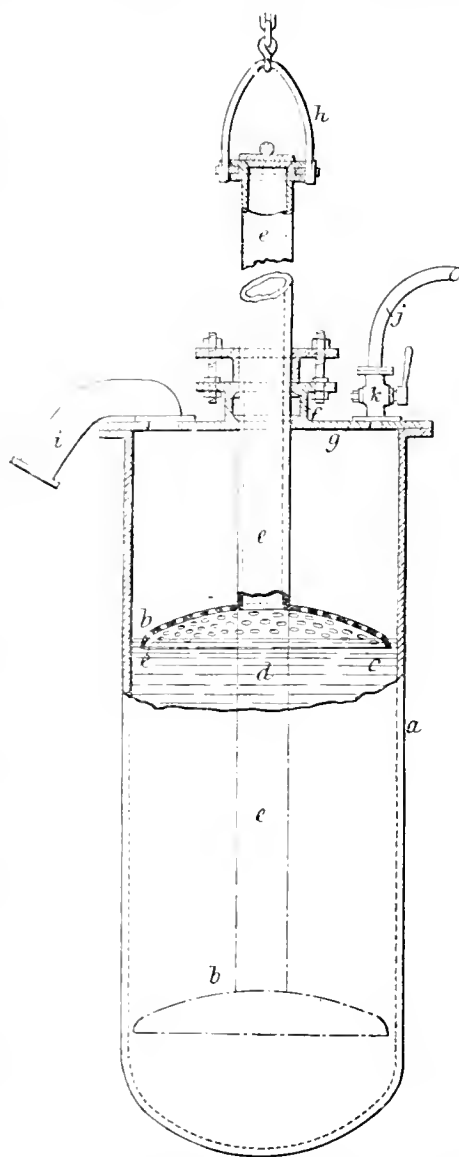
Improvements in Certain Metallic Alloys. E. L'Homme, Paris, France. Eng. Pat. 2722, July 19, 1888. 6d.

THE patent relates to the production of bronze or brass that possesses great hardness, toughness, and tensile strength, and which is capable of being rolled or otherwise worked in either the hot or cold state. The alloy consists of copper, iron, manganese, zinc, nickel, silicon, and carbon. The method of procedure is as follows:—In a suitable crucible or furnace are melted copper, nickel, ferro-manganese, ferro-silicon, and ferrocyanide of potassium, zinc is then introduced and thoroughly incorporated with other metals. The draught is then lowered and about 2 per cent. by weight of carbonate of soda is added, and a few minutes later the metal may be run off into moulds. The novelty consists in using ferrocyanide of potassium, whereby carbon is introduced into the alloy, and in the addition of a minute proportion of nickel to alloys of this class, which has the effect of lowering the melting point of the mass and increasing the homogeneity of the alloy. The proportions used are, to every 100 lb. of copper, 34–62 lb. of zinc, 4–6 lb. of ferro-manganese (containing 84 per cent. of manganese), 1–2 lb. of ferro-silicon (containing 44 per cent. of silicon), 2–4 oz. of nickel, and 10–30 oz. of ferrocyanide of potassium.—H. S. P.

Improvements in the Manufacture of Sodium and Potassium and the Apparatus therefor. W. G. Forster, London. Eng. Pat. 10,785, July 25, 1888. 6d.

THE patent is for apparatus used in the following process for making potassium or sodium. A reducing agent, such as carbon or carbon and iron mixed, is introduced gradually and from time to time, and preferably in a heated condition, into a bath of fused incandescent alkali, such alkali being either a carbonate or hydrate, or wholly or partially deprived of its hydrogen and oxygen by the use of finely-divided iron while in a fused condition. The invention consists of a contrivance for mixing the carbon with the fused alkali and preventing it from floating at the top of the bath. The alkali is fused in an upright cylindrical iron vessel *a*, fitted with a cover *g*. Into this vessel is placed a perforated iron disc *b*, of nearly the same diameter as the vessel. The disc is curved downwards at its rim and is attached to a hollow handle *c*, longer than the vessel. This handle passes through a stuffing box *f*, in centre of the cover, and by attaching it to

a chain and pulley or to a lever the disc may be moved up and down in the vessel, thus submerging the carbon and agitating the charge of alkali and carbon. The vapours and



gases generated in the process pass away by a pipe *i*, let into the cover of the vessel. The hollow handle of the disc is fitted with a loose cover and serves as a pipe for introducing the charge of alkali and the additions of carbon. It may also be used for discharging the waste alkali at the end of the reduction. For this purpose the loose cover of the hollow handle is removed and a short bend attached. The escape pipe for the vapours is then closed and the disc lowered nearly to the bottom of the bath. The confined gases then force the liquid residue up through the handle and through the bend into a suitable receptacle. Or, if preferable, coal gas may be forced into the vessel through inlet-pipe *j*, under sufficient pressure to expel the liquid residue. *k* is the stop-cock for pipe *j*. One of the chief advantages of the invention is that much larger vessels may be employed than those usually used in the manufacture of potassium and sodium.

The claims are:—1. In the manufacture of sodium and potassium, keeping the carbon submerged in the fused incandescent alkali by mechanical means. 2. The use of

apparatus, as described and shown, for the above purpose and for agitating the carbon with the heated liquid alkali, and allowing escape for the vapours produced in the process.
3. The improved apparatus.—H. S. P.

Improvements in Metallic Alloys. P. M. Parsons, Blackheath. Eng. Pat. 11,512, August 9, 1888. 4d.

THE patent relates to alloys of copper and zinc, or copper and tin, or copper, zinc, and tin together with steel, iron, and manganese, which last may be added as ferro-manganese or spiegeleisen, as described in Eng. Pat. 482 of 1876. The patentee now adds aluminium to such alloys, whereby their strength is increased, they are rendered more fluid when molten, and oxidation is diminished so that from such alloys very sound and sharp castings can be made. He finds that one-eighth of one per cent. of aluminium has an appreciable influence on the character of the alloy, and this amount may be increased with advantage to about two to three per cent. A still larger quantity of aluminium may be used if a very hard refractory metal is wanted, but at the same time the alloy becomes more brittle. These qualities may both be modified by reducing the tin or the zinc as the aluminium is increased. The aluminium may be added in any convenient way. For instance, after fusing all the other ingredients, pieces of aluminium may be introduced into the fused mass by means of a pair of tongs or other suitable appliance, and then, by stirring, the aluminium becomes melted and combines with the other metals.

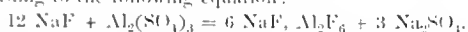
—H. S. P.

A New or Improved Process for Extracting Gold, Silver, and other Metals from Refractory Ores, Sands, and Residues. E. de Rotterdam, Bludow, Russia. Eng. Pat. 12,074, August 21, 1888. 8d.

THE process consists of five operations:—(1.) Roasting; (2.) The extraction of the secondary metals; (3.) The removal of the protoxide salts; (4.) The extraction of the fine gold; and (5.) The final washing of the residue to collect the coarse gold. The roasting is carried on by preference in a Mueckell furnace, and is modified according to the nature of the ore. The roasted material is then leached with warm dilute sulphuric or muriatic acid, which "transforms the protoxides and salts at minimum of oxidation into oxides and salts at maximum of oxidation." The liquor obtained is treated with scrap iron by which the copper, silver, &c. are precipitated. The residue is submitted to the action of nascent chlorine by running in a solution of chloride of lime simultaneously with dilute hydrochloric acid, whereby a solution of chloride of gold is obtained which is at once run off to prevent further contact with the ore, "which would tend to reduce again to the metallic state the gold contained in the said solution." The solution also contains some silver, both which and the gold are extracted by ordinary methods. Any coarse gold remaining in the residues may be separated by mechanical means. The feature of this process is stated to be that only the most finely-distributed gold or that which is unobtainable by mechanical means is extracted by the chlorine, after which the coarse gold is recovered.—A. W.

Improvements in the Manufacture of Artificial Cryolite and similar Compounds. C. Netto, London, From C. Winkler, Freiberg, Germany. Eng. Pat. 12,135, August 22, 1888. 6d.

SLAG from the manufacture of aluminium from cryolite is melted with dehydrated sulphate of alumina in the proportion of 100 parts of the former to 32 parts of the latter, whereby the fluoride of sodium is decomposed with the formation of the double fluoride of sodium and aluminium according to the following equation:—



The sulphate of sodium is separated by lixiviation. Artificial cryolite can thus also be prepared from sodium or potassium fluoride in the first instance.—A. W.

A Method of Utilising Flux Skimmings from Galvanising Works. H. J. Kirkman, Swansea. Eng. Pat. 17,623, December 3, 1888. 4d.

ON treating the flux skimmings from galvanising works with water, zinc chloride and ammonium chloride pass into solution, leaving an insoluble residue containing zinc. The zinc may be recovered from this residue by any of the known processes. To the aqueous solution obtained as above described, lime (in the form of milk of lime), gas liquor, magnesia, sodium hydrate, sodium carbonate, or ammonia, is added in sufficient quantity. The precipitate of zinc hydrate or carbonate, as the case may be, thus formed, is separated from the solution, washed, dried, and, if need be, calcined. It may then be used as a pigment or the zinc may be recovered from it by the ordinary means. The solution, containing ammonium salts, may be treated by any of the known methods for the recovery of ammonia. Should any of the above mentioned substances, when added to the solution of the flux skimmings, decompose the ammonium salts and cause the evolution of ammonia, the solution may be treated in closed vessels and the evolved ammonia recovered by any of the known methods.—H. S. P.

Certain Improvements in the Amalgams, and Method of Applying the same, used in Amalgamation of Gold and Silver. M. Johnson, W. E. Field, and J. S. Beeman, Saint Kilda, Australia. Eng. Pat. 1602, January 29, 1889. 6d.

THE object of the invention is to prevent the "sickening" or "flooding" or "floating" of the mercury or amalgam used in extracting gold or silver, and in cases where the amalgam used has "sickened" or "floored," to cause the particles to remite or "quicken." The invention consists in adding a small quantity of zinc (or cadmium or magnesium or other suitable metal, sodium and potassium excepted) to the mercury to be used, and after mixing the zinc amalgam thus formed with the auriferous or argentiferous ores under treatment, pouring upon the mixture dilute sulphuric acid or hydrochloric acid or an aqueous solution of caustic potash or other suitable alkali, or of chloride of ammonium or any other suitable salt, so as to generate hydrogen on or from the surface of the amalgam. The proper proportion of zinc to be used with a given quantity of mercury so as to form the zinc amalgam varies according to the nature of the ores or material under treatment, and can only be determined by experiment. For many classes of ores it has been found that 1 part of zinc to 90 of mercury forms a suitable amalgam. The process may also be carried out by amalgamating the gold or silver first and then adding the pieces of zinc and the acid, alkali, or suitable salt, to the mixture in the amalgamating pan or after removal from the pan. Or by mixing the mercury and the ore and the acid or alkali and allowing the whole to flow over, on or under plates or "rilles" which are covered with zinc amalgam. Or the ore and mercury together with the acid or alkali may be mixed and triturated in a pan of zinc or covered with zinc.—H. S. P.

Improvements relating to the Galvanising of Metals and to Apparatus therefor. T. Midgley, Beaver Falls, U.S.A., and W. B. Nye, Boston, U.S.A. Eng. Pat. 8255, May 17, 1889. 6d.

THE material to be coated with zinc such as iron wire, sheets, pipes, &c., is made to pass, after having been cleaned with acid, through a bath of molten lead and upwards through a small body of melted zinc floating on the surface of the lead and confined within a small area by suitable moveable partitions. Drawings are given. The advantages claimed are: less oxidation of the zinc; less waste of zinc from the action of acids; a more flexible material, as the iron is not cold when it enters the zinc; and the prevention of the destruction of the pans usually employed for melting the zinc by confining the latter between partitions on the surface of the lead.—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improvements in Secondary and other Electric Batteries. H. Pieper, Liege, Belgium. Eng. Pat. 11,569, August 10, 1888. 6d.

To increase the capacity and efficiency of batteries they are subjected to a pressure considerably greater than that of the atmosphere, while in use; in the case of some gases, chlorine for example, sufficient pressure is maintained to liquefy them as they are formed by the electrolytic action. Sometimes the pressure is produced artificially by air, and at others by the gases themselves as they are given off in an hermetically sealed vessel.—B. T.

Improved Cell or Containing Vessel for Electric Batteries. H. G. C. Serrin, Paris, France. Eng. Pat. 12,163, August 23, 1888. 11d.

THE new cell is formed by making any number of cavities of the required size in a piece of natural wood of suitable size, and using each of these cavities as one cell of a battery. The battery can be used for any of the ordinary purposes, and can also have any desired apparatus mounted upon it.—B. T.

An Improvement in Electrical Batteries. W. Clark, London. From L. Maiche, Paris, France. Eng. Pat. 13,215, September 12, 1888. 4d.

A SOLUTION of citrate of ammonia, of varying strength according to circumstances, is used as the improved exciting agent.—B. T.

Improvements in or relating to Galvanic Batteries. G. C. Dymond, Liverpool. From C. Gassner, Mainz, Germany. Eng. Pat. 18,754, December 22, 1888. 4d.

AN isolated coal electrode is placed in a vessel of zinc, and the space is filled up with an exciting compound made by dissolving one part of sal-ammoniac and one of chloride of zinc in two parts of water, and then adding four parts of plaster powder, thus forming a thin pulp-like mass, which hardens in a short time.—B. T.

Improvements in Galvanic or Primary Batteries. C. Maltby-Newton, Croydon. Eng. Pat. 7356, May 3, 1889. 6d.

THE positive plates are made up of oxide of lead and syrup of sugar or molasses, the oxide of lead used consisting preferably of a mixture of flake litharge and powdered litharge.

The syrup and oxide are mixed up to a stiff paste, spread over each side of a perforated iron, copper, or lead gauze support, and baked. The negative pole consists of a plate of zinc, tin, or lead, and the whole is immersed in a solution of caustic soda contained in a vessel preferably made of iron.—B. T.

Dry Galvanic Cells. C. H. Mehner, Berlin, Germany. Eng. Pat. 7597, May 7, 1889. 4d.

A "MINERAL gelatin," which is in itself an excitant, is combined with the exciting solutions to form a pasty jelly-like mass suitable for a dry cell. This mineral is formed by adding magnesia to a concentrated solution of chloride of magnesium.—B. T.

Improvements in and connected with Electric Batteries. W. J. S. Barber-Starkey, Bridgnorth. Eng. Pat. 7619, May 7, 1889. 6d.

PLASTER of Paris is mixed with a suitable salt, such as the sulphates of sodium, potassium, or magnesium, soluble in the electrolyte, the mixture is quickly gauged and, while in the plastic state, placed in the cells between the plates. Upon the addition of water or the electrolyte the salt is dissolved out, leaving a very porous mass of plaster capable of absorbing a considerable quantity of the electrolyte and, at the same time, keeping the plates in one unalterable position. Porosity may also be gained by using some finely-divided fibrous material instead of the salt.—B. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Manganese Oxalate as a Drier. J. Castelaz. Chem. Ind. 12, 163.

MANGANESE oxalate, best obtained by treating the carbonate with oxalic acid solution, on heating with an oil to about 150° decomposes into carbonic acid, carbonic oxide, and oxide of manganese. By such treatment the oil gains in a high degree the capacity of drying. Whilst most of the driers hitherto used, when boiled with the oils, colour the latter, manganese oxalate can be used so as to yield almost colourless drying oils.—W. S.

Fatty Oil from Cyperus Esculentus. C. Hell and S. Twerdomedoff. Ber. 22, 1742—1745.

THE tubers of *Cyperus esculentus* contain, besides sugar, a considerable amount of fatty matter. The fat was extracted by means of petroleum ether, and was found to average 27.1 per cent. of the tubers. The oil is fluid at ordinary temperatures, yellow in colour, and possesses a smell somewhat similar to that of burnt sugar. When cooled below zero, a small quantity of solid glyceride separates. On saponification, the fatty acids were found to consist of oleic and myristic acids only, the bulk being oleic acid. The oil, therefore, seems to consist of the glyceride of oleic acid mixed with a little myristic glyceride.—H. T. P.

PATENTS.

Improvements in the Manufacture of Soap and Detergents. J. J. Bowley, Battersea. Eng. Pat. 9857, July 6, 1888. 4d.

THE object of this invention is to render soap more cleansing and non-corrosive to the material washed. For this purpose kerosene, petroleum, or shale oil is added to ordinary soap.—E. J. B.

Improvements in Soap and Plasters. Edith Emily Gillam, South Kensington. Eng. Pat. 10,294, July 16, 1888. 4d.

THE object of this invention is to produce a disinfecting, antiseptic, anti-rheumatic, and antifebrile soap, by mixing together ordinary curd soap and from 10 to 20 per cent. of eucalypt oil.—E. J. B.

Cooling or Refrigerating Lubricating Oils, and Apparatus therefor. D. Crawshaw, Sale. Eng. Pat. 10,803, July 26, 1888. 6d.

WHEN heavy bearings are lubricated, the practice is to cause a copious flow of oil through the journal, the escaping oil being collected and pumped back to the journals. The re-use of the oil is open to the objection that it soon becomes excessively heated, and thus loses its viscosity and lubricating power. This is obviated by the use of a cooler consisting of a number of tubes immersed in cold water.

—E. J. B.

Improvements in or appertaining to Composition or Soap used for Cleansing and Disinfecting Purposes. J. Crossley, Liverpool. Eng. Pat. 12,001, August 20, 1888. 4d.

This improved composition consists of a mixture of soda crystals or ash, ordinary soap, and petroleum.—E. J. B.

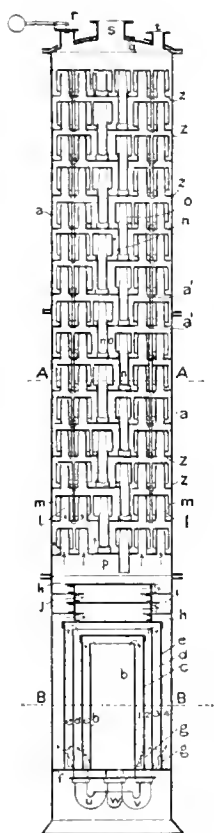
A Blue Soap for Laundry Washing. G. R. B. Kempton, West Ham. Eng. Pat. 5680, April 3, 1889. 4d.

The object of this invention is to produce a blue soap, the use of which renders the subsequent employment of blue in laundry work unnecessary.

The inventor incorporates with ordinary soap a solution of aniline green in strong acetic acid. By the action of the alkali of the soap, the green is converted into blue, uniformly colouring the mass.—E. J. B.

Improved Apparatus for Rectifying Glycerin. R. O. Unglaub, Pendleton. Eng. Pat. 8196, May 16, 1889. 6d.

GLYCERIN vapour is made to pass through the cylinder A in the direction of the arrows. It is first made to



traverse the cylinders *b, c, d, e*, at the tops of which are the baffle plates *h, i, j, k*. Above these cylinders is a series of pipes *l*, fitted at the top with bonnets *m*. There is also a double row of pipes *n*, fitted with bonnets *a*, and traps *p*. The upper end of the cylinder is furnished with a safety valve *r*, opening inwards, and a pipe *s*, for drawing off the vapour.

The action of the apparatus is as follows: The impurities in the glycerin vapour condense on the surface of the cylinders, baffle plates, and pipes, and fall down to the bottom of the cylinder, where they are run off by the pipes *u, v, w*, the purified vapours being drawn off at the top and subsequently condensed.—E. J. B.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

On the Green Ultramarine. J. Szilasi. Ann. 251, 97—111.

According to the researches of J. Philipp, R. Hoffmann, and K. Heumann, blue ultramarine is a definite chemical compound. The author has tried to prove first by analysis and afterwards by preparing derivatives from the green ultramarine that the latter also is a chemical compound and not a mixture. He analysed three kinds of this substance obtained from two different sources. Under the microscope they appeared entirely homogeneous, they contained no free sulphur or iron, and were free from other admixtures. The results of the analyses were remarkable for the fact that all three agreed very well together. The author describes further some derivatives prepared from the *Green ultramarine*, *Silver ultramarine*, *Lead ultramarine*, and *Zinc ultramarine*. From these experiments he draws the conclusion that green ultramarine is a definite chemical compound.—A. L.

Painting on Cement Plaster. Sels. Chem. Zeit. 13, 696.

It is to be applied direct to plaster the caustic alkalis in the latter destroy the paint and make it peel off. Sulphate of iron (copperas) has been used to effect the so-called "killing" of the cement, the sulphuric acid of the copperas converting the caustic alkali or lime into sulphates, and thus destroying alkalinity, but a more efficient treatment is to soak the plaster with linoleic acid. When plaster so treated becomes dry any paint can be used with impunity.—E. E. B.

PATENTS.

New or Improved Composition or Liquid applicable for Preventing the Accumulation of Scale in Steam Boilers. J. W. C. Hamilton, Liverpool. Eng. Pat. 9324, June 26, 1888. 4d.

The composition is made by adding from two to eight ounces of the following mixture to one gallon of purified paraffin.

	Per Cent
Essential oil of citronelle	49
" " cassia	25
" " lemon	9
" " eucalyptus	17

In some cases about four per cent. of crude camphor may be added.—E. J. B.

An Improved Method or Process of Treating Steel, Iron, or any Combination of such Metals, to Prevent their Oxidising, Rusting, or Corroding. T. W. Helliwell, Brighouse. Eng. Pat. 9570, July 2, 1888. 4d.

The metal to be treated is heated "to about 600 degrees," whereby its "pores are opened," and immersed in a mixture composed of six pints of boiled oil, one "pint of fat," and one "pint of turpentine" for 5—15 minutes, then removed and either allowed to dry spontaneously or in an oven at "400 degrees." A second coating may be applied if desired. Metal treated thus is said to be protected from rusting or corrosion.—B. B.

Improved Coating or Preservative Material for Iron, Steel, and other Structures, or for Coating the Bottoms of Iron and Steel Ships or other Vessels, and Process for Manufacturing the same and other Products from Gas Tar. J. H. Eastman, Liverpool. Eng. Pat. 10,192, July 13, 1888. 4d.

Gas tar is freed from "ammonia and certain acids" alleged to militate against its employment as a preservative coating, by agitating it, heated to about 100° F., with water and calcium sulphate in the proportion of 20 gallons of water

and 10 lb. of calcium sulphate to 100 gallons of tar. The phenols form lime compounds, and the ammonia yields ammonium sulphate; the former are recovered by acidulating with sulphuric acid and extracting with light tar oils, and purified by re-solution in caustic soda, removal of the neutral oils, and reprecipitation by sulphuric acid; the latter is obtained from its aqueous solution by evaporation.

The purified tar is mixed with one-tenth of its bulk of light petroleum, or coal-tar naphtha, and used as a preservative material for iron and steel.—B. B.

An Improved Compound for removing Paint from Painted Surfaces. P. Brentini, London. Eng. Pat. 11,398, August 7, 1888. 4d.

Four pounds of Irish moss, 3 lb. of methylated spirit, and 3 lb. of fuller's earth are mixed with 30 lb. of water, the whole boiled, and a solution of 16 lb. of caustic soda and 16 lb. of caustic potash dissolved in 28 lb. of water added, after which the product is stirred until it is cold and has solidified to a brownish gelatinous mass. The proportions of the ingredients may be varied. The compound is used by applying it to the painted surface with a brush, allowing it to remain thus for 20 minutes to one hour, and then washing it off together with the paint that has been disintegrated by its action.—B. B.

An Improved Varnish for Cleaning and Preserving Harness and other Leather Goods. S. B. Reswick, Birkenhead. Eng. Pat. 11,579, August 11, 1888. 4d.

Four ounces of shellac, half an ounce of camphor, and one ounce of rosin are dissolved in one pint of methylated spirit and shaken at intervals for 48 hours. The mixture is then coloured according to the kind of leather with which it is to be used. Other rosins, solvents, and proportions may be adopted.—B. B.

XVI.—SUGAR, STARCH, GUM, Etc.

The Amylodextrin of W. Nägeli, and its Relation to Soluble Starch. H. T. Brown and G. H. Morris. Chem. Soc. J. (Trans.) 55, 449—461.

AMYLODEXTRIN was first described by W. Nägeli in 1874. He obtained it by the long-continued action of dilute acids upon ungelatinised starch in the cold, when the residue was found to consist of amylo-dextrin. It was obtained in a pure state by treating this residuum with hot water and precipitating the solution with alcohol. Nägeli describes amylo-dextrin as separating from its solutions in crystalline spherules, made up of minute needles arranged radially. He assigned to the pure substance a rotatory power of $[\alpha]_{175}^{\circ} 175^{\circ}$ — 177° , and stated it to be non-diffusible. Of late years chemists have taken it for granted, mainly on the authority of Musculus and Gruber, and of A. Meyer, that amylo-dextrin is identical with soluble starch and the so-called starch cellulose.

The authors have now submitted this substance to a careful examination, and whilst failing to confirm in all respects Nägeli's statement regarding its properties, they have shown that it is a body of definite chemical composition, and have determined its relation to soluble starch, with which it certainly is not identical.

The authors show that when ungelatinised potato starch is treated in the cold with hydrochloric or sulphuric acid of about 10—12 per cent., little or no change can be observed in the microscopical appearance of the granules during a period of about 21 days. Notwithstanding this fact, the starch has been profoundly modified in its properties. Within about 24 hours of the commencement of the experiment the granules are found to have lost their power of forming a viscid paste with hot water; they dissolve to a perfectly limpid solution, and the substance which separates out on evaporation and cooling is found to have all the

properties of the soluble starch prepared by the limited action of diastase or dilute acid upon starch-paste at elevated temperatures. It is entirely without structure, and in the solid state has no influence on polarised light. It is coloured intense blue by iodine, both in solution and in the solid state, and it has a specific rotatory power in solution of $[\alpha]_{333}^{\circ} = 216^{\circ} 0'$, and no cupric reducing power. When the digestion with acid has proceeded for a few days, the altered starch substance is found to have a gradually decreasing optical activity, whilst at the same time it acquires the property of reducing Fehling's solution, a property which goes on steadily increasing up to a certain point. Meanwhile the iodine reaction of the granules changes from a deep blue, through purple, reddish-purple, and reddish-brown to a final pale yellowish-red. After about three weeks' digestion the starch granules commence to disintegrate, and this action, which takes place principally along their lines of stratification, is complete in about three months. Chemical alteration of the residue continues for some time longer, but a point is ultimately reached beyond which no further change takes place.

The residue left after some months, representing about 60 per cent. of the starch originally taken, consists almost entirely of the so called amylo-dextrin. Purified by solution in water and precipitation with alcohol it gave the following numbers on analysis:—

$$[\alpha]_{336} = 206^{\circ} 25'$$

$$K_{336} = 9^{\circ} 07'$$

The authors then show that its composition can be expressed in terms of maltose and dextrin; it thus conforms to the rule previously established by them (Chem. Soc. J. (Trans.) 47, 538) for all starch transformation products. Its composition is:—

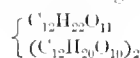
Maltose	-	14.87	which requires	$[\alpha]_{336} = 205.4$
Dextrin	-	85.13		$K_{336} = 9.07$
		100.00		

Brown and Morris state that one of the best marked properties of amylo-dextrin is that of forming spherocrystals, which are very beautiful in form when the substance is slowly separated out from solution. These spherocrystals resemble in their appearance so closely those of inulin that it is impossible by mere microscopic examination to distinguish between the two. That amylo-dextrin is really a homogeneous substance, and not a mixture, was proved in the following ways:—

- (1.) It is absolutely unfermentable, and therefore cannot contain free maltose.
- (2.) It cannot be differentiated by fractionation of its solutions with alcohol, nor by methods of partial solution.
- (3.) The same is true with regard to dialysis. Contrary to Nägeli's statement, the authors find that amylo-dextrin is sensibly diffusible, and passes through the dialyser unchanged.

These facts, coupled with its distinctly crystalline nature, convinced the authors that they had to do with a perfectly definite substance, and a critical examination of the various stages in the production of this substance showed that it is derived from the partial or limited hydrolysis of soluble starch, the first product in the reaction. This partial hydrolysis of the starch ceases when a certain point is reached, the final product being amylo-dextrin.

Amylo-dextrin closely resembles in constitution and properties the malto-dextrin described by the authors in 1885 (Chem. Soc. J. (Trans.) 47, 538). Thus when treated with diastase or malt-extract both these substances are completely hydrolysed to maltose, whilst the authors have shown in their previous papers that starch, even under the most favourable conditions, leaves a residue of one-fifth of highly stable dextrin. Malto-dextrin was represented by Brown and Morris as consisting of one amylin- or maltose-group united to two anylin- or dextrin-groups. Thus:—



Amylodextrin can be represented in the same manner, and the authors' results show that it is made up of *one* amylin- or maltose-group united to *six* amylin- or dextrin-groups. Thus:—

$$\left\{ \begin{array}{l} C_{12}H_{22}O_{11} \\ (C_{12}H_{20}O_{10})_6 \end{array} \right\}$$

Calculated. Found.

which requires $[\alpha]_{D}^{20} = 206.11$ 206.25

$K_{D}^{20} = 9.08$ 9.07

whilst a determination of the molecular weight by Raoult's method gave—

$$\begin{aligned} \Lambda \text{ (coefficient of depression)} &= 0.0086 \\ M \text{ (molecular weight)} &= 2220.0 \end{aligned}$$

The above formula requires $M = 2286$.

Amylodextrin is differentiated from the two substances with which it has been confounded—soluble starch and the so-called starch cellulose—by its solubility, its iodine colouration, its crystalline structure, and its behaviour with diastase and with acids.—G. H. M.

The Determination of the Molecular Weights of the Carbohydrates. Part II. H. T. Brown and G. H. Morris. Chem. Soc. J. (Trans.) 55, 462–471.

THE authors first draw attention to the fact that the results given in their first paper on this subject have been confirmed by Tollens and Mayer (Ber. 21, 1566 and 3503), and by de Vries (Compt. Rend. 106, 751); they then give their later experiments in which a thermometer graduated to one-fiftieth of a degree, and capable of being accurately read to 0.004° C., was used.

Galactose, $C_6H_{12}O_6$, $M = 180$.

—	Calculated for $C_6H_{12}O_6$	Found (Mean).
Λ (coefficient of depression) ..	0.106	0.1073
M (molecular weight)	180.0	177.0

Inulin, $n C_6H_{10}O_5$ or $C_{36}H_{62}O_{31}$.

It has been generally considered that the formula $n C_6H_{10}O_5$ expressed the constitution of inulin, but the recent researches of Kiliani indicate that a formula whose simplest expression is $C_{36}H_{62}O_{31}$ or $6 C_6H_{10}O_5 + H_2O$ is more probably correct. The numbers obtained by Raoult's method were:—

—	Calculated for $2 C_{36}H_{62}O_{31}$	Found (Mean).
Λ	0.0006	0.0088
M	1980.0	2150.0

From all the facts, and the great similarity between inulin and amyloidextrin (see preceding abstract) the authors attribute the following formula to the two substances—



Inulin, $M = 1980$. Amyloidextrin, $M = 2286$.

The amylin- and amylin-groups in the two compounds possess very different optical properties, and behave differently with regard to cupric reduction. The ultimate products of hydrolysis with dilute acids are also very different, being in the one case levulose, and in the other dextrose.

Amyloidextrin, $\left\{ \begin{array}{l} C_{12}H_{22}O_{11} \\ (C_{12}H_{20}O_{10})_6 \end{array} \right\}$, $M = 2286$.

See preceding abstract.

Maltodextrin, $\left\{ \begin{array}{l} C_{12}H_{22}O_{11} \\ (C_{12}H_{20}O_{10})_2 \end{array} \right\}$, $M = 990$.

This substance was described by the authors in 1885. Submitted to Raoult's method it gave the following numbers:—

—	Calculated for $\left\{ \begin{array}{l} C_{12}H_{22}O_{11} \\ (C_{12}H_{20}O_{10})_2 \end{array} \right\}$	Found (Mean).
Λ	0.0131	0.0197
M	990.0	965.0

Starch, $n (C_6H_{10}O_5)_n$.—The authors found it impossible to apply Raoult's method to starch-paste; solutions of soluble starch produced so slight a depression that no reliable results could be obtained; a number of concordant results pointed, however, to a molecular weight of 20,000 to 30,000. In order to ascertain whether the failure in this case was due to a high molecular weight, or to the inapplicability of the method to colloid substances, the authors examined an arabic acid, having a rotatory power of $[\alpha]_D = +61.16$; this gives results pointing to a value for M of 717, thus rendering it most probable that the small influence exerted by soluble starch on the freezing point was due to its high molecular weight.

Indirect evidence of the size of the soluble starch molecule was then sought from an examination of the dextrins. In former papers the authors have shown that when starch is broken down by diastase, a resting-stage in the reaction is reached when the amount of dextrin present in the conversion corresponds to one-fifth of the weight of the starch taken, and they have also shown from this and other facts that the molecule of soluble starch must be five times the size of the molecule of this stable dextrin. Determinations of several preparations of this dextrin gave the following numbers:—

—	Calculated for $20 C_{12}H_{20}O_{10}$	Found (Mean).
Λ	0.0029	0.0030
M	6180.0	6221.0

Consequently the value of soluble starch would be five times this, namely, its formula would be $5 (C_{12}H_{20}O_{10})_{20}$ and its molecule weight 32,400.

The size of the starch molecule having been as far as possible determined in this indirect way, the authors turned their attention to the dextrins. It is usually considered that these substances constitute a polymeric series, and it was endeavoured to apply Raoult's method to the solution of this question. A number of the higher dextrins were prepared from starch transformations stopped at an early stage of hydrolysis, and examined. All the results obtained show that the freezing method affords no evidence of there being any difference in molecular size between the so-called high and low dextrins, the numbers being, in fact, almost identical with those given above.

From a consideration of the results obtained with soluble starch, and with dextrins of varying position in the series, the authors conclude that the evidence points to the conclusion that the dextrins are metameric, and not polymeric compounds, as was suggested by O'Sullivan in 1879. They therefore abandon their former working hypothesis of the hydrolysis of starch by diastase, and now consider the starch molecule to consist of four complex amylin-groups, arranged round a fifth similar group, which constitutes a molecular nucleus. When hydrolysis takes place this complex is broken up, four amylin-groups being liberated; these are capable in turn of undergoing further hydrolysis into one or more malto-dextrins, and ultimately into maltose, whilst the fifth amylin-group, which constituted the nucleus of the original molecule, resists the action of hydrolysing agents, and forms the stable dextrin of the No. 8 equation.

The authors therefore assign to each amylin-group of the five, the formula $(C_{12}H_{20}O_{10})_{20}$ corresponding to a molecular weight of 6,480; the molecule of soluble starch being thus represented by the formula $5(C_{12}H_{20}O_{10})_{20}$ which corresponds to a molecular weight of 32,400.—G. H. M.

Pentacetyl-dextrose. E. Erwig and W. Koenigs. Ber. 22, 1464—1467.

Up to the present time the only crystalline derivatives of grape-sugar known, which prove the presence of five OH-groups in the carbohydrate are aceto-chlorhydrate, $C_6H_5OCl(OC_2H_5O)_4$ and acetonitrose $(OC_2H_5O)_4C_6H_7O$, (ONO_2) , neither of which crystallises very readily.

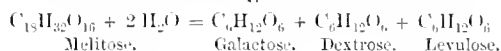
The authors have succeeded in obtaining a pentacetyl-dextrose by boiling pure grape-sugar (5 grms.) for 10 minutes with acetic anhydride (20—22 cc.), and a trace of zinc chloride; the yield is good.

As pentacetyl-dextrose crystallises well, and can be easily obtained in a pure state, its formation can be employed for the identification of grape-sugar.—F. S. K.

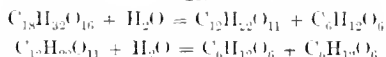
The Inversion Products of Melitose (Raffinose). C. Scheibler and H. Mittelmeier. Ber. 22, 1678—1686.

According to the observations of different chemists, it seems probable that melitose yields on inversion a mixture of three glucoses: galactose, dextrose, and levulose. The inversion may take place either in one or two stages, as shown by the following equations:—

I.



II.



By the action of very dilute sulphuric acid, melitose is split up according to the first equation under II. That the reaction takes this course was shown by the fact that the osazone prepared from the inversion products could be separated into two portions, one soluble, the other insoluble in hot water. Now, according to E. Fischer, the osazones of the simple glucoses are all insoluble in hot water, whilst the diglucoses, such as milk sugar, yield an osazone soluble in hot water. The glucose formed was levulose. The diglucose produced has apparently the composition of milk sugar, but a closer examination proved it to be a new body. Its specific rotatory power, as calculated from the optical activity of the products of inversion, is considerably higher than the specific rotatory power of lactose. Its osazone is a yellow powder, melting, when quickly heated, at 176° — 178° C. Lactosazone melts at 200° C. The new osazone is fairly soluble in hot alcohol, but separates slowly on cooling. It is difficultly soluble in ether, chloroform, and benzene, easily soluble in warm strong acetic acid, forming a dark red solution. So far the authors have been unable to obtain the new sugar in the crystalline state. They propose to name it "melibiose." The complete inversion of melitose requires protracted heating with sulphuric acid, the solution becoming very yellow in colour, and a small quantity of humin substances being separated. The mixed osazones prepared from the products of inversion were practically insoluble in hot water, and melted at 200 — 201° C. (Compare this Journal, 1887, 445).—H. T. P.

The Oxidation of Rhamnose (Isodulcitol) by Nitric Acid. W. Will and C. Peters. Ber. 22, 1697—1704.

MALIN obtained, by the oxidation of rhamnose with strong nitric acid, an acid of the formula $C_6H_{10}O_8$. This result is incompatible with the present view of the constitution of rhamnose, which is considered to be an aldehyde of the formula $C_6H_{12}O_5 + H_2O$. The authors have, therefore, re-investigated the subject, and find that the chief product

of the oxidation of rhamnose by nitric acid is trihydroxy-glutaric acid. The potassium salt of the acid was prepared, and found to be in every respect identical with the potassium salt of trihydroxyglutaric acid, as described by Haushofer. The calcium salt, $C_6H_7O_8(Ca + 3H_2O)$, is prepared by mixing a strong solution of the potassium salt with calcium chloride. The barium compound is prepared in a similar way. On adding lead nitrate to a dilute solution of the potassium salt, a white amorphous precipitate of the lead salt is obtained. The silver compound obtained in a similar manner is a voluminous, colourless precipitate, rapidly changing to the crystalline state. The formation of this acid settles any doubts as to the constitution of rhamnose, and proves it to be $CH_3.CHOH.CHOH.CHOH.CHOH.CO.H$.

In a former paper the authors described a lactone, $C_6H_{10}O_5$, obtained by the action of bromine and water on rhamnose. This body was very similar to Kiliani's meta-saccharin. The authors have prepared crystals of the body, and find it to be totally different to meta-saccharin.

—H. T. P.

PATENTS.

Process and Apparatus for obtaining Sugar Liquor from Sugar Cane, or for obtaining Extracts. H. A. Hughes, Rio Grande, N.J., U.S.A. Eng. Pat. 7131, April 29, 1889. 8d.

THE main feature in this invention is the manner in which sugar cane, or sorghum, is subjected to the process of diffusion. In this case the diffusion battery consists of a series of shallow round cells placed in an annular tank provided with a cover, to which the cells are attached, the annular tank serving as a steam or hot-water jacket to the cells. By means of a crane with horizontal arms arranged round a vertical shaft placed in the centre of the battery system, baskets made of perforated sheet copper, and containing the cane chips, are placed in the cells, which contain water, in rotation, the chips being exhausted when they leave the last cell. When the liquor in the first cell is sufficiently dense it is drawn off and the cell refilled with water, the process being carried out in the well known systematic manner. To avoid the gradual removal of water from the first cell, if the chips were introduced dry, the baskets containing the chips are first dipped into another tank of strong sugar liquor before being introduced into the regular battery cells. Apparatus is also described for removing the leaves from the canes and cutting and shredding the stalks. Detailed drawings accompany the specification.—W. M.

Apparatus for Refining Loaf Sugar in the Moulds. C. Steffen, Vienna, Austria. Eng. Pat. 8052, May 14, 1889. 8d.

THE apparatus consists of "a series of moulds with or without sieves at their apex according to the kind of sugar used, that is sugar in hard crystallised form, or in the form of granular pulpy mass, arranged one above the other so as to form an air-tight fitting column-like battery, into the upper mould of which the lixiviating fluid, consisting of a saturated solution of pure sugar, is led, from whence the said fluid descends through all the moulds in the said battery, and leaves the last mould as an impure syrupy fluid, the moulds in the said battery being exchanged by removing the uppermost mould containing perfectly refined sugar, and inserting a fresh mould, charged with sugar to be treated, at the lowermost end of the battery."

Compressed air is used to force the liquor out of the uppermost mould when it has been sufficiently refined. Drawings accompany the specification clearly showing the mechanical carrying out of this process.—W. M.

XVII.—BREWING, WINES, SPIRITS, Etc.

PATENTS.

Improvements in the Rectification of Alcohol. A. T. Christophe, Paris, France. Eng. Pat. 12,642, September 1, 1888. 6d.

PREVIOUS to distillation the spirit is treated in the cold with sodium amalgam, or with an alloy of sodium with tin, lead, or other suitable metal. Calcium hypochlorite (bleaching powder) is also added. The operation is best conducted as follows: The spirit is placed in a large vat provided with stirring apparatus, and diluted with water to about 10 per cent. strength. Bleaching powder is then stirred in at the rate of 1 gram. per litre of the diluted spirit. After standing some minutes the sodium amalgam or alloy is added in such quantity that about 15–20 grms. of sodium are present per 100 litres of the spirit. The stirrers should be kept in motion for half an hour or more. After some time the spirit is transferred to the rectifier and distilled in the usual manner. It will be found that the good spirit comes over at an earlier stage than usual, and the yield is larger and better in quality.—H. T. P.

A Process for Producing Extract of Hops, and for the Preparation of a Beverage or Beverages therewith. L. Groezinger, Stuttgart, Germany. Eng. Pat. 13,212, September 12, 1888. 6d.

THE resinous matters are first removed by means of spirits of wine. The extraction is carried on in wooden or tinned vessels provided with false bottoms and taps for drawing off the liquor. The hops are tightly packed in and covered with four parts of alcohol to one of hops. After two days the extract is run off and the hops pressed. The hops are next boiled with water in a copper boiler. The hops are placed on three trays made of woven tin wire stretched over tin hoops. These trays rest on projections inside the boiler and can be removed at will. The pressed hops are shaken out and placed between the divisions of the boiler and boiled with 15 parts of water for every one part of original hops. After half an hour the extract is run off, and the extraction continued with a fresh portion of water, and so on. The decoction so made can be clarified with gelatin, albumen, &c., in the usual way. To make beer from this extract, malt-sugar and colouring matter are added, and the mixture is filtered and aerated with carbonic acid gas. The extract may also be employed to improve fermented beer at any stage of its preparation. For this purpose a stronger extract may be made by mixing the spirit infusion with the first and second decoctions, and taking only 6–8 parts of water in the preparation of these decoctions.—H. T. P.

Improvements relating to Apparatus for the Pasteurisation of Beer, Wine and other Liquids. W. Kuhn, Clermont-Ferrand, France. Eng. Pat. 15,261, October 23, 1888. 11d.

THE apparatus consists of a large copper cylinder surrounded by a sheet iron jacket or outer cylinder, the whole being arranged horizontally. The ends of the two cylinders can be easily taken off, so as to allow of the apparatus being cleaned. A large copper coil occupies the whole length of the inner cylinder. One end of the coil passes right outside the apparatus; the other end communicates with the space between the two cylinders. The apparatus is provided with a pressure gauge, two thermometers, and a number of taps for the entrance and exit of beer, gas, and heating and cooling water. The whole is supported on iron feet. The beer to be pasteurised is filtered and forced into the apparatus at the bottom. When full, the tap is closed, and hot water is circulated through the coil and jacket. When the beer has been brought to the desired temperature and pressure, it is again rapidly cooled by passing cold

inconvertible liquid through the coil. Pure air or carbonic acid gas is then forced into the apparatus, and the beer transferred to sterilised and hermetically closed casks. These cylinders may also be combined in sets of three, the liquid to be sterilised being heated in the first, partially cooled in the second, and completely cooled in the third. An arrangement is described in which the coils are placed vertically. It consists of three copper vessels superimposed and provided with coils, casings, &c. as before. The beer is heated in the top vessel, and passes through the middle and bottom vessels, in which it is cooled. A third apparatus is described, by means of which a continuous flow of sterilised beer may be obtained, without loss of gas. It consists of three vertical cylinders with coils, &c., each preceded by an additional coil. Between each set of two coils, and also at the beginning and end of the apparatus, there is a pump. Beer is forced continuously through the apparatus. It is sterilised in the first two vessels, and cooled in its passage over the second and third set of coils. No escape of carbonic acid can take place at any stage, for the pump-valves are so arranged that when one is open the preceding and following ones are closed.—H. T. P.

Apparatus for Supplying Carbonic Acid Gas to Liquors in Casks or other Receptacles. H. Hürtter, Coblenz, Germany. Eng. Pat. 5940, April 6, 1889. 6d.

THE apparatus consists of a wrought-iron gas cylinder, open at one end, in which a valve is screwed. A narrow passage connects the reservoir with the valve chamber. A screw spindle passes through a stuffing box into the valve chamber. The spindle terminates outside in a triangular head, so that by means of a key it can be screwed right down on the narrow opening leading from the reservoir, closing it. The valve chamber is provided with a lateral opening, by means of which the reservoir is filled and emptied. To provide means for fixing the apparatus in cask, the nut at the top of the valve chamber carries a tube, which is screw-threaded outside. Having filled the cylinder through the side passage, the valve is screwed down and protective caps screwed on the lateral opening and over the valve. The apparatus may be kept filled for an indefinite time. To insert the apparatus in a barrel, the latter is provided with a screw bung, having an opening closed by a screw plug. The bung is unscrewed, the apparatus screwed in place of its inner plug, so that the head of the valve may be reached through the opening in the bung: the apparatus is passed into the cask, and the outer bung now carrying the apparatus screwed fast. By turning the spindle from the outside by means of the key, the gas will escape inside the cask.—H. T. P.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A)—CHEMISTRY OF FOOD.

PATENT.

An Improved Manufacture of Cattle and other Food. A. W. MacIlwaine, Kingston-on-Hull. Eng. Pat. 10,488, July 19, 1888. 4d.

By extracting the residue from the preparation of mustard from mustard seed, by means of volatile solvents and steam, the inventor renders it fit for admixture with cattle and other food.—E. J. B.

(B)—SANITARY CHEMISTRY.

PATENT.

Improvements in the Method of applying Soluble Disinfectants and Antiseptics, and in means therefor. R. Le Neve Foster, Manchester. Eng. Pat. 7602, May 7, 1889. 4d.

SOLUBLE disinfectants in a solid form, e.g., carbolic, cresylic or other tar acids, are enclosed in a cage of wire work or perforated metallic sheeting, such cage being either floated on the liquid to be impregnated or fixed at the normal fluid level thereof.—C. C. H.

(C)—DISINFECTANTS.

PATENT.

Improvements relating to the Utilisation of Peat for Antiseptic and other Purposes. C. Rutten, Grivepécé, Belgium. Eng. Pat. 11,465, August 8, 1888. 6d.

PEAT has long been used as a dressing for wounds, but though it possesses surprising healing qualities it has not been largely used on account of its inconvenient character. The present invention remedies this by producing a peat wadding. After dessication the raw peat is heckled to remove knots, then beaten and mixed with a small quantity of cotton, hair, or wool, or other suitable material, to give more cohesion to the finished mass; it is carded. Finally, it is slowly boiled in water, with or without the addition of antiseptics, such as corrosive sublimate, and carded into a uniform nap of wadding; this renders it soft, pliable, and absorbent, without detracting from its valuable properties as a surgical bandage.—C. C. H.

XIX.—PAPER, PASTEBOARD, Etc.

Aluminous Cake: Its Composition and Use in Paper Making. Chemical Trade Journal, 5, 158.

SULPHATE of alumina is extensively used in the sizing of paper pulp in the beater engine. There is a large home consumption of aluminous cake, and also a large export trade between this country, the Continent, and America. Its application is confined to the manufacture of cheap printing papers. For finer grades of paper it might also be used providing not too much per ton of paper were required and that it were free from iron. Its mode of preparation is as follows:—

The china clay is first of all calcined by being heated on the bed of a reverberatory furnace until all hygroscopic, and practically the whole of the combined water has been driven off. The calcined clay is now withdrawn and cooled, and consists essentially of an anhydrous silicate of alumina, together with other substances which, in our particular case, may be looked upon as impurities, namely, a small percentage of lime, and a little silicate of iron, a portion of which, however, is doubtless decomposed during the calcining operation. The calcined clay is then removed when cold, and is finely ground in a mill suitable for the purpose, the ground portion being riddled upon a very fine sieve. The coarse granules of clay, which do not pass through the sieve, return to the mill and are re-ground, whilst the sieved portion is used for mixing with the oil of vitriol. This mixing of the clay with the oil of vitriol is the most important operation in the preparation of aluminous cake, and is generally carried out according to exact measurement in large cast-iron vessels or vessels of other material lined with lead and fitted with agitators with which the mixture is stirred. The clay is introduced into the "mixer" simultaneously with the acid in suitable proportions, the acid being of suitable strength. A very violent reaction takes place, in which the sulphuric acid splits up the silicate of alumina

(clay), liberating the silica, and combining with the alumina to form sulphate of alumina. Any lime, and indeed the greater part of the silicate of iron, also oxide of iron, which are present in the calcined clay, are also acted upon, forming soluble salts, which, as a matter of fact, constitute the impurities of aluminous cake. After the violent action has subsided, and the thick putty-like mass begins to get stiffer, the charge of clay and acid is dropped through a door in the bottom of the mixer into a large iron waggon with moveable sides, where it is kept warm and allowed to remain for twelve or more hours to enable the chemical action to cease. After the lapse of this time the moveable sides of the iron waggon are removed, and the mass of aluminous cake, which is still hot and comparatively soft, is loosened, and by means of a screw worked automatically with suitable machinery, is pushed forward about half an inch at a time underneath the knife of a huge guillotine, which cuts the face of the block in a vertical direction as the knife descends, the aluminous cake falling in fragments into a waggon placed immediately underneath. The cut cake is then stored in heaps until it appears dry, or until all further possibility of the acid acting upon the clay has ended. In this state it is placed in bags and sold to the paper makers. Its composition is fairly regular, and may be represented by the following analyses of the English-made article:—

ANALYSES OF ALUMINOUS CAKE.

	"A."	"B."
Sulphate of alumina	Per Cent. 41.80	Per Cent. 39.49
Free sulphuric acid	84	2.65
Sulphate of peroxide of iron	45	50
Silica, undecomposed clay, &c., or substances insoluble in water	24.90	20.48
Water, lime, magnesia, less, &c.	32.01	36.97
	100.00	100.00

The quality of "A" is superior to that of "B," because it contains considerably more sulphate of alumina, less free sulphuric acid and sulphate of peroxide of iron, and more insoluble matter. The amount of free acid in "B" is very high and is really unusual. Where it contains this ingredient in such quantity the aluminous cake is somewhat soft and appears damp and dull in colour.

Aluminous cakes seldom contain much sulphate of lime, and if they do, this impurity does not affect their applicability in the manufacture of paper. Nor, indeed, does the presence of a small quantity of free acid such as that contained in "A," because it can always be neutralised by the soda contained in the resin size used along with aluminous cake in the process of sizing paper pulp. Excepting dirt, the sulphate of peroxide of iron (ferrie sulphate) is the only impurity which the cake usually contains, and it is this towards which the paper maker has such an objection. As a matter of fact, however, the purposes for which aluminous cake is used are such as not in most cases to be influenced by the presence of a small quantity of sulphate of iron like that which exists in ordinary aluminous cake. The iron salt will, of course, have a telling effect upon the finished paper, should it be present in abnormal quantity, say to the extent of four or five per cent., but as a general rule it does not contain anything like this quantity. The amount of anhydrous sulphate of alumina which it usually contains is from 40 to 42 per cent. (equal to from 11.93 to 12.52 per cent. of alumina (Al_2O_3)). This sulphate is the real sizing material, and that for which the cake is used, and in practice its percentage amount should always be regular or within certain limits.

The distinguishing feature of aluminous cake when compared with other aluminous compounds used by paper makers for sizing, lies in the fact that it always contains

a certain percentage of silica and undecomposed clay which are insoluble in water, but serve as loading material when it is added in the crude solid state to the pulp in the beater engine. In the manufacture of common news- and cheap printing-papers, when loading substances are used, this insoluble matter in the aluminous cake remains with the fibre, and appears in the finished sheet of paper, representing so much ash.

By virtue of this fact, the insoluble matter possesses a value of its own, corresponding to its equivalent in weight and the value of china clay, which, as is well known, is the most commonly used loading material in the paper trade.

Aluminous cakes should be free from grit and dirt of any kind, and it is usually added directly to the pulp in the beater engine, no care on the part of the paper maker being taken to free it from these impurities before use. The insoluble matter consists of varying quantities of silica and undecomposed clay. Although these are in a fine state of division, they do not possess the same properties as china clay. Neither of them feel so soft or soapy when rubbed between the fingers. The silica is in a state of very fine powder, but nevertheless does not possess the power of communicating that body and surface frequently required in finished paper, and any lack of surface on papers sized with aluminous cake is very likely due to the presence of this ingredient. The requirements of the printer demand that paper, when used on the high-speed printing machines of the present day, will not yield any dust, and as it is difficult to fix silica within the fibre when in a very fine state of division on soft size paper, especially when starch cannot be or is not used, the probability is that this silica, and indeed the undecomposed clay as well, is thrown off on unwinding the reel as it enters the printing machine and causes the trouble referred to, besides stopping up the type. A common basis of comparison of the amounts of ferrie sulphate in aluminous cakes offered in the market, is generally adopted. If the amount of sulphate of iron be calculated on 100 parts of anhydrous sulphate of alumina in each of the analyses of the foregoing samples, the relative quantities of iron salt are strictly comparable. Anhydrous sulphate of alumina is really the useful ingredient to paper makers in the aluminous cakes they buy, and hence to compare one sample with another, all impurities should be calculated on, say, 100 parts of sulphate of alumina. In the case of the impurity, viz. ferrie sulphate, in analysis "A" we have thus, 1.076 parts, and in "B" 1.269 parts on 100 of anhydrous sulphate of alumina. This example may be extended of course to comparison with the other impurities.—W. S.

PATENTS.

Bleaching Paper Pulp by Electricity. E. H. M. Andreoli, Brixton. Eng. Pat. 8161, June 4, 1888. 6d.

THIS process relates to the bleaching of paper pulp, &c. by means of an electrolysed solution of common salt or sea water. The inventor claims in addition: The construction of anodes and cathodes by fusing, casting, reducing, and peroxidising chloride of lead alone (for cathodes) and in combination with other metallic salts, such as chloride of manganese (for anodes); the use of an alternating current; the treatment of paper pulp in bleaching tanks where the electrolyte, raised to its proper degree of bleaching power by the action of oxygen or ozone in its nascent state, in combination with chlorine and hydrogen, circulates and is maintained at the required chlorometric standard by the influx of freshly electrolysed solution to replace the corresponding quantity of exhausted electrolyte which flows out of the tank by a pipe, and also of a large peroxidised anode and a spongy lead or carbon cathode through which an electric current passes. He also claims the whole process for bleaching paper pulp by the action of hypochlorite of sodium electrolytically generated by means of plates made of a cheap conductive material not easily attacked and corroded by chlorine or oxygen, such as wood charcoal, either for both cathode and anode, but specifically for anode, in the electrolytic tank where chlorine is generated

and combines with hydrogen and oxygen in a more or less active state. It is advisable to heat the liquid to be electrolysed to 60° C.—E. J. B.

Improvements in Machinery or Apparatus for Coating Paper or other Fabric with Glue, Gum, Paste, or other Fluid or Semi-fluid Material. G. J. Feldon, Lambeth. Eng. Pat. 18,066, December 11, 1888. 8d.

A CYLINDER is fixed upon a shaft mounted so as to revolve in a bath of the coating material, so that the underside of the periphery of the cylinder is immersed in the bath. The fibre to be coated is drawn across the cylinder from between nipping rollers covered with india-rubber.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Myrtle Oil and Myrtol. E. Jahns. Arch. der Pharm. 27 [3], 174.

THIS oil as used medicinally begins to boil at 160° and about 80 per cent. distilled over up to 240° C. The residue consisted of high-boiling terpenes partly resinised and partly polymerised. From the portion boiling between 160° to 240° C., by repeated fractional distillation the following constituents were separated:—

A Terpene, $C_{10}H_{16}$, boiling between 158° and 160°, and having a specific rotation $[\alpha]_D^{20} = +36.8^\circ$. Its properties led the author to believe it to be right-handed *Pinene*.

Cineol, $C_{10}H_{18}O$, which purified by Wallach's method, boiled constantly at 176°.

A Camphor, probably of the formula $C_{10}H_{16}O$, in small quantity, boiling at 195° to 200° C. The therapeutic value of the *Myrtle Oil* is to be traced to the amount of cineol present in it, the latter substance being identical with eucalyptol and eucalyptol.—W. S.

Some New Compounds of the Quinine Alkaloids. J. Hesse. Pharm. Zeit. 1889, 191.

THE compound of phenol with some salts of the quinine alkaloids of left-handed polarisation have long been known and are much used as febrifuges, as e.g., quinine phenol sulphate, $(C_{20}H_{21}N_3O_2)_2 \cdot SO_3 \cdot C_6H_5O + 2 H_2O$. The author has recently prepared a new compound of phenol with quinine bisulphate. If carbonic acid be added in equivalent proportion to a hot aqueous solution of quinine bisulphate, on cooling at first an oily mass separates out, above which delicate white needles are gradually formed, of the composition $C_{20}H_{21}N_3O_2 \cdot SO_3 \cdot C_6H_5O + 3 H_2O$. This compound is very unstable. If it be dissolved in hot water, on cooling the first-named normal salt crystallises out. Quite in accordance with this is the behaviour of the acid Quinine resoreinol sulphate, the acid Quinine quinol sulphate, the acid Quinine pyrogallol sulphate, and the acid Cinchonidine pyrogallol sulphate, for one and all they separate out the normal salts when the attempt is made to recrystallise them from hot water. The author further prepared and describes the normal Quinine oreinol sulphate, Quinine catechol sulphate, Cinchonidine quinol sulphate, as well as the Quinine resoreinol, Quinine catechol, and Quinine pyrogallol hydrochlorides. They are beautifully crystallised compounds and some of them excellent febrifuges.—W. S.

Mercury Benzoate. E. Lieventhal. Pharm. Zeit. Russl. 28, 310.

ONE hundred and twenty-five parts of mercuric oxide are dissolved in 250 parts of nitric acid (1.20 sp. gr.), the solution diluted with 4,000 parts of water and filtered; to this a solution of 188 parts of sodium benzoate in 4,000 parts of water is gradually added with agitation. The voluminous precipitate of mercuric benzoate obtained, after washing, pressing and drying, forms a light, white powder, soluble with difficulty in ether, alcohol, chloroform and water.—O. H.

Macassar Oil. L. v. Itallie. Apoth. Zeit. 1889, 4, 506.

Schleichera trijuga is one of the *Sapindaceæ* and bears red-brown seeds averaging 0.5 grm. in weight; these contain about 36 per cent. of a buttery fat which is "Macassar oil." It has a specific gravity of .924 at 15° C., melts at 28° C., has an iodine number of 53, a saponification equivalent of 219 (1 grm. requires 230 mgm. of potash for saponification), contains 91 per cent. of insoluble fatty acids and 6.3 per cent. of glycerol. The fatty acids present include acetic, butyric, lauric, arachidic and oleic acids.

—B. B.

Macassar Oil. K. Thümmel. Apoth. Zeit. 1889, 4, 518.

A SAMPLE examined by the author had a melting point of 21°—22° C. instead of 28° C. given by Itallie (see preceding abstract). The presence of hydrocyanic acid was detected and 0.047 per cent. obtained by steam distillation. Benzaldehyde was recognised in the distillate by its transformation into benzoic acid by the action of potassium permanganate. These substances might have owed their origin to sophistication with bitter almond oil; an examination of the seeds would settle this point.—B. B.

Compounds of Mercury with Phenols. E. Merck. Apoth. Zeit. 1889, 4, 651.

Mercury phenate, Hydrargyrum phenolicum, is obtained by precipitating corrosive sublimate with sodium phenate. According to the conditions of precipitation a more or less basic salt is obtained which is used for injections in the treatment of syphilis.

Mercury thymylate is obtained by precipitating mercuric nitrate with sodium thymylate and forms a greenish-violet precipitate of the formula $C_{10}H_{13}HgOH$.—E. E. B.

Distilled Perfumes and Essential Oils. Report by Consul Mason, United States Consulate, Marseilles, 602.

THE process of distillation varies but slightly for all varieties of lavender, and the same apparatus is often used successively for each kind of plant as its season of flowering and harvest arrives. The necessary machinery includes as its principal feature a copper alembic, usually about 6 ft. in height by 4 in. diameter, the beak of which is carried over and terminates in a spiral coil immersed in cold water. Each alembic has, near the top, an opening closed by a man-head, secured by bolts as in ordinary steam machinery. Through this opening the mass of fresh plants is packed into the interior until it is completely filled. Near the bottom of the alembic another similar opening is provided through which the spent material may be withdrawn with a pronged hook like a manure fork with curved tines. The bottom is covered with a perforated copper diaphragm, under which lies a flat coil of pipe, likewise perforated, through which steam is introduced from a boiler in which a pressure of from 5 to 7 atmospheres is maintained. The alembic being thus charged with raw material—either freshly gathered or dry—and the man-heads closed, the steam is turned on and forces its way upward through the mass, absorbing and carrying the perfume over into the submerged coil, where the oil condenses and trickles out with the distilled water, upon which it floats by reason of

lighter gravity. In about three hours the perfume is exhausted, when the alembic is emptied and recharged. Three hundred pounds of dried lavender plants, or 220 lb. of *Aspic*, are required to produce 1 lb. of essential oil.

There are two species of the absinthe plant—the large and small—which are used respectively in the manufacture of absinthe liqueurs and vermouth. In manufacturing the liqueur the upper leaves and twigs of the plant are macerated with hyssop, calamus, citronelle, anise, fennel, diadane, and other vegetable substances. The decoction thus obtained is distilled, and the product treated with alcohol, sugar, and various colouring matters.—A. J. S.

Report on New Drugs and Fine Chemicals. Merck's Bull. 2 [6].

Chromic Acid.—This acid has been known as an escharotic in the nasal and pharyngeal cavities as far back as 1885. Danger had hitherto been found in the use of this stringent means of topical causticisation, of cauterising the adjacent healthy parts. This danger has been traced to the usual presence of sulphuric acid in the preparations offered. This sulphuric acid makes the chromic acid (anhydride) deliquescent and causes it therefore to run upon adjacent parts and so spread the action too far. If but traces of sulphuric acid are present the action may be injurious, and hence the Prussian War Department ordains that only chemically pure chromic acid may be used in the treatment of foot-sweat among the troops.

Pyrodiene or Acetyl-phenyl-hydrazine.—Guttmann's researches (Berliner Med. Ges. May 1, 1889) fully confirm the results of Dreschfeld of Manchester.

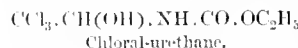
Antiseptic (Brominated Antifebrine or Parabromophenyl Acetamide), $C_6H_4(Br)NH.COCH_3$, is devoid of smell or taste. It crystallises in small, pearly prisms, melting at 164.5° C. It is insoluble in cold, with difficulty in hot water, only slightly in glycerol, but easily in alcohol or ether. A one per cent. alcoholic solution may be treated with twice its volume of water or thrice its volume of glycerol, without turbidity ensuing.

Evalgine (Methylphenylglucetamide or Methylated Antifebrine), $C_6H_5N(CH_3)CO.CH_2$ —It appears in the form of white plates or fine white needles, melting at 101° C. Compare this Journal, 1889, 412 and 567.

Methacetine (Orymethyated Antifebrine or Para-acetamidine), $C_6H_4(OCH_3)NH.COCH_3$.

As might have been suspected, from its chemical constitution, so analogous to that of Phenacetine, it appears that Methacetine has developed physiological properties quite similar to those of the former substance. Its action is antithermic, without untoward accessory symptoms, though frequently, according to Mahner, heavy perspirations ensue. The antiseptic properties of Methacetine are proved by the fact that a 1 per cent. solution arrests the decomposition of milk, and prevents the ammoniacal fermentation of urine.

Chloral Urethane, CC_l3.CH(OH)NH.CO.OC₂H₅ is obtained by the union of 1 mol. of chloral (not the hydrate) to 1 mol. of urethane, thus:—



It is a crystalline mass, insoluble in cold water, and decomposed by boiling water into its two components. Alcohol and ether dissolve it readily, and water separates it from these solutions. Its melting point is about 103° C.; it attains this point only, however, after partially decomposing from 100° C. upwards. Chloral-urethane was first investigated as to its therapeutic properties by Hübner and Sticker (*Deutsche med. Wochenschr* 1886 [14], 236), and compared with ethylidene-urethane and methyl-urethane. The last two compounds were found to be entirely inert in doses of 1

to 4 grms., whilst chloral-urethane produced hypnotic effects like ethyl-urethane, although in a less certain and persistent degree. Mairet and Combemale (*Mondpellier med.*, 1886, 149) concluded that the toxic effect outweighed the hypnotic in prominence and importance of symptoms. The sleep induced was always attended with paralysis of the hinder parts in the case of animals.

Nicotine Bitartrate (Acid tartrate).—The manufacturing method for preparing this salt was invented by Dr. Dreser, of Strasburg. It is a beautifully crystalline substance, and perfectly stable, whilst on the other hand all the remaining known simple salts of nicotine are very difficult to crystallise, and hence the strengths of their solutions become variable and unreliable. Also the solutions of the free alkaloid have the tendency to resinify, thicken, and darken, and to become therapeutically unavailable. The *Bitartrate* (Dreser) crystallises in fine white tufts of needles, and is very readily soluble in water. Its composition, on analysis, shows the proportions $C_{10}H_{11}N_2$ (nicotine) = 32.53 per cent.; 2 $(C_4H_4O_6)$ tartaric acid = 60.51 per cent., and 2 H_2O = 7.34 per cent. The physiological experiments (*Archiv. der Pharm.* 1889, 269) showed that the well known specific effects of the pure alkaloid are all produced likewise by this salt, and in like degree.—W. S.

Synthesis of Active Coniine. A. Ladenburg. *Ber.* 22, 1403—1405.

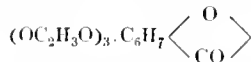
SCHORLEMMER ("Rise and Development of Organic Chemistry") has stated that the complete synthesis of active coniine has not yet been accomplished, but the author has previously shown that the alkaloid in question can be obtained from its elements.

Acetic acid can be prepared synthetically, and from it acetone, isopropyl alcohol, and glycerin can be successively obtained. Glycerin can be converted first into bromallyl, and then into trimethylene bromide, and from the latter piperidine and finally pyridine can be produced. α -Picoline can be obtained from pyridine (Ladenburg and Lange, *Ann.* 247, 5), and can be converted into coniine (Ladenburg, *Ann.* 247, 80). (This Journal, 1887, 224.)

The dextro-tartaric acid, which is necessary to the production of the active base, can also be prepared from its elements.—F. S. K.

Acetyl Derivatives of Quinic Acid. E. Erwig and W. Koenigs. *Ber.* 22, 1457—1464.

Triacetylquinide—



is obtained when quinic acid (10 grms.) is boiled with acetic anhydride (70 cc.). After distilling most of the acetic anhydride and acetic acid the residue is repeatedly evaporated with absolute alcohol on the water-bath, washed with cold ether to remove resinous impurities, and recrystallised several times from boiling alcohol with addition of animal charcoal. The yield of pure substance is 8 grms. Triacetylquinide melts at 132°, is almost insoluble in cold dilute sodium carbonate and only sparingly soluble in cold water and cold alcohol, but readily in the boiling solvents. The conversion of quinic acid into the crystalline and easily-purified triacetylquinide can be employed as a most characteristic reaction for the identification of small quantities of the acid.

When triacetylquinide or quinic acid is heated with acetic anhydride at 240° an isomeric triacetylquinide (isotriacetylquinide) melting at 139° is formed. The yield of pure substance, isolated as described above, is 50 per cent. of the quinic acid employed. Isotriacetylquinide is almost insoluble in cold dilute sodium carbonate, and is similar to triacetylquinide in its behaviour towards solvents.

When quinic acid is boiled with acetic anhydride and sodium acetate the principal product is the triacetyl derivative, melting at 132°, but when a small quantity of anhydrous zinc chloride is employed instead of sodium acetate, tetracetylquinic acid is formed in almost theoretical quantities.

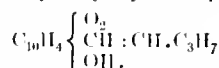
Tetracetylquinic Acid. $(OC_2H_3O)_4 \cdot C_6H_7 \cdot COOH$, melts at about 130°—136°, and is readily soluble in hot water and sodium carbonate, but only sparingly in carbon bisulphide, and almost insoluble in light petroleum.

When quinic acid is heated with acetic anhydride at 170° a mixture of triacetylquinide and tetracetylquinic acid is obtained.

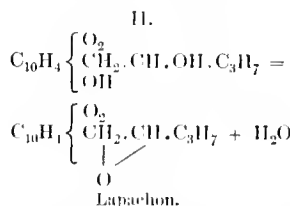
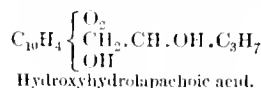
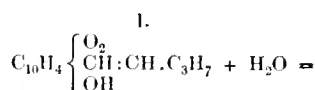
The two triacetylquinides are probably γ - or δ -lactones of quinic acid. Quinic acid seems to contain two OH-groups in the γ - and δ -position to the carboxyl-group for, when an aqueous solution is evaporated with bromine, protocatechuic acid is formed. The formation of meta-chlorobenzoic chloride by heating quinic acid with phosphorus pentachloride also indicates the presence of a γ -OH-group. A third OH-group seems to be in the α -position, as quinic acid, like other α -hydroxycarboxylic acids, evolves carbonic oxide and yields hydroquinonedisulphonic acid when treated with concentrated sulphuric acid.—F. S. K.

Lapacholic Acid and its Derivatives. S. C. Hooker and W. H. Greene. *Ber.* 22, 1723—1727.

The authors have obtained lapacholic acid from a South African wood called *Bethabana*. The substance is identical with that got by Sievert from the lapacho-wood of South America and examined by Paterno. Amongst the derivatives of lapacholic acid obtained by the latter is a body formed by the action of concentrated sulphuric acid, which crystallises in red needles, and to which the name lapachon was given. Paterno assigned the formula $C_{15}H_{11}O_3$ to the acid, regarding it as hydroxyamylene naphthoquinone—



and looked upon lapachon as consisting of two molecules of the acid united by the oxygen atoms of the ketone groups, and as having the formula $C_{30}H_{22}O_6$. The authors have examined this latter body further and find that it possesses all the characteristic properties of a quinone; also its molecular formula as determined by Raoult's method is $C_{15}H_{11}O_3$, and not the double of this. To account for this change it is assumed that lapacholic acid when treated with strong acid first takes up a molecule of water to form an intermediate compound, which is then acted upon by the acid with the elimination of water and the formation of lapachon, which is regarded as a derivative of naphthofurfuran. The following equation expresses the change, using Paterno's formula for the acid:—



Lapachon is not affected by treatment with alkalis or with alkaline carbonates in the cold, but it dissolves in the former on heating, and from this solution acetic acid separates a red oil which solidifies to a yellow crystalline mass melting at 125° C. when pure, and which gave on analysis numbers agreeing with the formula $C_{15}H_{10}O_3$. This is regarded as hydroxyhydrolapacholic acid, the intermediate product in the above reaction. The barium and silver salts of this acid are characteristic.

Other derivatives of lapacholic acid obtained by Paterno are regarded as derived from naphthofurfuran.—C. A. K.

Pseudo-ephedrine. A. Ladenburg and C. Oelschlägel.
Ber. 22, 1823—1827.

NAGAI extracted an alkaloid *Ephedrine* from the plant *Ephedra vulgaris*, the physiological properties of which have been examined, but there is very little known of its chemical nature. From the same genus *Ephedra*, Merck has isolated a second alkaloid by extracting the leaves with alcohol, and to this the name of pseudo-ephedrine is given. This substance has been examined by the authors. It is obtained in the pure form as the hydrochloride by treating the alcoholic extract of the leaves with ammonia, shaking out with chloroform, and after distilling off the latter converting the residue into the hydrochloride and recrystallising this repeatedly from ether-alcohol. This salt is readily soluble in water and alcohol; it melts at 176° and has the formula $C_{10}H_{15}NO \cdot HCl$. The free alkaloid is a crystalline body possessing a slight and very pleasant smell. It dissolves readily in alcohol and ether, slightly in hot water, and melts at 114°—115°. An analysis and a molecular weight determination by Raoult's method agree with the formula $C_{10}H_{15}NO$. Of the salts the picrate, periodide, and the double salts with platinum chloride, cadmium iodide and bismuth iodide are not crystallisable. The gold double salt forms crystalline needles; the hydrobromide melts at 174°—175°, the hydriodide at 165°, and both crystallise well.

Treated with potassium nitrite the hydrochloride yields a nitroso-compound, $C_{10}H_{13}N_2O_2$, showing the base to be a secondary amine. On oxidation with potassium permanganate pseudo-ephedrine yields only benzoic acid; the hydrochloride heated with strong hydrochloric acid in a sealed tube yields a product boiling at 130°—150°, and which on oxidation also yields benzoic acid. At the same time an amine which, from the analysis of its platinum double salt, appears to consist of methylamine together with an amine richer in carbon, results. From these facts the authors regard the following constitutional formula for pseudo-ephedrine as probable:—



The product got by treatment with hydrochloric acid would most likely be a mixture of benzyl-alcohol and phenyl ethyl carbinol, from which benzoic acid would result on oxidation. That there are two replaceable hydrogen atoms is proved by treatment with benzoyl chloride when a crystalline body, $C_{10}H_{13}NO(C_6H_5 \cdot CO)_2$, is obtained.—C. A. K.

Betaine and Choline from the Seeds of Vicia Sativa.
E. Schulze. Ber. 22, 1827—1829.

BETAINE and choline can be extracted from the vetch (*Vicia sativa*) by treating the finely powdered seeds with 90—95 per cent. alcohol, distilling off the latter and then adding tannic acid and lead acetate to the turbid aqueous solution of the residue. After removing the lead in the filtrate by sulphuretted hydrogen and evaporating down the solution obtained after filtering off the lead sulphide, a syrup remains, and this on being extracted with first absolute and then 95 per cent. alcohol after acidifying with hydrochloric acid, yields an extract from which the cholin and betan are precipitated as double chlorides on the addition of an alcoholic solution of mercuric chloride. By decomposing the double salts with sulphuretted hydrogen and filtering off the sulphide of mercury, the chlorides of betaine and of cholin remain in solution, and can be separated by fractional crystallisation from cold absolute alcohol.

11—12 grms. of betaine and 3—3½ grms. of choline were extracted from 20 kilos. of the seeds. Some betaine remains in the residue after extracting the above-mentioned syrup with alcohol; this residue also contains the nitrogenous substance vicin previously isolated from vetch seeds by Ritthausen (J. Prakt. Chem. [2], 24, 202).

It was incidentally remarked by the author that the double platinum chloride of choline crystallises in regular octahedra as well as in prisms.—C. A. K.

Advantage of Santoninoxime over Santonin. F. Coppola.
Rep. de Pharm. 1889, 45, 257.

SANTONIN often produces symptoms of poisoning owing to the large amount of lactic acid formed in the bowels when it is used as a vermifuge, the acid effecting the solution of the santonin. Cannizaro has obtained crystallised santoninoxime by the action of hydroxylamine hydrochloride on santonin in an alkaline solution. This is not poisonous, and is just as efficacious as santonin when given in doses two to three times as large.—E. E. B.

Growth of Quinine in Java. Nederl. Tijdschr. v. Pharm. Chem. en Toxicol. 1889, 1, 152.

THE yield in 1888 was 700,000 lb., of which 603,845 lb. were sent to Batavia. The yield for 1889 is estimated at 900,000 lb. the small yield of 1888 being attributed to prolonged drought.—E. E. B.

Crude Cocaine.

IN the current number of *Ephemeris* it is stated that it is highly probable that the importation of coca leaves into the States and Europe for the manufacture of cocaine is nearly at an end. For more than a year past crude cocaine has been sent from Peru to the States and Europe in rapidly increasing quantities, and of better and better quality than in 1885, when it was first made. During 1888 the quantities exported from Peru became very large, and the quality reached 90 to 96 per cent., and occasionally even 98 per cent. There are now at least four manufacturers in Peru, and the chief market for their products is Hamburg, and, curiously enough, their products can be had better, cheaper, and in a shorter time from Hamburg than from Peru. Besides this, there is a combination of the makers now to keep up the price and to confine the sales to Hamburg. Some idea of the very large quantities produced may be had from the circumstance that one maker has a single contract with a European house for 70 kilogs., or about 154 lb. per month. Another curious circumstance connected with this young industry is that one of the largest and most successful makers is by trade, and was by occupation, a bricklayer when Dr. Squibb's processes were published, and simply took them up as a better and more promising trade for making money. The advantages of exporting the crude alkaloid rather than the coca leaves are many and important. As cocaine is transported in the treasure chests of the steamers the difference in freight is about as ½ lb. to 100 lb. of the leaves. But a much more important economy is shown by a comparison of the yield of alkaloid, by the same process from the same leaves, as worked here and in Peru, the yield there being 13 to 15 per cent. greater. This is owing to the fact that the leaves in transport undergo deterioration. Crude cocaine comes either in granular powder or in fragments of press cake of all sizes and forms up to an inch or two in superficial area, and from a quarter of an inch to an inch in thickness. The general colour is a dull, creamy-white, but is rarely quite uniform throughout any package, varying from a dirty or brownish white to very nearly white. But in this matter of colour it is constantly improving. The fragments vary more in consistence than in colour. A large proportion are hard, compact, and slightly horny when cut or scraped, while others are softer, more porous and chalk-like, and easily cut or scraped, the general density being lighter than the softest, lightest chalk. In Hamburg crude cocaine is nearly all sold upon assays which have generally been in fair accord with each other, and the New York Custom house has generally accepted them in adjusting the duty.—*Chemist and Druggist.*

Discovery of Podophyllin in the Himalayas.

Allen's *Indian Mail* for the 12th August last, quoting from a Lahore paper with reference to a discovery of podophyllin in the Himalaya, says:—

“Dr. George Watt has made a discovery which seems likely to provide the hill tribes of the higher Himalaya

with a lucrative trade, and to supply the medical profession with an abundance of podophyllin, a drug which, as many Anglo-Indians have good reason to know, is a valuable specific in disorders of the liver. Hitherto America has enjoyed a monopoly of the podophyllin plant (*Podophyllum peltatum*), but the researches of Dr. Watt and the analysis by Dr. Hooper, quinologist to the Madras Government, demonstrate that the Himalayan variety (*Podophyllum emodi*) yield three times as much of the valuable resin as the American root, and that it possesses the same medicinal properties. This valuable plant grows wild in the higher, rich, and shady temperate forests from Sikkim to Simla, Kashmir, Hazara Tibet, the Kuram Valley, and Afghanistan. It is fairly plentiful on the northern forest-clad slope of the familiar Shalai hill, seen from Simla; on the almost equally well-known Nagkanda hill and in the Chumba State there are many mixed forests with their glades almost exclusively covered with this prony-rose-like herb. In his notes on the subject Dr. Watt remarks that it is surprising that the natives of India, who have discovered so many drugs, should have failed to detect the properties of the podophyllum root."

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Ammonia in the Gelatin Emulsion. Photogr. Wochenbl. 1889, 15, 132.

In preparing an emulsion by the cold process with ammonia, Belitzki recommends that most of the ammonia be neutralised with sulphuric acid towards the end of the process. An excess of acid must be avoided, as the least trace of free acid diminishes the sensitiveness of the emulsion. If some aurin-collodion be placed on a glass plate and the emulsion added to it, a rose-red colour will be produced if the emulsion is alkaline.—E. E. B.

Preparation of Plates Sensitive to Colour. E. Obernetter. Photogr. Wochenbl. 1889, 15, 133.

The emulsion is made with little gelatin and poured over the plates thin. It is not advisable to add the colouring material to the emulsion at once. If a bath be used for dipping the coloured plates, it has the disadvantage of becoming weaker after the immersion of every plate, so it is preferable to pour the colouring material in an extremely dilute solution over each plate separately, after washing it thoroughly. A good recipe for the colour solution is:—50 parts erythrosin solution (1:1,000), 50 silver nitrate solution (1:1,000), 3 ammonia. The plates may be exposed with or without a yellow screen, but in the former case more than twice as long an exposure is necessary. For developing, an alkaline solution of pyrogallol acid or a hydroquinone solution is used.—E. E. B.

Use of Sodium Sulphite in the Fixing-Bath. Photogr. Archiv. 1889, 30, 161.

When a gelatin dry plate, which has been developed by means of pyrogallol acid, is placed in the fixing-bath of sodium hyposulphite, unless the pyrogallol acid solution has been perfectly removed by washing, the plate will become yellow. To obviate this, William Bell recommends the addition of sodium sulphite to the sodium hyposulphite (proportion 1:5). Negatives fixed by this solution have the tone and character of collodion negatives prepared by the wet process, and the bath can be used much longer.

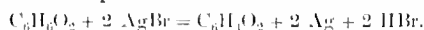
—E. E. B.

Citric Acid in the Hydroquinone Developer. Thomas. Photogr. Archiv. 1889, 30, 162.

The developer consists of two solutions, which are mixed in equal volumes immediately before use. No. 1 consists of 5 parts hydroquinone, 32 sodium sulphite, 2 citric acid, and 1 potassium bromide in 128 parts of water. No. 2 consists of 5 parts caustic soda in 128 of water. This is eight times as powerful as the ordinary pyrogallol acid developer.—E. E. B.

Theory of the Hydroquinone Developer. Phot. Rundschau. 1889, 3, 119.

HYDROQUINONE, $C_6H_6O_2$, is prepared by the action of sulphurous acid on quinone, $C_{10}H_6O_4$. By the action of the former on exposed silver bromide two atoms of hydrogen unite with the bromine liberated and silver is set free, which forms the picture—



Quinone is thus formed again, and the hydrobromic acid combines with the alkali which is necessarily always present in the developer. The alkaline bromide retards development, and on this account old solutions always develop more slowly. The sulphurous acid in the sodium sulphite is supposed to prevent or diminish the rendering of the gelatin brown by the action of the quinone.—E. E. B.

Intensifying by Means of Hydroquinone. Phot. Rundschau, 1889, 3, 194.

If a gelatin negative has been treated with mercuric chloride to intensify it until it has become quite white, instead of then treating it as usual with ammonia it is advised by Dr. Mallmann to wash the plate quite free from any adhering mercuric chloride, and then pour over it a solution of hydroquinone containing sodium sulphite or dip the plate into this solution. The result is an intense negative of a bluish-black tone.—E. E. B.

PATENT.

Improvements in Photometers for Measuring the Intensity of Light in Photographic Camera. J. Decoudun, Paris, France. Eng. Pat. 11,578, August 10, 1888. 8d.

By means of this apparatus the intensity of the light focussed on the screen of the camera, and from that the time of exposure, may be determined. The photometer consists of a series of translucent sectors of a rotary disc, or, as in a modification, of a stationary disc divided into squares or spaces of different degrees of translucency, each bearing a letter or other sign indicating the period of exposure. In the former case the disc is rotated to bring "the gradually darkening luminous points" opposite a lens and eye-piece, while the stationary disc is mounted in a tube also provided with eye-piece and lens. When placed against the focussing screen and viewed through the lens, the letter which is least visible indicates the time of exposure.—O. H.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENTS.

Improvements in Explosive Compounds. A. V. Newton, London, From A. Nobel, Paris. Eng. Pat. 10,722, July 24, 1888. 4d.

This invention relates to the manufacture of an explosive consisting of nitrate of ammonia and picrate of ammonia in the proportion of three parts of the former to one part of the latter.

Gum arabic, dextrin, or an analogous substance is added in the proportion of about $\frac{1}{2}$ per cent. of the material, with a view of hardening it.—C. N. H.

Improvements in Protecting and Preserving Explosives.
C. Lamm, Stockholm, Sweden. Eng. Pat. 11,751,
August 15, 1888. 6d.

THE object of this invention is to protect and preserve explosives which contain hygroscopic salts.

In carrying out the invention, carnauba or other palm wax is employed mixed with Japan wax, naphthalene, paraffin, &c. as a waterproof coating for the explosive when made up into blocks or cartridges.—C. N. H.

XXIII.—ANALYTICAL CHEMISTRY.

On a New Hydrometer. W. Láska. Zeits. f. Instrumentenkunde, 9, 176.

IN consequence of capillary action, measurement by the hydrometer is not certain.



If p be the weight, α capillary constant, ω the angle of contact (Randwinkel), r the radius of the hydrometer, v the volume immersed, d the density of the liquid, u the volume of the instrument in the air, and δ the specific gravity of the air, then—

$$p + 2\pi r \alpha \cos \omega = v d + u \delta$$

or when $u \delta$ is very small and can be neglected—

$$p + 2\pi r \alpha \cos \omega = v d.$$

If, now, p be largely increased, while α and r remain the same, then—

$$p_1 + 2\pi r \alpha \cos \omega = v_1 d$$

$$p_1 - p = (v_1 - v) d; \text{ or } d = \frac{p_1 - p}{v_1 - v}.$$

By means of the instrument shown in the figure which is based on this formula, the influence of capillary action can be avoided. To the upper part of A the tube B is fused. Its use is obvious. The instrument is placed in the liquid and the height read off; a known weight of mercury is then run into B and the height again read off (best by a cathetometer). The difference of height in mm. in weight of mercury in milligrams represents the specific gravity of the liquid.—O. H.

Arsenic in Glycerin (Glycerol). L. Siebold. Pharm. Conference, Newcastle-on-Tyne. Pharm. J. 1889, 205.

THE author has investigated colourless and odourless samples of glycerin sold for toilet and pharmaceutical purposes (this Journal, 1889, 639—640). The majority of the samples tested were found to contain arsenious acid varying in proportion from 1 part in 4,000 parts to 1 part

in 6,000. A few samples exceeded this proportion, and one contained as much as 1 part in 2,500. Some samples free from arsenic were traced all to one process of manufacture, described as being that by which, as a rule, glycerin used for dispensing purposes is understood to be used. The process followed in testing, which was demonstrated by the author, was a modification of one recently recommended by Vulpinus and Flückiger, which depends upon the action of the gas given off by a mixture of the glycerin with zinc and very dilute hydrochloric acid in a test tube upon a paper cap that has been touched with a drop of a solution of mercuric chloride, a yellow spot being the result of the presence of minute traces of arsenic. A further observation by the author was consistent with arsenic being sometimes introduced into glycerin from the glass of the containing bottle, and it is proposed to further investigate this point; but there was a general agreement among the speakers that such quantities of arsenic as those found in some cases were more probably introduced during the manufacture.—W. S.

Solidification of Nitrogen Trichloride. F. Birhans. Compt. Rend. 109, 63.

NITRIC oxide and oxygen in the proportions of 6—8 volumes of the former to 1 volume of the latter were passed through a U-tube cooled to 54°. The large excess of nitric oxide is necessary to prevent the formation of any nitrogen peroxide. The gases must be well dried previously by passing over pumice stone moistened with sulphuric acid, dry baryta, and lime. The blue liquid which collects in the U-tube may be solidified by a mixture of methyl-chloride and carbonic acid with snow, that is to say, at a temperature of -82°C . —A. R.

Wiborgh's Volumetric Process for the Estimation of Sulphur. A. Vosmaer. Chem. Zeit. 13, 695.

THE author substitutes twill for white calico for the collection of the cadmium sulphide, but otherwise performs the analysis as described by Wiborgh. The standard iron is prepared by fusing cast iron with sulphide of iron. Half a gram of a sample is ample for analysis.—E. E. B.

Volumetric Estimation of Sodium Carbonate in the Presence of Sodium Hydrate in Commercial Caustic Soda. H. Goebel. Chem. Zeit. 13, 696.

A DROP of an alcoholic solution of phenol phthalein is added to the cold solution and standard acid added till the colour is destroyed; a drop of Porrier's blue (C. L. B.) is added and then more acid till the solution becomes purple (the colour of an ammoniacal solution of copper). The difference between the first and second titration corresponds to half the sodium carbonate present.—E. E. B.

On the Absorption of Atmospheric Gases by Water.
O. Pettersson and K. Söndén. Ber. 22, 1439—1446.

THE authors have determined the quantity of dissolved gases in water from the Baltic and in the town's water of Stockholm. The results obtained differed so materially from the coefficients of absorption calculated by Bunsen, that it was found advisable to repeat Bunsen's experiments with pure water. The apparatus used is shown in the figure. The side tube of flask A is Y-shaped. One limb is in connexion with the reservoir C, the other with the vessel F, which contains mercury. The caoutchouc tubing between F and D is surrounded by a coil of copper wire. Before introducing the water, F is entirely filled with mercury and the stopcock y is closed. A and B having been filled with water, x is opened and y closed. All the air is now expelled by vigorous boiling of the water in A and of that portion which has passed into F. The operation takes half an hour. In one experiment N and O may be determined, but not CO_2 .

Sulphuric acid should not be added to the water, otherwise mercurous salt is liable to be formed at the cost of the oxygen expelled. After removing CO_2 with caustic soda, oxygen is absorbed by a solution of pyrogallic acid. The great advantage of this apparatus is that constant and almost perfectly accurate results are obtained with it, as the water to be analysed is shut off from contact with the outer air by mercury. Boiling may be continued indefinitely. It is of the greatest importance that the water used should be kept as nearly as possible at the same temperature while it

stress should be laid upon the determination of these gases in water analyses than has hitherto been done. Thus, to find a water abnormally deficient in oxygen, would point to the influence of animal or vegetable life. Attention is drawn to the fact that spring water often contains marsh gas dissolved along with nitrogen. These two gases are obtained together during analysis, and if the volume be larger than is noted down for nitrogen at the given temperature in the above table, the mixture must be further analysed by combustion with oxygen. Thus the authors have found as much as .7 cc. CH_4 per litre in a spring water. Sometimes however there is really an excess of nitrogen, due to the high air-pressure in the regulators of the waterworks, which leads to supersaturation so far as nitrogen is concerned, but not in regard to oxygen.

The town's water was richest in oxygen in September (about 3 cc. over the average); the lowest amount was found in February (about $1\frac{1}{2}$ cc. under the average). The variations in the amount of carbonic acid were just in the reverse order. The maximum of CO_2 was in September (29 cc.) the minimum in March (18 cc.), which facts are probably due to more favourable conditions for oxidation at the summer's heat.—A. R.

The Solubility of Oxygen in Water. L. W. Winkler. Ber. 22, 1764—1771.

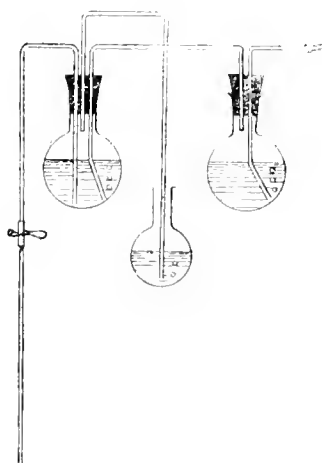
In a former paper (Ber. 21, 2843) the author showed that Bunsen's determination of the absorption coefficients of oxygen, nitrogen, and air required correction. The present paper is devoted to the more accurate determination of the solubility of oxygen in water.

The oxygen was estimated in water saturated with air at different temperatures (0° — 30° C.) by the iodometric method described by the author in a former communication, and from these values the absorption coefficients were calculated.

The analytical method was also improved, regard being had to the fact that under ordinary conditions the reagents themselves contained oxygen in solution. This source of error was overcome by employing almost saturated solutions of the reagents, viz., 80 grms. MnCl_2 , 4 H_2O dissolved and made up to 100 cc. The caustic soda and iodide of potassium were about 12 times normal strength.

The hydrochloric acid was freed from oxygen by passing carbonic acid through it and then boiling, whereby the carbonic acid was expelled, carrying the oxygen along with it. This process was repeated several times, and the author lays special stress on the necessity of boiling the acid to get rid of the last traces of oxygen. The following apparatus was used: (Fig. 1).

Fig. 1.



is being saturated with air. The authors were only satisfied when no change greater than 1 C. was observable in 5—6 hours.

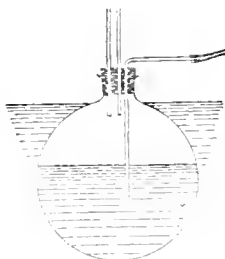
The following figures were obtained, corresponding to cc. in 1 litre of water, saturated with air, by frequently pouring from one vessel into another:—

Tem- perature of the Water.	Found.			Calculated for Absorption at 760 mm. Pressure.		Per- centage of Oxygen.
	Baro- meter.	N.	O.	N.	O.	
0	772	19.85	10.15	19.53	10.01	38.88
+ 6.00	771	16.58	8.30	16.34	8.28	33.60
+ 6.32	741	16.20	8.18	16.60	8.30	33.55
+ 9.18	729	14.96	7.60	15.58	7.90	33.60
+ 13.70	771	14.37	7.24	14.16	7.14	33.51
+ 14.10	770	14.35	7.15	14.16	7.05	33.24

As the relative quantity of oxygen, nitrogen, and carbonic acid contained in a natural water gives important indications concerning its origin and condition as well as to its suitability for drinking purposes, it is desirable that greater

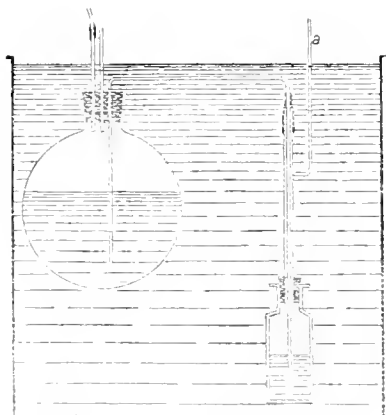
Two boiling flasks of about 100 cc. capacity containing 20 per cent. hydrochloric acid are employed. In one of them the carbonic acid is washed, after which it passes into the second flask. The second flask is provided with a syphon tube for withdrawing the solution of hydrochloric acid after it had been freed from oxygen. The results of the experiments are given, showing that the reagents thus prepared were free from oxygen. Another point is that the amount of oxygen which water is capable of absorbing from the air is influenced by the height of the column of water. Consequently it is best to calculate the solubility of gases in terms of a column whose height is = 0. It suffices to add half the pressure of the water column to the barometer reading and take that as the atmospheric pressure. The estimations were made as follows: A 4-litre flask (Fig. 2)

Fig. 2.



was half filled with carefully di-tilled water, and the neck closed with an india-rubber stopper through which passed two short straight tubes and one long bent one. Thoroughly purified air was led through the long tube and the contents of the flask shaken from time to time. The flask was kept at constant temperatures. When the water was thoroughly saturated with air the height of the barometer was noted, and by means of the arrangement shown in Fig. 3, some

Fig. 3.



of the water was carefully transferred to a carefully calibrated flask, one of the short tubes being meantime connected with the gas-holder supplying the pure air. The calibrated flask was taken out of the water-bath and the temperature of its contents carefully determined, the necessary reagents were then added, and the whole thoroughly mixed. The titration took place after 24 hours.

During this time the flask was closed against air entering by placing it stopper downwards in a beaker full of water. Detailed results of the determinations are given, and from

these have been calculated the solubility and absorption coefficient of oxygen. "That quantity of a gas reduced to 0° and 760 mm. which is dissolved by unit volume of a liquid at 760 mm. is the *solubility* (β') of the gas. On the other hand, the quantity which is taken up by a liquid when the pressure of the gas itself, without the tension of the liquid, amounts to 760 mm. is called the *absorption coefficient* (β) of the gas. In both definitions a column of liquid height = 0 is understood."

In the following table the results of the author's determination of the *absorption coefficient* (β') and the solubility of oxygen in water under normal pressure are compared with Bunsen's figures, and the last column (β' 209°6) gives the quantity of oxygen in cc. in 1,000 cc. of water saturated with air.

t degree C.	Bunsen's Absorption Coefficient.	β .	β' .	β' 209°6
0	0.04114	0.04890	0.04890	10.187
1	0.04007	0.04759	0.04728	9.910
2	0.03907	0.04633	0.04601	9.643
3	0.03810	0.04512	0.04479	9.387
4	0.03717	0.04397	0.04362	9.142
5	0.03628	0.04286	0.04250	8.907
6	0.03544	0.04181	0.04142	8.682
7	0.03465	0.04080	0.04040	8.467
8	0.03389	0.03981	0.03941	8.260
9	0.03317	0.03889	0.03847	8.063
10	0.03250	0.03802	0.03756	7.873
11	0.03189	0.03718	0.03670	7.692
12	0.03133	0.03637	0.03587	7.518
13	0.03082	0.03560	0.03507	7.352
14	0.03034	0.03486	0.03431	7.192
15	0.02989	0.03415	0.03358	7.038
16	0.02949	0.03347	0.03288	6.891
17	0.02914	0.03283	0.03220	6.750
18	0.02884	0.03220	0.03155	6.614
19	0.02858	0.03161	0.03093	6.482
20	0.02838	0.03103	0.03032	6.356
21	..	0.03048	0.02974	6.233
22	..	0.02994	0.02917	6.114
23	..	0.02943	0.02862	5.999
24	..	0.02893	0.02808	5.886
25	..	0.02844	0.02756	5.776
26	..	0.02797	0.02705	5.669
27	..	0.02750	0.02654	5.564
28	..	0.02705	0.02605	5.460
29	..	0.02660	0.02556	5.357
30	..	0.02616	0.02507	5.255

—C. N. H.

Proceedings of the Austrian Society of Chemical Industry.
Meeting of June 1, 1889. Chem. Zeit. 13, 781.

J. Stoklasa drew attention to the solubility in water of crystallised calcium tetrahydrogen phosphate. According to the volume of water employed, the salt is more or less

decomposed into monohydrogen calcium phosphate and phosphoric acid, as shown below :—

Ratio of Salt to Water used for Solution.	Percentage of Salt Decomposed.
1 : 1	25
1 : 25	12.5
1 : 50	6
1 : 56	3
1 : 200	0.1

One part of calcium tetrahydrogen phosphate, therefore, requires 200 parts of water for complete solution. The liberated phosphoric acid was estimated by titration with decinormal soda and methyl orange, the total amount of phosphoric acid being determined with molybdic acid. The quantity of undecomposed phosphate in the filtrate from the monohydrogen calcium phosphate was calculated from the amount of calcium found.

The same chemist further mentioned a method of determining phosphoric acid in superphosphates, &c. 10 grms. of the superphosphate are brought into a litre flask and the flask filled to the mark. The solution is filtered, and 50 cc. of the filtrate are treated with ammonium citrate and magnesia mixture and shaken up for 5–6 minutes; then a volume of ammonia equal to one-fourth the volume of the mixture is added. The precipitated magnesium ammonium phosphate is collected, ignited, and weighed as pyrophosphate. The ammonium citrate solution is made by dissolving 250 grms. of citric acid in 500 cc. of water; 20 cc. of this solution, after neutralisation with ammonia, are used for the test. The following results show the accuracy of the method :—

Material Analysed.	Percentage of Phosphoric Acid.		
	Found by Ammonium Citrate Method.	Found by Molybdic Acid Method.	Calculated.
Monohydrogen calcium phosphate, (pure)	52.36	52.16	52.2
Tricalcium phosphate [Ca ₃ (PO ₄) ₂ ·2H ₂ O] ...	41.30	41.27	41.05
Bone meal	26.40	26.60	..

—E. B.

On Schützenberger's Process for the Estimation of Dissolved Oxygen in Water. Sir H. E. Roscoe and J. Lunt. J. Chem. Soc.

THE authors have lately made the above method the subject of careful investigation, and have succeeded for the first time in placing this important estimation on a satisfactory footing.

As the measurement of the amount of dissolved oxygen in waters, whether pure or impure, has an important bearing on many technical processes, it may not be unfitting to give a short account of this investigation in the Journal of the Society of Chemical Industry.

The method depends on the reducing action of sodium hyposulphite, Na₂S₂O₅,* on a blue solution of indigo-carmin. A dilute solution of hyposulphite added to the blue liquid turns it yellow; in this condition the liquid is a most delicate test for the presence of free oxygen, either gaseous or dissolved.

The process hitherto used may be given shortly as follows :—A large Woulff's bottle is filled with hydrogen, and about 30 cc. of water introduced into the vessel. To this liquid is added indigo-carmin sufficient to colour it

blue. Hyposulphite solution is now added from a burette until the blue is turned to yellow. The water to be examined is now added to the reduced solution, with an immediate restoration of the blue colour, due to oxidation by the dissolved oxygen contained in the added water. The amount of oxygen is estimated by noting the volume of hyposulphite required to restore the yellow colour, or in other words, that required to counteract the oxidation produced by the amount of oxygen added. Two curious observations had previously been made by Schützenberger and confirmed by other observers.† One was that after the estimation was effected as above described, the reduced yellow liquid quickly regained its former blue colour, and this, if again decolourised, repeatedly returned to blue until about double the previous amount of hyposulphite had been used.

The other observation was, that if a much larger quantity of indigo-carmin be employed, the amount of dissolved oxygen found is about double that obtained when only a small amount of indigo is used. Schützenberger's explanation being that the reaction between hyposulphite and dissolved oxygen is a different one to that taking place between hyposulphite and indigo-carmin; that in the former case half the oxygen became latent as hydroxyl, with subsequent slow liberation of oxygen, whilst in the latter reaction no hydroxyl was formed. Hence, in the first case, only half the total oxygen is obtained, whilst in the second the whole is found.

The authors explain these observations as follows :—

Low Result when the Water has been exposed to Hydrogen.—The cause of these anomalous results was indicated by an experiment in which the water to be analysed, contained in a Winchester quart bottle, was allowed to stand in an atmosphere of hydrogen overnight, estimations being made before and after such exposure. The results obtained show that diffusion is the disturbing influence, for when aerated water is introduced into an atmosphere of pure hydrogen it immediately begins to lose oxygen by diffusion into the hydrogen until an equilibrium is established. This is a fact hitherto overlooked by the experimenters with this process.

Explanation of the previous Experiments.—This explains the previous observations, viz., that the highest results are obtained when the hyposulphite is added quickly and immediately after the introduction of the water into an atmosphere of hydrogen, because the oxygen is estimated and combined before it has had time to diffuse to any great extent, the slight difference in the time of exposure between a quick and a slow titration being quite sufficient to give a marked loss of oxygen by diffusion during the slower addition of hyposulphite. The variation in the results of the apparently identical experiments first given, being explained by the slightly longer or shorter time taken over each titration, and the consequent greater or less facility for diffusion.

Results less in proportion to the amount of exposure to Hydrogen.—This conclusion, that diffusion is the disturbing influence, is borne out by further experiments easily suggested by the preceding.

Conditions influencing the Amount of Diffusion.—The rapidity and amount of the diffusion of dissolved oxygen depend on (1) the surface area of water exposed to hydrogen, influenced by the size and shape of the vessel and the degree of agitation during titration. (2) The volume of the atmosphere of hydrogen. (3) The time of exposure, up to the point of equilibrium (under the law of partial pressures). (4) The volume of water.

The authors show that the large size of the vessel hitherto recommended for the estimation is greatly conducive to the rapid loss of oxygen by diffusion, and by using the same solutions in a smaller titration vessel a greatly increased amount of oxygen was obtained.

Reason for the Return of the Blue Colour.—In carrying out the oxygen estimation in the usual manner, the blue colour after having once been destroyed by the hyposulphite almost immediately returns, and if this subsequent colouration be destroyed the colour will again return, and so on

* Prepared by the action of zinc dust on a strong solution of sodium bisulphite saturated with sulphur dioxide, with subsequent neutralisation by lime.

† Dupré, The Analyst, 10, 156; and Ramsay and Williams Chem. Soc. J. (Trans.) 49, 751.

for a long time. The blue colour returns even when the hydrogen used is perfectly freed from all traces of oxygen by passing through the two long tubes filled with beads moistened with the alkaline solution of potassium pyrogallate used in all our experiments.

No Return of the Blue Colour when Free Oxygen is Absent.—If the liquid containing indigo-carminc and also the atmosphere above it are perfectly free from uncombined oxygen, and hyposulphite be added until the blue is turned yellow, no return of the blue colour takes place.

Proof of the Diffusion of Dissolved Oxygen into Hydrogen.—A positive proof that when pure hydrogen comes in contact with aerated water it is contaminated with oxygen, has been obtained as follows:—

A large flask was filled with a fairly strong indigo-carminc solution which was decolourised carefully with hyposulphite. Matters were so arranged that pure hydrogen, freed from all traces of oxygen as before stated, could be passed through aerated water, and thence into the large flask, driving out the sensitive yellow liquid through a tube passing to the bottom of the flask. In this way the hydrogen, contaminated with oxygen from the aerated water, is imprisoned above a solution which will indicate the presence of oxygen by the formation of a blue colour. This blue colour was observed at the surface of the liquid, and after a few minutes it became very intense and unmistakable.

Influence of the Amount of Indigo-Carmine used.—These experiments explain a singular observation made by Schützenberger, namely, that by using a small amount of indigo-carminc only half the dissolved oxygen is estimated,

when the first decolourisation of the solution is effected; whilst when a much larger quantity of indigo-carminc is employed the whole of the dissolved oxygen is found. The explanation given by him being that the reaction between reduced indigo and dissolved oxygen is a different one from that taking place between hyposulphite and dissolved oxygen, inasmuch as in the latter reaction half the oxygen becomes latent as hydroxyl with subsequent slow liberation of oxygen, whilst in the former no hydroxyl is formed.

His observation, however, will bear another interpretation, namely, if more reduced indigo be present than is sufficient to combine with all the dissolved oxygen contained in the added water, this oxygen is immediately combined by the reduced indigo and its diffusion prevented. Hence all the oxygen is obtained. The use of so large a quantity of indigo, however, so disturbs the end-reaction, from the presence of so much of the yellow compound, that "it is difficult to fix the point at which the last trace of blue has been discharged with any degree of accuracy." (Dnpré.)

A new method must satisfy the following conditions:—

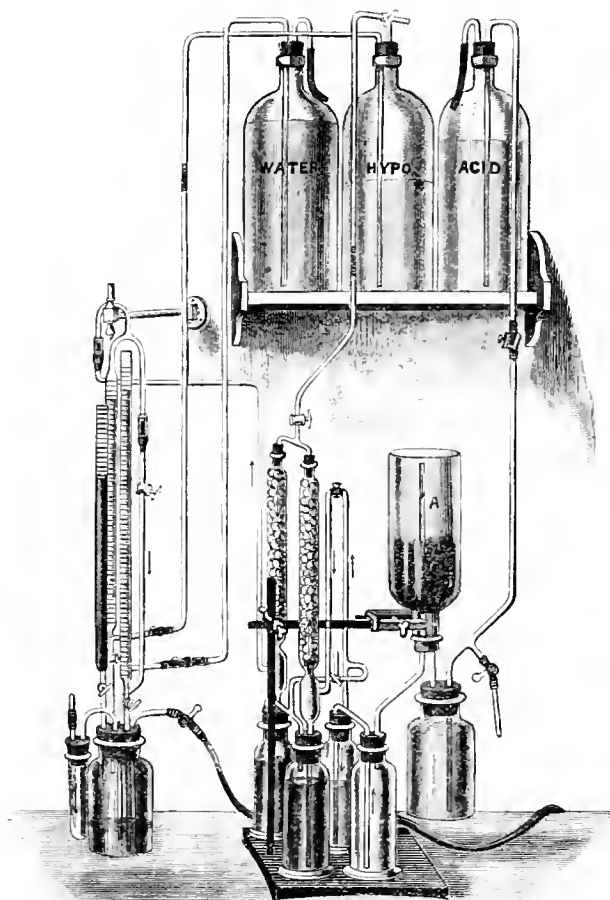
(1.) The aerated water must not at any time expose its uncombined oxygen to an atmosphere of hydrogen.

(2.) Precautions must be taken to ensure the use of an atmosphere perfectly free from oxygen, and the apparatus used must not permit any ingress of air.

(3.) When the vessel in which the analysis is made is first filled with water to expel air or to obtain the sensitive yellow liquid, the first portion of gas, having been in contact with aerated water, is contaminated with oxygen and must be entirely driven out.

Apparatus adopted.—Fig. 1 shows the apparatus adopted by us for carrying out the estimation.

Fig. 1.



It consists essentially (1) of an apparatus for the continuous generation and purification of hydrogen, by the action of dilute sulphuric acid on zinc; (2) a 200-cc. wide-mouthed bottle fitted with three burettes with glass taps, inlet and outlet tubes for a current of hydrogen, and an outlet tube for the titrated liquid; (3) Winchester stock-bottles of hyposulphite, indigo (not shown), and water, communicating with their respective burettes by glass siphons.

The hydrogen generated in A passes through two wash-bottles containing caustic potash, thence through two Emmerring's tubes filled with glass beads moistened with an alkaline solution of potassium pyrogallate, an arrangement being made whereby the beads may be re-moistened with fresh pyrogallate from the bottles beneath, the liquid being forced up by hydrogen pressure.

Pure hydrogen is supplied continuously (1) to the stock-bottle of hyposulphite, (2) to the hyposulphite burette, and (3) to the titration bottle.

The New Method.—A sample of water is examined as follows:—

(1.) 20 cc. of the water is introduced into the small bottle and about 3 cc. of indigo solution added.

(2.) A moderate current of hydrogen is passed through the blue liquid by a very fine jet for three minutes to free both water and supernatant gas from free oxygen.

(3.) Hyposulphite is now carefully added, during the flow of hydrogen, until the change from blue to yellow occurs, taking care not to overstep this point.

(4.) A further measured quantity of hyposulphite is now added (say 10 cc.) sufficient to combine with all the dissolved oxygen in the volume of water, 50–100 cc., proposed to be used in the estimation.

(5.) The important point now is, that the water is run in from a burette by a capillary tube passing *beneath the surface of the liquid* to the bottom of the vessel. Thus we introduce the water into a liquid which will at once combine the free oxygen, and thus prevent its diffusion on coming in contact with the hydrogen, the reduced indigo acting as an indicator for the complete oxidation of the hyposulphite. The liquid is kept in constant motion during the addition of the water, which is shut off the moment a permanent blue colour appears.

(6.) The blue is decolourised by a further slight addition of hyposulphite. The volume of water used, and the total hyposulphite, minus the first addition, are noted, and the estimation repeated for confirmation.

When the water contains very little oxygen the second addition of hyposulphite may be omitted, the reduced indigo-carmin being sufficient to take up all the dissolved oxygen. In this case, care must be taken that the oxygen added should require not more than half the hyposulphite first added to decolourise the indigo-carmin.

Standardisation of the Hyposulphite.—In order to complete the estimation it is necessary to know the strength of the hyposulphite solution employed. This has entailed a very considerable amount of labour, inasmuch as of the two methods hitherto adopted for this purpose, the first was found to be fundamentally wrong, and the second to depend on erroneous data.

The authors examine the copper method of standardisation, depending on the decolourising effect of hyposulphite on a standard solution of ammonio-cupric sulphate.

They adopt the method of standardisation depending on a titrating of fully aerated distilled water, aerated at a known temperature and pressure, but find, on investigation, that the oxygen value of such water is inaccurately given by Bunsen's coefficients of absorption, previously used for the standardisation, and they substitute the following values which they have determined by using apparatus specially constructed for the purpose of extracting the dissolved gases by boiling the water *in vacuo*, and subsequently measuring the volume of oxygen.*

Method of Aeration.—Before giving the results of the estimations made with distilled water saturated with air, it is necessary to describe the method of aeration.

Freshly distilled water adjusted to the required temperature was aerated by vigorous agitation in two Winchester

quart bottles half full of water, the air being renewed five or six times by emptying the contents of one bottle into the other and again dividing into two portions, which were repeatedly agitated with fresh air.

When aerated, one bottle was filled and allowed to stand, stoppered, for half an hour to an hour, to get rid of minute air-bubbles. Then the gases were extracted and analysed, the barometer having been read to obtain the pressure at which the water was aerated.

The numbers obtained indicate close agreement between the several experiments at each temperature, and also throughout in the ratio between the oxygen and total oxygen plus nitrogen, a ratio always between 33 and 34 per cent.

They show a wide discrepancy from Bunsen's numbers, but agree well with Dittmar's determinations.†

The following table has been constructed, giving the oxygen values for fully aerated distilled water for each half degree between 5 °C. and 30 °C., and for an *observed*‡ pressure of 760 mm.:—

OXYGEN DISSOLVED BY DISTILLED WATER. 5°–30° C.

Temp. °C.	Cc. Oxygen N.T.P. per Litre Aq.	Diff. for 0.5 °C.	Temp. °C.	Cc. Oxygen N.T.P. per Litre Aq.	Diff. for 0.5 °C.
5.0	8.68		18.0	6.54	
5.5	8.78	0.10	18.5	6.47	0.07
6.0	8.89	0.09	19.0	6.40	0.07
6.5	8.99	0.09	19.5	6.34	0.06
7.0	9.09	0.09	20.0	6.28	0.06
7.5	9.22	0.09	20.5	6.22	0.06
8.0	9.33	0.09	21.0	6.16	0.06
8.5	9.44	0.09	21.5	6.10	0.06
9.0	9.55	0.09	22.0	6.04	0.06
9.5	9.66	0.09	22.5	5.99	0.05
10.0	9.77	0.09	23.0	5.94	0.05
10.5	9.88	0.08	23.5	5.89	0.05
11.0	9.99	0.08	24.0	5.84	0.05
11.5	10.10	0.08	24.5	5.80	0.04
12.0	10.21	0.08	25.0	5.76	0.04
12.5	10.32	0.08	25.5	5.72	0.04
13.0	10.43	0.08	26.0	5.68	0.04
13.5	10.54	0.08	26.5	5.64	0.04
14.0	10.65	0.08	27.0	5.60	0.04
14.5	10.76	0.08	27.5	5.57	0.03
15.0	10.87	0.07	28.0	5.54	0.03
15.5	10.98	0.07	28.5	5.51	0.03
16.0	11.09	0.07	29.0	5.48	0.03
16.5	11.20	0.07	29.5	5.45	0.03
17.0	11.31	0.07	30.0	5.43	0.02
17.5	11.42				

Indigo Standardisation.—When once the hyposulphite has been carefully standardised by distilled water, this rather troublesome aeration may be avoided by finding the oxygen-value of the indigo-carmin solution. This solution, remaining constant may be used for the subsequent standardisation of the hyposulphite.

* "Challenger" Reports, Vol. I., Pt. I, p. 160.

† In this table the results are calculated for aeration at an *observed* barometric pressure of 760 mm. When the observed pressure is *below* 760 mm., the value must be *subtracted* for every 10 mm. diff. The same value must be *added* when the pressure is *above* 760 mm.

It is only necessary to take a suitable quantity of indigo solution, diluted with water if necessary, free it from all dissolved oxygen by a current of pure hydrogen continued for five minutes, they carefully decolourise with hyposulphite, the value of which has been carefully found by using aerated distilled water. The hyposulphite solution slowly loses strength even when kept in hydrogen, and should be standardised daily when required to be used.

Comparison of the New Method with the Volume of Gas found.—We next proceed to apply the volumetric process as thus modified to the examination of samples of water from different sources, and to compare the results with the absolute volume of gas obtained by boiling out the same water *in vacuo*.

A further comparison was made with very impure Thames water collected at Crossness, opposite the southern outfall for London sewage, 12 miles below London Bridge.

These in like manner indicate that the method gives good results, even with an impure water of this character.

The process thus applied to waters of such varied character, and containing such widely different amounts of oxygen, with a mean difference of only 0.5 cc. from the value obtained by extracting and measuring the gases, shows that, although perfect accuracy cannot be guaranteed for the process thus improved, yet the results obtained are not far removed from the truth, and certainly give very valuable indications as to the oxymetric condition of samples of water submitted to its operation.

Influence of Acidity and Alkalinity.—Although the method is applicable to pure and impure waters, and even to brackish waters, this is not the case if the water contains even small quantities either of free acid or alkali. Thus, if $\frac{1}{1000}$ th part of sulphuric acid be added to pure water, not only is the oxygen value obtained a different one, but the whole reaction is disturbed. The volume of hyposulphite required for the first decolourisation is greater; this only produces a light straw-yellow, instead of the fine deep yellow of a normal titration. The delicacy of the reaction is altogether destroyed, a much larger volume of water than usual only slowly producing a light blue colour, instead of the distinct colouration produced by even half a cubic centimetre of pure water in a normal titration. Oxalic acid has a similar action. The same proportion of ammonia has an entirely opposite effect. The oxygen value is raised instead of lowered, and the delicacy of the reaction is not impaired, although the colour reaction is very much modified.

Sodium bicarbonate has no effect.

Of course, when other substances than oxygen, which decompose hyposulphite, are present in the water, the accuracy of the method is proportionately disturbed.

Delicacy of the Reaction.—With pure water, the change of colour is a very highly sensitive reaction and the most delicate test for the presence of free oxygen we possess, one part of oxygen in two million parts of water being sufficient to bring about a distinct change of colour.

Diffusion of Oxygen through India-rubber.—The delicacy of this reaction may be employed to show the rapid diffusion of atmospheric air through india-rubber tubing. The experiment is made as follows:—

100 cc. of water and 3 cc. of indigo-carmin are freed from oxygen and decolourised in the usual way. The liquid is then forced out by hydrogen pressure on opening A.

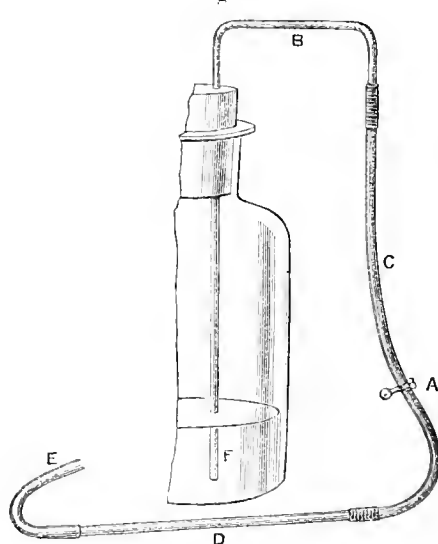
When the liquid has flowed through B, C, D, E, for a few seconds, the pinch-cock A is closed.

The liquid is seen to be yellow at F, B, and D, and is allowed to remain in the india-rubber tube C for five minutes. If now A be carefully opened, so as to allow the former contents of C to be seen in the glass tube D, it will at once be observed that whilst the liquid in F, B, and D had remained unchanged, that in C had turned quite blue, from the absorption of atmospheric oxygen diffused through the india-rubber. Even one minute's exposure is sufficient to give an indication.

This experiment has a practical bearing on the construction of the apparatus as figured in Dupré's paper and in Sutton's work on volumetric analysis, 5th edition, in which the hyposulphite solution is made to pass through several

feet of india-rubber tubing before reaching the titration vessel, its strength, of course, diminishing with the time of remaining in contact with the india-rubber.

Fig. 2.



In the form adopted by the authors, the hyposulphite is conveyed from the stock-bottle to the titration vessel by a glass syphon, and only sufficient india-rubber used to accommodate a pinch-cock and to make one other connexion necessary for the free motion of the titration vessel.

Suggested Applications of the Method.—This process is perhaps most applicable to water analysis. It is well known that organic and bacterial contamination most frequently exist side by side, the one calling forth the other. The activity of these micro-organisms shows itself in the diminution of the dissolved oxygen, which is used up by the bacterial forms during their active life in changing the organic impurities present in the water. Then, again, the process might be used in the brewery, more especially at the fermentation stage of the wort. The deleterious effect of a sluggish fermentation is often felt by the brewer, and this may be due in part to the low state of aeration of the wort.—J. L.

Estimation of Ferrocyanogen in Spent Material from Gas Purification. O. Kumblauch. Jour. f. Gasbeleuchtung, 1889, 450—459 and 493—500.

The author points out that the difficulties surrounding the estimation of ferrocyanides in spent gas purification material arise from the impurities present, and he asserts that neither titration with copper sulphate nor with permanganate give reliable results, inasmuch as, in the latter case, the material in question always contains substances other than ferrocyanides which are readily oxidised by permanganate, even after the removal of thiocyanates. Whilst in the former case the impurities interfere either by directly reacting with the copper sulphate or by impairing the delicacy of the end reaction. Moreover, neither the amount of iron nor cyanogen present can be regarded as an accurate measure of ferrocyanides; for according to our present knowledge of their composition it cannot be stated with certainty that these constituents are really present in the form we assume them to be—in fact, the author has come across compounds which resemble, but which are not identical with ferrocyanides. Attention is drawn to the difficulty of removing all the iron not in the form of ferrocyanide in the presence of the different kinds of organic matter present; the author has also observed the decomposition of ferrocyanides with the deposition of iron hydroxide. In both these cases the iron numbers would give incorrect results. In fact, the author has come to the conclusion that

there is no method by which the commercial value of the spent material can be accurately gauged, and therefore he suggests that a method ought to be adopted which will give some insight into the technical value of the material, and involve processes similar to those used in its technical application. And with this object in view, he has devised a method on the following scheme:—Conversion of the insoluble ferrocyanogen into soluble ferrocyanides, purification of the extract, and then estimating the ferrocyanide direct by titration with copper sulphate. Having ascertained, in a series of special experiments, the temperature at which the drying might be conducted without decomposing the material; the conditions under which the conversion of insoluble into soluble ferrocyanides might be effected with the smallest production of substances which would interfere with the titration, such as the quantity and strength of the potash duration of, and temperature during contact; best means of removing interfering substances; modes and accuracy of testing—after completing these investigations, the author incorporated the results in, and adopted the following method:—The whole sample of 200–250 grms. is dried at 50–60° C. until of constant weight, taking from 5 to 6 hours. The dried sample is pulverised, and passed through a sieve with 360 meshes to the square centimetre; if any sawdust is present it remains on the sieve, and is weighed separately. 10 grms. of the sifted stuff is treated in the cold with 50 cc. of a 10 per cent. solution of potassium hydroxide in a flask marked at 250 cc., and at 255 cc., either for 15 hours with frequent agitation, or for 16 hours agitating only during the first and last two hours, the flask is then filled to the 255 cc. mark, and the contents filtered. 100 cc. of the filtrate is run into a hot solution of ferric chloride, containing 60 grms. of ferric chloride, and 200 cc. of hydrochloric acid (sp. gr. 1.19) per litre, and the whole filtered hot (at about 80° C.) through a folded filter covered over in a hot water funnel, the precipitate is washed with hot water, but not for too long a time. The filter is spread in a porcelain dish, and treated with 20 cc. of 10 per cent. potash, taking care that none of the Prussian blue escapes decomposition; the liquid is washed into a quarter litre flask, and tested for hydrogen sulphide with sodium nitroprusside. If there is not an immediate and distinct reaction, the liquid is filtered, 50 to 100 cc. acidified with 2.5 or 5 cc. of sulphuric acid (1:5), and titrated with copper sulphate. If hydrogen sulphide is present, the unfiltered liquid is treated with 1 to 2 grms. of lead carbonate, filtered quite clear, and then titrated. The copper sulphate solution contains 12 to 13 grms. per litre, and is standardised by titrating with a solution of pure potassium ferrocyanide containing 4 grms. per litre. To test the completion of the reaction either the spot or filter test is employed; in the former a drop of the liquid is placed on filter-paper, and a drop of ferric chloride is placed near it; then, as the drops spread and come in contact, the appearance of a blue colouration where the liquids meet indicates incomplete reaction; but where this formation of the blue ceases to be observed the action is completed according to this test. In the filter test a portion of the liquid is carefully filtered through a minute filter, and the clear liquid tested with ferric chloride; this is the more delicate test, and therefore always registers slightly higher results than the spot test. Care must be taken to always use the same proportion of acid in the titration, and to allow, in all cases, the same time for the copper sulphate to react, and also for the appearance of the blue colouration in testing: 2 minutes for the spot test, and $\frac{1}{4}$ to $\frac{1}{2}$ minute for the filter test. Calculations may be based on either the spot or filter litre except when lead has been used, then the latter only must be used for the calculations, which are simple enough. Multiplying by 0.541 converts percentage of potassium ferrocyanide into hydroferrocyanic acid; by 0.678 into Prussian blue; by 0.369 into cyanogen; by 0.383 into hydrocyanic acid.

As a rule the spot and filter titrations only differ from 0.2 to 0.6 cc. when from 8 to 12 cc. of the copper solution of the above strength is used, and the addition of the last $\frac{1}{10}$ cc. of copper solution is sufficient to dispel the blue colouration which gives way to a brownish hue or to a colourless state. Another point is that most filter-papers contain sufficient

iron to give the blue colouration without any further addition of iron, and with pure ferrocyanides and most samples of spent material from gas purification, the titrations obtained by the spot test with and without the addition of iron are alike. But the author observed that sometimes instead of the blue colour giving way readily in the usual manner, the solution in the filter test remained persistently green or greenish-yellow, the consequence being that the filter test registered much higher than the spot test; moreover in such cases the spot test with iron registered higher than the spot test without iron. A number of experiments were instituted to inquire into this matter, and it appears to be due to those substances already referred to, which apparently contain iron and cyanogen in varying quantities; they also contain sulphur. They appear to undergo decomposition and gradually yield ferrocyanides. They are dissolved by potash, and are apparently precipitated by ferric chloride, but are not, it seems, of the same value as ferrocyanides, but as they undergo conversion they ought to be estimated. In fact, on keeping for some time they disappear, and material containing them will after some months cease to show indications of them, and the spot and filter titrations will be normal; so also material which has been stored or regenerated does not contain them. The author suggests, as the outcome of his experiments, the following method of correcting for these impediments:—Add to 200 or 300 cc. of the solution slightly more copper sulphate solution than is required by the spot titration, too little copper sulphate causes decomposition even with pure ferrocyanide; filter, pour the filtrate into hot ferric chloride, decompose and titrate the Prussian blue formed, and, if it is thought desirable, the filtrate from this precipitate is treated in the same manner. The numbers obtained in this way are added as corrections to the numbers obtained in the usual manner, and it is then found that the spot and filter titrations approximate more and more, the latter becoming less the former increasing. It therefore seems that in these cases the spot test shows too little and the filter test too much, and therefore an alternative for the fractional titration would be an agreement between the parties concerned to adopt some mean result for the basis of valuation; for instance, mean of the spot test without iron and the filter test. Tables of analytical results of the examination of some purification materials are given. It is pointed out that in valuing material the ferrocyanogen as well as the hydrogen sulphide absorbing power must be considered.

The Separation of Copper from Antimony. Finkener. Mith. Königl. techn. Versuchs. 1889, 76–86.

Fine separation is effected in two stages: first by the precipitation of the bulk of the copper, as cuprous iodide in an acid solution, and then by the removal of the remainder as sulphide in an ammoniacal solution. The author has established the following facts, serving as a basis for his method:—

- (1) Cuprous iodide carries down antimony even in the presence of tartaric acid from a nitric acid solution of the two metals, but does not do so if the antimony be first converted into a double salt of antimony pentafluoride and an alkaline fluoride by the addition of the latter.
- (2) Free iodine in the presence of an alkaline fluoride converts antimony trifluoride into the pentafluoride, though somewhat slowly; the process is hastened by heat and the addition of sulphuric acid.
- (3) Sulphurous acid reduces antimony pentafluoride slowly in the presence of potassium iodide; the addition of hydrochloric acid hastens the reaction, but the presence of potassium fluoride almost completely inhibits it.

From this the following method is derived:—If the solution to be treated contain the antimony as a pentad compound all that is necessary is to add an alkaline fluoride, then potassium iodide and sulphurous acid, heat gently, filter off the bulk of the copper as cuprous iodide, and wash with boiling water made acid with sulphuric acid. In the event of the antimony being in the triad state the

solution may be first treated with chlorine or bromine water, or oxidation may even be effected by the iodine liberated by the action of the cupric salt also present on the potassium iodide, provided time be allowed for it before the addition of sulphurous acid.

The filtrate containing all the antimony and a little copper is oxidised by bromine water, and the metals precipitated together by sulphuretted hydrogen, the mixed sulphides dissolved in hydrochloric acid with the addition of potassium chlorate, ammonium tartrate added, and ammonia in excess: the resulting solution is heated on a water-bath and sulphuretted hydrogen water added little by little until no further precipitation occurs. By thus minimising the quantity of ammonium sulphide present, re-solution of cupric sulphide is avoided.

The filtrate containing only the antimony is acidulated with sulphuric acid and sulphuretted hydrogen passed through; the antimony is determined in the sulphide thus precipitated by heating it, together with its filter, with hydrochloric acid, and determining the sulphuretted hydrogen evolved by standard iodine solution. The author has established that antimony sulphide precipitated in the presence of sufficient ammonium tartrate to convert all chlorine present into ammonium chloride is of normal composition, and yields the theoretical quantity of sulphuretted hydrogen when heated with hydrochloric acid. (Rose, *Analyt. Chem.* 6th edit., II., 478.)

The analytical results quoted show the method to be reliable, if potassium or sodium fluoride in the proportion of about 1 gm. to 0.275 gm. of antimony be used, and the solution in which the first stage of the separation is effected be about 200 cc.

The process is also stated to be equally applicable to the separation of copper and arsenic.—E. E. B.

Analysis of Crude Tartrates. N. v. Lorenz. *Chem. Zeit.* **13**, 693—694.

THE author defends the statements made by him in a former criticism upon Goldenberg's original process for analysing tartrates (this *Journal*, 1888, 136 and 239).

—E. E. B.

On the Sulphate and Carbonate of Lithium. F. Kobbé. *Pharm. Zeit.* **34**, 312.

IN most text-books it is stated that lithium sulphate is soluble in alcohol. This, according to the author, is not correct, as lithium sulphate is insoluble in strong alcohol, though it is taken up, according to the quantity of water present, by dilute alcohol. On this account the following method adopted by the German Pharmacopœia for testing the freedom of lithium carbonate from potassium, sodium and magnesium salts is not satisfactory:—"0.1 gm. of lithium carbonate dissolved in a few drops of dilute sulphuric acid must yield a clear solution on addition of 4 grms. of alcohol." Under these conditions even the purest carbonate gives a marked precipitate, on account of the insolubility of the lithium sulphate. The author suggests the following:—

A solution of 0.5 gm. of lithium carbonate in 10 grms. of dilute sulphuric acid must remain clear on addition of 20 cc. of alcohol; 3 per cent. of potassium carbonate or 0.5 per cent. of calcium carbonate produces a turbidity.

—O. H.

The Presence of Pyridine in Amyl Alcohol; a New Compound of Picric Acid. H. von Asbóth. *Chem. Zeit.* **13**, 871—872.

A NUMBER of specimens of amyl alcohol were found to yield, when used as a solvent for picric acid, crystals of what proved to be pyridine picrate, thus pointing to the presence of pyridine in the samples tested, none of which had been denaturated. Hungarian amyl alcohol was found to be free from pyridine, and this is considered by the

author to be due to the fact that in Hungary the spirit is distilled by steam (Bohm-Fredersdorf or Ilges' method is employed), whilst in many parts of Germany from which the samples containing pyridine were got, Dorn's or Pistorius' distillation apparatus is in use. In these the flame comes into direct contact with the boiler containing the alcohol, and any insoluble matter contained originally in the mass would probably be carbonised, yielding pyridine as a decomposition product. Recently the steam distillation apparatus has been more extensively in use in Germany than heretofore, and samples of amyl alcohol obtained in 1888 were found to be free from pyridine. The pyridine picrate forms needle-shaped crystals which are difficultly soluble in alcohol and in cold water. They melt at 141.5°, and are decomposed by strong acids or bases with separation of pyridine. Heated gently they are partially decomposed; strongly heated they explode. Their formula is $C_5H_5N.C_6H_2(NO_2)_3.OH$. To employ this picrate as a test for the presence of pyridine in amyl alcohol, picric acid is dissolved in the sample, the solution filtered and the crystals which separate on cooling recrystallised from hot water.—C. A. K.

Distinction of Resorcinol from Carboic Acid and from Salicylic Acid. H. Boddé. *Nederl. Tijdschr. v. Pharm. Chem. en. Toxikol.* 1889, **1**, 163.

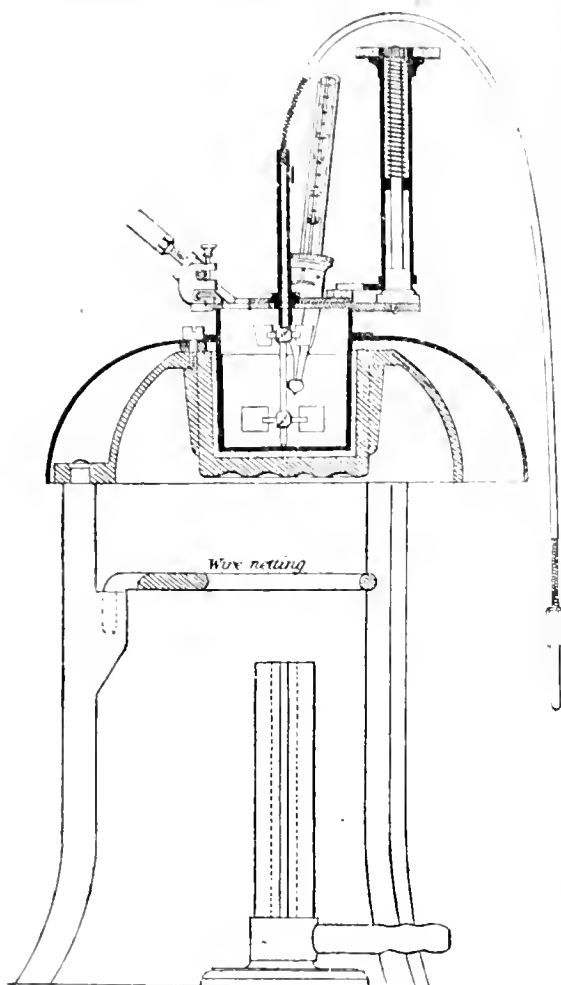
A SOLUTION of resorcinol, either in water or in alcohol, gives a violet colouration on addition of a drop of sodium hypochlorite which soon turns yellow, and which on warming or on further addition of hypochlorite becomes dark yellow, red, or dark brown. One part of resorcinol in 10,000 parts of water can be detected by the violet colouration. Carboic acid, salicylic acid, benzoic acid, and allied bodies do not give the violet colouration, the solution either remaining colourless or showing a slight fluorescence; on warming it turns slightly yellow. A solution of resorcinol treated with a few drops of ammonia and then with a few drops of sodium hypochlorite gives a red-violet colouration which turns yellow on standing and dark green on boiling. Salicylic acid, benzoic acid, and antifebrin give no colouration with this reagent; phenol gives a blue-green colouration.—C. A. K.

The Flashing Point of Mineral Lubricating Oil. Holde. *Mitth. Königl. techn. Versuchs.* 1889, 64—75.

THE objections that are now conceded with respect to the methods of determining the flashing point of kerosene, formerly in use, are valid in the case of mineral lubricating oils. An apparatus on the lines of the Abel instrument is what is needed. A modification of the Pensky apparatus (Schädlér's *Fette u. Oele d. Fossilien*, p. 443) was devised and is shown in the accompanying figure. The chief point in which it differs from the Abel oil-tester is the presence of an agitator with two sets of blades, so that both the oil and the atmosphere in the cup immediately above it are kept homogeneous. By this means local inequalities in the heating are obviated, a result which is also favoured by the even distribution of the hot gases from the lamp shown beneath the vessel itself. On this account there is little fear of arriving at an erroneous result by moderately rapid heating, a risk attending the use of the older forms. A rise of 12° C. per minute towards the close of the experiment may safely be adopted.

Some oils contain much water and give very irregular values for their flashing points. The presence of moisture may be recognised by heating the oil in a test tube in a clear oil-bath kept at about 140° C. As its temperature approaches 120° C. it begins to froth and may even "bump," while the film of it on the walls of the test tube is seen to be an emulsion of water and oil, and does not become clear even at 150° C. It is easy to distinguish these indications of the presence of water from those of entangled or dissolved air which is sometimes present. It is of course necessary in making this experiment (as in sampling the oil) to avoid even a trace of moisture in the vessels used.

Section through the Middle.



The results of numerous experiments demonstrating the closeness of the agreement of the figures obtained by the use of this apparatus, and the unreliability of more primitive methods, are recorded in voluminous tables.—B. B.

Detection of Mineral Oil in Fatty Oils. Holde. Mith. Königl. techn. Versuchs. 1889, 75.

BENEDIKT'S process ("Analysen der Fette und Wachstern," p. 102), which consists in saponifying the oil with alcoholic potash, and adding ammonia to the solution, thus producing a turbidity if mineral oil be present, needs attention to be paid to his prescription, as a too weak alcohol fails to yield a clear solution, even with pure fatty oils; a large excess of ammonia, too, causes in any case a precipitate, the potash soap being thrown down.

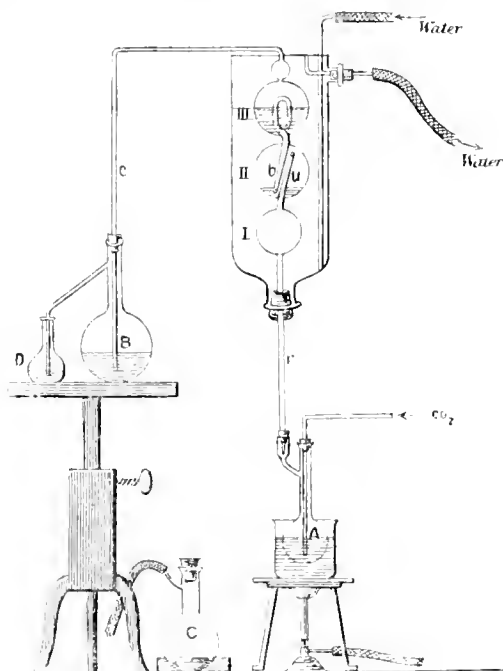
The author describes and recommends the following method:—A piece of caustic potash the size of a pea is heated in a test tube with about 5 cc. of absolute alcohol until dissolved; three or four drops of the suspected oil are then added, the heating continued for one minute and 3 or 4 cc. of distilled water added. If the solution remain clear a fatty oil only is present. Any little flocks of soap visible before the addition of water dissolve afterwards; even 1 per cent. of mineral oil causes the formation of a distinct turbidity.—B. B.

Estimation of Lime in Soils. F. Reverdin and C. de la Harpe. Chem. Zeit. 13, 726.

The lime present in soils serves different purposes. Not only does it act as a binding material for the soil and a promoter of the oxidation of the nitrogenous organic matters, but it also serves as an important plant food. And in these respects all lime salts do not act alike, for whilst, for instance, finely-divided calcium carbonate assists the formation of nitrates, calcium sulphate acts indifferently. It is therefore of importance to estimate the directly active lime in making an analysis of soil. P. de Mondesir does this by measuring the volume of carbonic acid gas which is liberated by treating the soil with tartaric acid. But this treatment causes the lumps of calcium carbonate to be dissolved, and as only the surface of the same is active, the method is unsatisfactory. The authors propose the following method: The sample of soil is digested on the water-bath for several hours with an excess of a mixture of equal molecules of sodium oxalate and carbonate. The sodium oxalate solution must have been standardised and the mixture be so concentrated that about 200 cc. will suffice for 20 grms. of the soil. The solution is filtered, the residue washed, the washings being added to the filtrate, and then the filtrate is acidified with hydrochloric acid. In most cases a precipitate of organic acids is produced, which must be filtered off. Sodium acetate is then added to the filtrate, and, after boiling, calcium chloride solution is added to precipitate the excess of oxalic acid, which is estimated with permanganate in the usual way. From the amount of oxalic acid which is found to be absorbed by the soil, may be calculated the quantity of active lime present. The carbonate of soda causes the magnesia to remain in the form of magnesium carbonate, whilst the sodium oxalate changes the finely divided calcium carbonate and other lime salts into calcium oxalate, but attacks only the surface of the lumps of calcium carbonate.—E. B.

Quantitative Determination of Methoxyl ($O.C_2H_5$). R. Benedikt and H. Grüssner. Chem. Zeit. 13, 872—873.

The method is a modification of that proposed by Zeisel (see this Journal, 1886, 335).

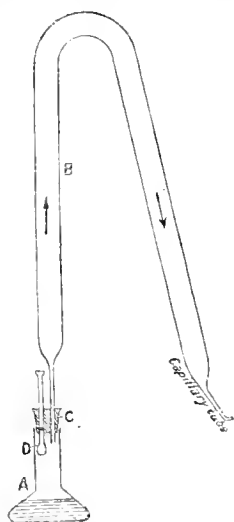


The substance (0.2 to 0.3 gm.) is placed in the flask A, the capacity of which is 30—35 cc., and there treated with 10 cc. of hydriodic acid of sp. gr. 1.70. A current of carbon

dioxide is passed through the flask, the heating of the latter being effected by a glycerol bath. The methyl iodide formed passes through the three bulbs I., II., and III. I. is empty, II. contains water, and III. water containing red phosphorus in suspension. These bulbs are surrounded by water, the temperature of which can be kept at 70° C. by passing in hot water; this is necessary in the determination of ethoxyl ($\text{O.C}_2\text{H}_5$). After passing the bulbs, the methyl iodide, which is quite free from hydriodic acid and iodine, is absorbed in the flask B by 5 cc. of a 40 per cent. solution of silver nitrate and 50 cc. of 95 per cent. alcohol. D is a safety flask containing 1 cc. of silver solution and 10 cc. of alcohol, but it was never found to contain a weighable quantity of silver iodide. The alcoholic solution is diluted with water, acidified with nitric acid, and the silver iodide filtered off and weighed.—C. A. K.

Volumetric Determination of Carbon Dioxide. F. Fuchs, Chem. Zeit. **13**, 873.

The flask A is partially filled with dilute hydrochloric acid and this then saturated with carbon dioxide either by passing



the gas into the acid or by adding sodium carbonate. In this way the space above the acid becomes entirely filled with carbon dioxide at the end of the determination, thus avoiding any error due to the varying composition of the gaseous layer above the acid. The exit tube B is filled with dry air and inserted in the stopper C. The substance is placed in the small bottle D and held in a hole in the stopper, from which it is liberated by pressing down the glass rod above it. The liberated gas is measured as usual. Results varying from 0.07 to 0.37 per cent. from the theoretical value are given.—C. A. K.

Simultaneous Determination of Hydrogen and of Nitrogen. C. Gehrenbeck. Ber. **22**, 1694-1696.

The combustion is carried out in an ordinary combustion tube open at both ends, in which the substance, intimately mixed with cupric oxide or with lead chromate, is placed. The stopper at the one end of the tube is furnished with a tube provided with a two-way cock, one passage of which communicates with an ordinary drying apparatus for air and oxygen, the other with a carbon dioxide generator. The calcium chloride tube is connected to the other end of the combustion tube, and attached to it is the apparatus for collecting the nitrogen (Schiff's apparatus was used). A second small calcium chloride tube is interposed between the two to prevent any sucking back of the liquid from the nitrogen apparatus into the calcium chloride tube. To conduct the analysis the whole apparatus is first filled with carbon dioxide (dried by means of sulphuric acid) and the

nitrogen determination made in the usual way. The two-way cock is then turned and the combustion completed in oxygen, this last being finally displaced by air.

Several test analyses are given with satisfactory results.
—C. A. K.

A New Method for the Quantitative Determination of Nicotine. M. Popovici. Zeits. f. Physiol. Chem. **13**, 445.

FIFTY grms. of the tobacco powder are moistened with 10 cc. of alcoholic soda solution (6 grms. of caustic soda in 40 cc. of water, with 60 cc. of 95 per cent. alcohol) and then extracted in a Soxhlet apparatus for 3-4 hours with ether. The extract is shaken with a moderately concentrated solution of nitrophosphomolybdic acid. The precipitate, which readily settles, after drawing off the ethereal layer is made up with water to 50 cc. and the nicotine set free by the addition of 8 grms. of finely-powdered barium hydroxide. The alkaline product containing free nicotine is filtered, and the rotary power of the filtrate determined in the polariscope; from this the quantity of nicotine can be found in a table prepared by the author, who employed ethereal solutions containing known amounts of nicotine, which was precipitated and treated as above, the rotary power being determined through a layer of the solution 20 cm. thick. Higher results are obtained by this process than by Kissling's; this is attributed by the author to the fact that some of the nicotine is lost in the latter process in distilling off the ether.—O. H.

New Books.

OEL- UND BUCHDRUCKFARBEN. Praktisches Handbuch für Firniß- und Farbendfabrikanten, von LOUIS EDGAR ANDÉS, Lack- und Firniß-Fabrikant. Mit 56 Abbildungen. All rights reserved. Wien, Pest und Leipzig. A. Hartleben's Verlag, 1889. London: H. Grevel and Co., 33, King Street, Covent Garden.

SMALL 8vo volume, bound in paper cover, price 4s. It contains 261 pages of subject-matter and 56 wood engravings. The treatment of the entire subject may be best exemplified by a summary of the contents, as follows:—Linseed oil; Purification and Bleaching of Linseed oil; Machinery and Apparatus used in purifying and bleaching oils. Chemical purification of Linseed oil. Oxidising agents for the conversion of Linseed oil into varnish. Theory of Varnish making. Manufacture of Linseed oil varnishes. The Colouring materials for paint—Artists' Oil—and Bright Printing Colours. The Colouring materials for Printers' black inks. Substitutes for Lampblack. Apparatus for Grinding and Triturating Colours. Mechanical arrangements for mixing the Binding materials with the Colours. Machines for grinding Colours. The Manufacture of Colours for Oil paints. Artists' Oil Colours. The Manufacture of Book Printing Colours. Composition Varnishes. Mixing the lampblack with the Varnish. Recipes for Printers' blacks. Improvements in the preparation of Book-printing Colours by Dr. H. Brackenbusch, &c., &c. The work closes with a full alphabetical index.

CHEMISCHE HOMOLOGIE UND ISOMERIE in ihrem Einflusse auf Erfindungen aus dem Gebiete der organischen Chemie. Eine patentrechtliche Studie von Standpunkte des Chemikers. Von DR. OTTO N. WITT. 1889. Berlin: Verlag von Rudolf Mückenberger. London: H. Grevel and Co., 33, King Street, Covent Garden.

THE object of this work (price 5s.) is briefly to discuss the relative positions of the organic chemist, discoverer, inventor, and patentee. It is an octavo volume of pamphlet form, containing 96 pages of text, and dedicated to Dr. H. Caro, the

well-known chemist, and Director of the Badische Anilin und Sodafabrik. It is subdivided as follows:—**PART I.** The Patent Laws of different Countries, and their Influence as regards Chemical Discoveries. **PART II.** Chemical Discovery and its Relations to Chemical Construction. **PART III.** Chemical Homology and Isomerism. **PART IV.** Homology and Isomerism as regards their Influence on the Patent System. **PART V.** Examples:—No. 1. Example of a Process which is distinguished from an already known Method by the Employment and Production of Homologous Substances. Consequences of this Homology. No. 2. Rejection of a Patent on the Ground of the Isomerism of the Ingredients used with Substances already known. No. 3. Granting of a Patent in spite of the Isomerism of the Products employed and produced with those of a Process already patented. No. 4. Granting of a Patent on the ground of the different Colour of the Isomerides obtained by the Process for which Protection is sought from that of already patented Isomerides. No. 5. Decision of the Government Jurisdiction of the 20th March 1889. **PART VI.** Final Conclusions.

CHEMISCH-TECHNISCHES REPERTORIUM. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und industriellen Chemie mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von DR. EMIL JACOBSEN. 1888. *Zweites Halbjahr.*—*Erste Hälfte.* Berlin: R. Gaertner's Verlagsbuchhandlung. Hermann Heyfelder, London: H. Grevel and Co., 33, King Street, Covent Garden.

OCTAVO volume in paper cover; the first issue for the second half-year of 1888. It contains 160 pages of subject-matter, plentifully illustrated with wood engravings, and in the former the following subjects are treated of:—

Building materials, Cements, Artificial stone, Colouring Matters, Dyeing and Printing. Fats, Oils, Illuminating and Heating materials. Fermented liquors. Tanning, Leather, and Glue making. Textiles. Glass and Earthenware. Wood and Horn. India-rubber. Cements, Gums, &c. Lakes, Varnishes, and Paints. Metals.

Trade Report.

(From Board of Trade and other Journals.)

RAILWAY AND CANAL TRAFFIC ACT, 1888.

On page 249 of the *Board of Trade Journal* for September will be found the text of a memorandum issued by the Board of Trade on this subject on the 8th August last.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

SWITZERLAND.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220·4 lb. avoirdupois. Franc = 9 ¹⁶/₁₀₀d.

The following decisions affecting the classification of articles in the Swiss Customs tariff were given by the Swiss Customs authorities during the month of July last:—

Fluoride of silicon and sodium (fluosilicate).—Category 17. Duty, 1 franc per quintal.

Paper used as blue for linen.—Category 38. Duty, 16 frs. per quintal.

Saccharin.—Category 246. Duty, 10 frs. per quintal.

Malt extract, in bottles or jars, with or without label.—Category 248. Duty, 10 frs. per quintal.

ITALY.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220·4 lb. avoirdupois. Lire = 9 ¹⁶/₁₀₀d.

The following decisions affecting the classification of articles in the Italian Customs tariff have recently been given by the Italian Customs authorities:—

Carbonate of lime obtained by precipitation.—Category 246a. Duty free.

Tanned hides, without hair, sewn.—Category 190d (5). Duty, 70 lire per quintal.

Pepsine acidulated with hydrochloric acid in the form of extract.—Category 62. Duty, 120 lire per quintal.

Non-alcoholic perfumeries, placed in little paper bags, are classified under "non-alcoholic perfumeries," the weight of the paper bags being included with the goods.

Vessels of celluloid for centrifugal machines intended for the bleaching of thread.—Category 226n. Duty, 11 lire per quintal.

UNITED STATES.

Recent Customs Decisions.

The following decisions affecting the classification of articles in the Customs tariff, and the application of the Customs laws of the United States, have recently been given by the United States Customs authorities:—

An article called "opium ashes," containing 6·02 per cent. of morphia, is dutiable at the rate of 10 dollars per pound under Schedule A. (T. I., 121).

Bauxite, ground or pulverised, is held to be free of duty under T. I., 604, on the ground of retaining its commercial designation irrespective of the condition in which it may be imported.

On the exportation of refined stearin, manufactured wholly from imported crude stearin, a drawback will be allowed of the duties paid upon a quantity of the imported material equal to the net weight of the exported article, less the legal retention of 10 per cent.

Bromo-fluoresceic acid, a derivative of coal tar, and itself a coal-tar colour, used in imparting colours to various fabrics, is classified under paragraph 82 (T. I., new), and dutiable at the rate of 35 per cent. *ad valorem*.

Ferro-silicon, ordinary pig-iron containing about 10 per cent. of silicon, and used in mixing with low grades of pig-iron to increase the percentage of silicon, and thereby strengthen the product, is dutiable as pig-iron at the rate of three-tenths of a cent per pound.

Fruit-juices, when containing over 20 per cent. of alcohol, should be classified under Schedule H. (T. I., 312), as "compounds or preparations of which distilled spirits are a component part of chief value," and subjected to a duty of 2 dollars per gallon.

So-called "jasmine water" is to be classified as a medicinal water under T. I., 93, and pay duty at the rate of 25 per cent. *ad valorem*.

Certain iron oxide used as a colour or paint to be classified under T. I., 87, for "colours and paints," and dutiable at the rate of 25 per cent. *ad valorem*.

Sylvénite is free as a manure salt.

Indian red (earth paint) is dutiable as colours at the rate of 25 per cent. *ad valorem*.

Albuminised paper is dutiable at 25 per cent. as paper not otherwise provided for.

"Chlorophyl" is dutiable as a vegetable colour at the rate of 25 per cent. *ad valorem*.

So-called creolen and ichthyol, products obtained from the distillations of English coal, are dutiable at the rate of 25 per cent. *ad valorem* as chemical compounds not otherwise provided for under T. I., 92.

So-called "primulin," a colour derived from coal tar, is dutiable under T. I., 82, at the rate of 35 per cent. *ad valorem*.

Certain Peruvian bark, not being in a ground state, but advanced in manufacture for the purpose of developing the alkaloid principle, is dutiable at the rate of 10 per cent. *ad valorem* under T. 1., 94.

Cherry juice, which is obtained from fruit in its natural condition, and which is simply charged with spirit to prevent fermentation, shall be classed under the special provision for "fruit juice," at the duty of 20 per cent. *ad valorem*.

Merchandise found, upon chemical analysis, to consist of a mixture of ground shellac and a ground turpentine gum, forming a fabricated mixture intended to take the place of pure ground shellac, was returned for duty as a manufactured article unenumerated under section 2513, Act of March 3, 1883, at the rate of 20 per cent. *ad valorem*.

TRINIDAD.

Tariff of Import Duties.

The following is a statement of the rates of import duty now levied in the island of Trinidad:—

Articles.		Rates of Duty.
		£ s. d.
Oleomargarine, butterine, or any preparation of fat other than lard or ghee.....	Lb.	0 0 1
Gunpowder.....	"	0 0 7
Earthen and glass-ware, for every 100l. of value.....		4 0 0
Leather manufactures, for every 100l. of value.....		4 0 0
Methylated spirits, admitted as such by the Collector of Customs.....	Lb.	0 1 6
All other spirits, strong waters, liqueurs, and cordials if not exceeding the strength of proof as ascertained by Sykes' hydrometer, except tinctures admitted by the Collector of Customs as being for medicinal purposes only, which shall be charged with duty at the rate payable by goods unenumerated..	Liquid gall.	0 9 0
And for every degree of strength beyond that specified above an additional duty of 1d. the liquid gallon.		
Oil, creosote, for every 100l. of value.....		4 0 0
Do., coconut.....	Gallon	0 1 0
Do., petroleum.....	"	0 1 0
Do., all other kinds.....	"	0 1 0
Oil meal.....	100 lb.	0 1 0
Opium, including all goods, wares, or merchandise mixed or saturated with opium or with any preparation thereof, except tincture of opium, admitted by the Collector of Customs as being for medicinal purposes only, which shall be charged with duty at the rate payable by goods unenumerated..	Lb.	0 10 0
Soap.....	100 lb.	0 2 1
All other goods, for every 100l. of value.....		4 0 0

Exemptions.—Arrowroot; bark; bones and horns, unmanufactured; charcoal; lime; manures; and starch.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

THE WEIGHTS AND MEASURES ACT, 1889.

A memorandum on the Weights and Measures Act, 1889, prepared by the Board of Trade, appears in the September number of the Board of Trade Journal, p. 322.

THE MANUFACTURING INDUSTRIES OF BRITISH INDIA.

The following information is extracted from the statement exhibiting the moral and material progress and

condition of India during the year 1887—88, ordered by the House of Commons to be printed on the 16th August last:—

The domestic industries of India, such as pottery and brass and iron work, continue to be practised after ancient methods all over India, but are giving way before the products of British factories.

The produce of the paper mills, of which there were four in the Bombay Presidency, and five in other parts of India, had increased in value from Rx. 177,995 in 1885 to Rx. 258,645 in 1887. There were 19 breweries at work, of which three were opened in 1887—88. They produced during the year 4,860,000 gallons of beer and porter.

Among other "large industries" which are shown in the Indian returns for 1887—88 may be mentioned:—

Soup factories.....	2
Tanneries (large).....	7
Sugar factories (large).....	9
Cutch and lac factories.....	50
Oil mills.....	28
Cement factory.....	1
Bone manure factories.....	2

It is reported that attempts are being made to improve the quality of the silk by inducing the natives to take more care of their worms, and by the judicious use of European mulberry seeds. With this view European seed has been distributed, and foreign cocoons have been introduced. Some experiments are also said to have been made successfully to get over the difficulty of spinning tussar by means of a chemical process.

Besides the large *sugar* mills at Cossipore, there are said to be 170 smaller factories in the district, at which sugar is refined according to the native method. In Jessore, sugar is manufactured all over the district. There is one manufactory at Kotechandpore, where 14,833 maunds of refined sugar were produced. It is observed, however, that the industry has declined since foreign sugar has been brought into the market.

There was a decrease in the manufacture of *salt* in all the Orissa districts except Pooree, where the out-turn increased from 5,000 maunds in the previous year, when the greater number of the manufacturers resigned their licences through objection to being placed under the Madras rules, to over 80,000 maunds, the manufacturers having resumed business. In Balasore the industry is fast dying out, owing to the competition of Liverpool salt.

The *brass* and *copper* manufactures of the Punjab depend for the raw material on importations, chiefly from Europe. In former times copper used to come from Cabul, but this has entirely ceased; and Chinese zinc has long been driven out of the market by the European spelter. Various copper and zinc ores exist in the Kulu Hills and other parts of the Himalayas, but the imported copper and brass are so cheap that there is no present hope of those ores being worked. The most noticeable feature in the more recent developments of the industry is its concentration in certain towns, which have acquired a reputation for the quality of their goods.

In May in conclusion he noticed that a native engineer, a man of considerable means and intelligence, has opened a *brass* factory at Moheshgunge, and it is said that the manufacture and trade in brass vessels are brisk.

There are various manufactories in the North-West Provinces and Oudh, of which the principal are 2,210 indigo factories, employing 66,530 hands.

There were three factories for the manufacture of *sugar*, one at Aska in Ganjam, and two in South Arcot at Nellikuppam and Iravallepet. The last-named factory was not worked during the year. The Behea sugar-cane mill was largely used in the western taluks of Bellary.

From Karachi it is reported that the introduction of *bone crushing* machinery has rendered it possible for ship-owners to convey bones at ordinary cargo rates, and that this fact may be expected to have a favourable influence on the largely expanding trade in the export of bones.

The *Reay paper mill* at Mundhwa, near Poona, with a capital of Rx. 50,000, commenced work during the year. It afforded employment to 180 persons on an average, and produced 130 tons of paper, valued at Rs. 5,460.

THE SALE OF MARGARINE IN RUSSIA.

A despatch, dated the 6th August last, has been received at the Foreign Office from Sir R. B. D. Morier, Her Majesty's Ambassador at St. Petersburg, enclosing a translation by Mr. Michell of a statement in the *Moscow Gazette*, describing the modifications adopted by the Council of the Empire in the scheme for the sale of margarine in Russia, which has now been returned to the Minister of Domains for further elaboration. The following is a copy of the translation in question:—

The Council of the Empire has considerably modified the scheme submitted to it by the Minister of Imperial Domains for the sale of margarine in Russia. The chief modifications consist in the prohibition to mix genuine butter with margarine; in the appointment of Government inspectors who will exercise strict supervision over margarine manufactories. Moreover, these manufactories must wind up their business in the course of the next five years, after which they will finally close, and permission to establish new margarine works will not be granted. The project has been returned with the above modifications to the Minister of the Domain for further elaboration, which, when completed, will be again discussed by the Council in its full assembly.

THE OLEOMARGARINE LAW IN THE UNITED STATES.

In July 1886 Congress passed an Act which was approved by the President August 2nd, imposing a tax on the manufacture, sale, importation and exportation of oleomargarine, and placing the whole matter under the control of the Commissioner of Internal Revenue. The system followed is very similar to that pursued in collecting the tax on tobacco.

The regulations to carry out the law have lately been revised, and go into effect September 1st. A brief résumé of the law and regulations may not be uninteresting at this time.

Section 8 of this Act provides: "That upon oleomargarine which shall be manufactured and sold, or removed for consumption or use, there shall be assessed and collected a tax of two cents per pound, to be paid by the manufacturer thereof; and any fractional part of a pound in a package shall be taxed as a pound. The tax levied by this section shall be represented by coupon stamps; and the provisions of existing laws governing the engraving, issue, sale, accountability, effacement, and destruction of stamps relating to tobacco and snuff, as far as applicable, are hereby made to apply to stamps provided for by this section."

Section 3 imposes upon manufacturers and dealers in oleomargarine special taxes, as follows:—

"Manufacturers of oleomargarine shall pay six hundred dollars. Every person who manufactures oleomargarine for sale shall be deemed a manufacturer of oleomargarine."

"Wholesale dealers in oleomargarine shall pay four hundred and eighty dollars. Every person who sells or offers for sale oleomargarine in the original manufacturer's packages shall be deemed a wholesale dealer in oleomargarine. But any manufacturer of oleomargarine who has given the required bond and paid the special tax, and who sells only oleomargarine of his own production, at the place of manufacture, in the original packages to which the tax-paid stamps are affixed, shall not be required to pay the special tax of a wholesale dealer in oleomargarine on account of such sales."

"Retail dealers in oleomargarine shall pay forty-eight dollars. Every person who sells oleomargarine in less quantities than ten pounds at one time shall be regarded as a retail dealer in oleomargarine."

Every manufacturer of oleomargarine is compelled by the regulations, in compliance with section 5 of the law, "before commencing business, and on the first day of May of each year before continuing business, to file with the collector of the district in which his factory is located a notice," on a prescribed form, stating the location, the character of the machinery and appliances used for manufacturing, the total capacity, in pounds, for producing oleomargarine each day of 24 hours, in his factory; to give "a

bond in an amount to be fixed by the collector, of not less than 5,000 dols., with two or more sureties satisfactory to him; and to file an inventory of all the materials that enter into the manufacture of oleomargarine, including all materials in process of manufacture, all finished products, and all other materials owned by him on that date." (See Forms 213, 214, and 215.)

He also keeps a book, which is open to the inspection of every Internal Revenue officer and agent, showing the amount of all materials used each day of the month in the manufacture of oleomargarine and all products, whether of oleomargarine, stearin, or other product; and makes monthly returns from his book on a prescribed form.

This monthly return, made out in duplicate (the original is placed on file in the office of the collector of the district in which the factory is situated, the duplicate is forwarded to the central office at Washington), shows the quantity and kind of material used for the production of oleomargarine, and the quantity of oleomargarine produced each day of the month; and also the quantity and kind of materials otherwise used during the month. It also gives in detail the quantity of oleomargarine sold, removed, or destroyed on each day of the month, with the serial number of the package, the name, place of business and residence of the persons to whom sold or consigned; together with a recapitulation showing the aggregate quantity on hand at the beginning of the month, the quantity produced, the quantity sold and removed, including losses, and the quantity on hand at the close of the month. The quantities of oleomargarine are stated in taxable pounds.

It sometimes happens that tax-paid oleomargarine is returned to the manufacturer. In this case he enters on his book and monthly return the serial number of the packages and the date when returned. In case it is worked over, it is credited on the material account, and if it is sold again intact, the date of the second withdrawal, and all other particulars, including the name and address of the new purchaser, are entered, in *red ink*, on his books and returns. (See Book, Form 60 and Form 216.)

Wholesale dealers are also required to keep a book and make a monthly return, showing in detail the quantity of oleomargarine received by them direct from the manufacturers, giving the date, from whom and whence received, by what manufacturer produced, together with the serial number of packages and number of taxable pounds; also the quantity of oleomargarine disposed of by them, with date, serial numbers of packages, taxable pounds, by what manufacturer produced, to whom sold or delivered, with name and address; also the quantity received from other wholesale dealers, the quantity disposed of to other wholesale dealers and the quantity disposed of to persons not known to be wholesale dealers. Oleomargarine disposed of by a wholesale dealer to himself as a retail dealer or consumer is included in such statements. (Book, Form 61 and Form 217.) Retail dealers are not required to keep books or make monthly returns.

Oleomargarine is put up in wooden packages, either solid packed, in rolls or in prints; and before removal from the factory is branded or stencilled with the serial number of the package, corresponding to the number on the stamp, the word "Oleomargarine," and the number of the factory and district: the packages also have a cautionary notice or label pasted on them. The stamp having been affixed is immediately cancelled. The face value of the stamp represents the tax on the number of taxable pounds of oleomargarine contained in the package.

The stamps are engraved and bound in book form, containing 200 stamps, each of the denominations 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 pounds. Attached to each stamp are nine coupons, each coupon representing one pound. The tax-paid stamp must be signed by the collector and have written thereon the date of the payment of the tax, the number of pounds, the number of the factory, the serial number of the package, and the name of the person by whom or for whom it was cancelled.

"Retail dealers in oleomargarine must sell only from original stamped packages, in quantities not exceeding ten pounds, and shall pack the oleomargarine sold by them in suitable wooden or paper packages." (Section 6.) These

packages must have, besides the name and address of the dealer, the word "Oleomargarine," and the quantity in pounds contained therein, written or printed upon them in letters not less than $\frac{1}{4}$ inch square, and must be so placed as to be plainly visible to the purchaser at the time of delivery to him.

The law makes provisions for testing substances suspected of being oleomargarine, and also "whether any substance made in imitation or semblance of butter, and intended for human consumption, contains ingredients deleterious to the public health." No samples, however, have ever been submitted under the latter clause.

Oleomargarine imported from foreign countries is not required to have the Internal Revenue stamps affixed thereto and cancelled unless it is withdrawn from the Custom house for consumption or sale in the United States.

Manufacturers of oleomargarine may export their product and be allowed credit for the taxable quantity exported according to law. The regulations go into minute details on the different steps to be pursued. (See Regulations, Series 7, No. 9, Revised, U.S. Internal Revenue.)

The law imposes heavy penalties for violations of its provisions. (See sections 4, 6, 7, 10, 11, 12, 13, 15, 17, 18, Act of August 2, 1886.)

From the manufacturers' and wholesale dealers' monthly returns a list is made, at the Washington Office, of the names and addresses of the different purchasers in each collection district, which list is sent to the several collectors of Internal Revenue. By this means a collector can verify his list of wholesale and retail dealers who have paid the special tax, and investigate and ascertain who may be dealers without having paid the special tax required by law.

The greatest trouble, in enforcing the national law and collecting the special taxes, has been met with in those States where the State law contains prohibitory features, which are enforced by arresting and imprisoning all dealers who have paid the internal revenue tax and whose names appear, therefore, in the collector's book, which is open to the public inspection: although beyond that these State officers do not appear to go. These State laws likewise prohibit the manufacture or sale of cheese containing foreign fats, and the use of oleomargarine at hotels, restaurants, or boarding houses; features of their laws which do not seem to be enforced. The consequence has been that dealers have abandoned the open sale of oleomargarine but continue to supply their customers, by placing their orders directly with the manufacturers, by whom the oleomargarine is shipped to the customers' residence, the dealers thus acting as the manufacturers' agents. The consumer of 10 lb. or more of oleomargarine has therefore no trouble in obtaining his weekly supply direct from the factory, but the large class of people in these prohibition States who want only a few pounds at a time are denied that privilege and are compelled to pay a great deal higher price for the lowest grades of poor rancid butter.

The following statements, showing the number of manufacturers, wholesale and retail dealers, from October 31, 1886, when the law first went into effect, to April 30, 1889, the end of the last special-tax year, engaged in the business each year; the quantity of oleomargarine produced, withdrawn from factories tax-paid, lost or destroyed, and exported, during the same period; and the receipts during the last two years, are compiled from the reports of the Commissioner of Internal Revenue:—

STATEMENT SHOWING NUMBER OF MANUFACTURERS AND DEALERS, AND OF THE QUANTITY OF OLEOMARGARINE PRODUCED IN THE UNITED STATES.

Special-tax Year.	Manu- facturers.	Wholesale Dealers.	Retail Dealers.	Quantity Produced.	Quantity withdrawn Tax-paid.	Lost or Destroyed.	Quantity Exported.	On Hand.
Oct. 31, 1886, to April 30, 1887	32	235	3,929	18,494,177	17,672,507	42,750	535,308	181,090 Nov. 1, 1886 2,531 April 30, 1887
May 1, 1887, to April 30, 1888	29	154	3,279	32,270,532	30,812,624	17,015	1,383,675	57,188 April 30, 1888
May 1, 1888, to April 30, 1889	23	169	3,906	37,409,064	34,981,909	2,917	2,065,849	358,398 April 30, 1889

STATEMENT OF THE RECEIPTS FROM OLEOMARGARINE DURING THE FISCAL YEARS ENDED JUNE 30, 1888 AND 1889.

Objects of Taxation.	Receipts during Fiscal Year.		Increase.	Decrease.
	1888.	1889.		
OLEOMARGARINE.	Dols.	Dols.	Dols.	Dols.
Oleomargarine, domestic and imported.....	653,355'10	677,302'40	23,947'30	..
Manufacturers of oleomargarine (special tax).....	17,150'00	12,400'00	..	4,750'00
Retail dealers in oleomargarine (special tax).....	123,258'54	134,631'51	7,372'97	..
Wholesale dealers in oleomargarine (special tax).....	79,376'24	73,914'00	3,537'76	..
Total.....	864,139'88	894,247'91	30,108'03	4,750'00

A peculiar but natural tendency, owing to the high rates of the special taxes, has been noted of dealers paying their special taxes for the last six months of the special tax year, viz., from November to May, and not for the whole year. In other words, during the spring and summer months, when dairy butter is cheaper than oleomargarine, there is no profit in selling the latter. The small manufacturer has been driven out of the business, for the reason that he could not produce enough to make it profitable with his limited plant.

It will be seen from the above statement that although the number of factories have been reduced from 32, when the law first went into effect, to 23 on April 30th last, the

domestic consumption and the exportation of oleomargarine has steadily increased. An average monthly increase of one-third of a million pounds in domestic consumption in the past year would seem to indicate that, notwithstanding the false impressions that were widely disseminated about oleomargarine, it has attained its permanent place among an increasing class of consumers as a cheap and wholesome article of food.

By the system pursued each manufacturer's package of oleomargarine can be traced from the time it leaves the factory duly stamped, branded, and labelled to the hands of the wholesale dealer, till it reaches the retail dealer and often the consumer. The retail dealers incur such heavy

penalties if they do not properly brand their packages with the word "oleomargarine," that the fraudulent sale of oleomargarine for butter, *i.e.*, at butter prices, is very limited.

A description of the American methods of manufacturing oleomargarine was printed in the Annual Report of the

Commissioner of Internal Revenue for 1888, p. clxi. (Abst. Jour. Soc. Chem. Ind. Vol. VIII., p. 408).

The following table, taken from the same report, p. clx., shows the extremes in composition of oleomargarine and its ingredients:—

EXTREMES OF COMPOSITION OF SAMPLES OF OLEOMARGARINE AND INGREDIENTS.

Oleomargarine.	Specific Gravity at 40° C.	Saponification Equivalent.	Vol. N ₁₀ NaOH for 2.5 Grms.	Ingredients.	Specific Gravity at 40° C.	Saponification Equivalent.	Vol. N ₁₀ NaOH for 2.5 Grms.
Oleomargarine:				Oleo oil:			
Average, 39 samples.....	*90397	286.0	0.370	Average, 13 samples.....	*90216	286.2	*053
Highest.....	*90326	291.6	0.382	Highest.....	*90268	288.4	*207
Lowest.....	*90291	282.3	0.080	Lowest.....	*99171	284.6	*000
Dairy butterine:				Neutral lard:			
Average, 9 samples.....	*90478	284.0	1.294	Average, 12 samples.....	*90362	286.6	*017
Highest.....	*90427	286.8	1.315	Highest.....	*90379	288.2	*208
Lowest.....	*90359	282.2	1.002	Lowest.....	*90334	284.6	*000
Creamery butterine:				Cotton-seed oil:			
Average, 7 samples.....	*90519	275.9	3.467	Average, 8 samples.....	*91198	285.7	*089
Highest.....	*90750	280.4	7.577	Highest.....	*91403	289.1	*471
Lowest.....	*90416	266.1	1.973	Lowest.....	*91082	283.3	*000

—U.S. Department of Internal Revenue.

THE ADULTERATION OF BUTTER AND LARD IN THE UNITED STATES.

A report to the Foreign Office, dated the 23rd August last, has been received from Captain W. F. Seagrave, Her Majesty's Consul at Baltimore, on the subject of the adulteration of butter and lard. The following is an extract from the report in question:—

Under the Act of Congress of August 1886 butter is defined as a "food product usually known as butter, and which is made exclusively from milk or cream, or both, and with or without salt or colouring matter."

Under the same Act, oleomargarine is defined as "certain manufactured substances, extracts, mixtures, and compounds, including such mixtures and compounds with butter, whenever made in imitation or semblance of butter. And when so calculated to be sold as or for butter."

Though the above may not be the strict chemical definition of oleomargarine, it is the legal one, and holds good throughout the United States, and for overlooking its provisions, certain members of a firm in the city of Baltimore had, not long ago, to serve a term of imprisonment.

Special attention, therefore, is called to it, because the dairymaid, who adds a little cotton-seed oil to her churning to make the butter come more quickly, is probably not aware that she is making oleomargarine, and infringing the law.

The analytic descriptions of oleomargarine in this part of the country, and which, anterior to present legislation, passed current as butter, are various.

In one case, three or four pounds of black grease drippings neatly covered with a layer of fairly good butter two or three inches deep, whether kneaded together or not, is now legally defined as oleomargarine.

Another sample contained 40 per cent. of tallow mixed with a similar preparation to that above described.

Another sample consisted of 50 per cent. of butter made up with water, casein, and boiled starch.

These various compounds, which now pass legally as oleomargarine, find their way from small country dairies to village shopkeepers, who take them in exchange for groceries, and so soon as they have accumulated two or three barrels of this stuff they despatch it to the large cities

and place it on the market, where it is readily disposed of for cooking. It is said that in the Western States this stuff undergoes some peculiar process of manipulation, and is turned into what is called "ladle-packed butter."

In these Eastern States, however, the manipulation of this class of so-called butter, even with the aid of chemicals, has not as yet proved a financial success. It was no doubt in referring to this so-called "ladle-packed butter" that the president of an agricultural college in the West, addressing an association of dairy farmers, described it in the picturesque and figurative language of the country as "a butter 40 per cent. below zero for badness, of a grizzly, white, brindled, streaked, cheesy sort, old enough to vote, and strong enough to stand alone under the influence of ice, and which had a flavour of its own, which it generously imparted to everything which it touched. To mention oleomargarine with so-called bakers' butter was, he said, an insult to the dead animal which furnishes the fat from which the oleomargarine is made." Yet there is plenty of this class of butter in every large city.

"Ladle-packed butter" is in the Eastern States presumably genuine butter which has been collected in small parcels from different farmers along a collector's route. At the end of his journey the collector mixes the different parcels together, gives it a uniform colour, and then packs it away in tubs, which are despatched to the commission merchant.

No doubt the packer mixes a small percentage of oleomargarine with his purchases, perhaps 10 per cent., though, if detected, he will most probably assure you that it got in accidentally at some farmhouse on his route.

If, however, sworn evidence is worth anything, there is little "ladle-packed butter" sold in the market in this State which does not contain about 10 per cent. of foreign fat, whether cotton-seed oil, or tallow, or stearin, or real oleomargarine.

In place of the old-fashioned churn, which is rapidly disappearing, the modern "creamery" is being everywhere established.

These creameries are, in other words, co-operative dairies where, instead of the antiquated methods, steam supplies the place of manual labour, and economy of manufacture is the prevailing characteristic, combined with care, cleanliness, and dividends.

The number of these creameries is already very great, and is daily increasing.

It is to them that the trade look for their supply of table butter, and the general verdict is that they produce a good article.

The adulteration of lard has assumed such huge proportions as to call for a special Act of Congress in order to protect the legitimate manufacturer and trader.

The new legislation assumes to have been based on sanitary grounds, but the real issue is the commercial injury done to the bona fide trader through wholesale adulteration. And no doubt it was high time that legal protection should have been extended to the latter.

About seven-eighths of the lard exported from the United States is termed "Western refined lard," or "compound lard," or "prime steam lard," and appears, according to the evidence laid before a committee of the United States Senate, to be compounded in the following manner. It was stated that the "packers went on until they began to put in the whole hog; head, trimmings, offal, everything went in making one 'straight brand,' known as 'steam lard.' Now the great packing houses in the West do not waste their time in cleaning the offal and pannich; they just throw everything into the tank—entrails, head, feet, and all."

The lard tank in a packing house is to-day a sort of receptacle for everything in the shape of grease on the establishment.

There is no longer any such article as No. 1 lard; everything goes in and it all forms "prime steam lard." For such lard, of course, some process of refining is necessary. For this purpose it is, when received from the packers, put into a large tank and open steam turned on, and the contents of the tank boiled for an hour or two, when it is allowed to settle, and the impure scum is skimmed off, and the skimmed lot allowed to stand for 10 hours, when, as it is alleged, all odour has disappeared.

One witness declared that regular refined lard contains approximately 50 to 75 per cent. of prime steam lard, 15 to 25 per cent. of pure cotton-seed oil, and about 10 per cent. of beef fat, or oleo, or stearin, the proportions being occasionally varied according to temperature and destination.

It is asserted that quite seven-eighths of the lard now sold in the United States is compounded after the above prescription.

Watered lard is by no means a novelty, about 30 per cent. of water is the limit that can be combined with lard without causing it to "spit" when used in cooking.

Cotton-seed oil is, as is expressed by its name, an oil pressed from cotton seed. The crude oil is of a red or even darker colour. It is refined by agitating crude oil with caustic soda, or, by another process, it is boiled with a solution of bleaching powder and subsequently agitated with sulphuric acid. The refined cotton-seed oil is of a pale-straw colour or almost white.

It does duty all over the United States as salad oil, and often as genuine olive oil; it is an extremely convenient product for the adulteration of butter, cheese, and lard, and is largely used for such purposes. Of course it is cheaper than any of the products with which it is combined, otherwise it is safe to say that valuable as may be its qualities as a food product it would never be used as an adulterant.

STATISTICS.

NOTES ON THE GERMAN DRUG TRADE.

(From Messrs. Gehe & Co.'s Semi-annual Circular.)

While German trade in general has had a fairly prosperous year in 1888, the drug and chemical industries have been touched by the general improvement to a very slight extent only. The imports of articles for use of the chemical industry and of pharmacy show a total of 243 millions of marks in 1888, against 219 millions in 1887, *i.e.*, an increase of 24 millions of marks; and if the average values of 1887 had been maintained there would have been exactly the same result, so that all the advances and declines of the

year have neutralised one another. The exports in the same category have been—in 1888, 236 millions of marks, against 226 millions in 1887. If the average prices of 1887 had also been maintained in this department, there would have been an increase of 17 millions, instead of 10 millions. The moral of these figures is that, while the Germans paid the same average prices for what they bought from abroad in 1888 as in 1887, they have had to sell their own products to the foreigner at a slight reduction.

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ended 31st August.	
	1888.	1889.
Metals.....	£ 1,679,638	£ 1,718,433
Chemicals, dyestuffs, and tanning materials.....	562,969	483,048
Oils.....	538,938	679,506
Raw materials for non-textile industries.....	4,059,247	4,985,328
Total value of all imports.....	30,006,140	32,902,028

SUMMARY OF EXPORTS.

	Month ended 31st August.	
	1888.	1889.
Metals (other than machinery).....	£ 3,381,848	£ 3,320,443
Chemicals and medicines.....	635,812	653,452
Miscellaneous articles.....	2,623,172	2,488,679
Total value of all exports.....	21,187,750	21,326,007

IMPORTS OF METALS FOR MONTH ENDED 31ST AUGUST.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Copper:—			£	£
Ore..... Tons	9,574	10,513	83,824	89,628
Regulus and precipitate..... "	9,867	14,557	362,615	343,114
Unwrought.... "	3,176	3,136	247,455	136,386
Iron and steel:—				
Iron ore..... "	322,316	290,546	219,148	222,924
Bar, bolt, &c.... "	14,118	14,059	126,648	133,750
Steel, unwrought.... "	839	1,199	7,858	8,186
Lead, pig and sheet.... "	10,294	11,580	138,139	147,437
Pyrites..... "	44,245	37,082	84,503	65,296
Quicksilver..... Lib.	1,988	77,596	178	9,108
Tin..... Cwt.	15,503	28,822	70,300	128,115
Zinc..... Tons	4,274	5,077	71,748	94,484
Other articles.....	..	..	258,222	340,095
Total value of metals.....	..	..	1,679,638	1,718,433

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH
ENDED 31ST AUGUST.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Alkali..... Cwt.	8,117	4,396	£ 8,127	£ 3,392
Bark (for tanners' and dyers' use) ..	38,467	35,978	13,362	15,154
Brimstone	85,884	68,120	19,583	18,058
Chemicals..... Value £	..	..	102,258	99,507
Cochineal	299	506	1,975	3,381
Cutch and gambier Tons	3,774	2,564	95,276	74,702
Dyes (coal tar) :—				
Aniline .....	..	..	22,936	25,802
Alizarine .....	..	..	19,303	25,753
Other .....	..	..	1,246	1,180
Indigo	867	744	13,267	8,789
Madder	1,934	1,275	1,492	1,424
Nitrate of soda....	193,520	75,920	86,557	32,417
Nitrate of potash ..	40,372	24,689	31,603	21,860
Valonia	1,957	2,408	28,638	35,136
Other articles... Value £	..	..	117,377	116,493
Total value of chemicals	..	..	562,960	483,048

IMPORTS OF OILS FOR MONTH ENDED 31ST AUGUST.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Cocoonut	22,450	13,513	£ 25,521	£ 20,654
Olive	1,813	2,155	61,831	76,209
Palm	103,922	86,185	100,115	88,545
Petroleum	7,674,539	9,196,189	200,673	256,460
Seed of all kinds ..	1,068	1,270	26,569	35,994
Train, &c.....	2,223	2,715	41,575	55,743
Turpentine	42,080	53,464	56,681	86,964
Other oils..... Value £	..	..	52,973	58,937
Total value of oils...	..	..	568,938	679,506

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE
INDUSTRIES FOR MONTH ENDED 31ST AUGUST.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Bark, Peruvian ..	11,510	4,336	£ 45,185	£ 17,261
Bristles.....	173,885	201,914	24,387	39,118
Caoutchouc.....	15,656	13,267	151,685	125,393
Gum :—				
Arabic.....	5,812	4,094	20,992	14,554
Lac, &c.....	8,405	3,419	20,537	11,931

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE
INDUSTRIES FOR MONTH ENDED 31ST AUGUST—*cont.*

Articles.	Values.		Quantities.	
	1888.	1889.	1888.	1889.
Gutta-percha	2,964	7,204	£ 2,903	£ 103,173
Hides, raw :—				
Dry.....	11,865	37,498	109,554	92,493
Wet	19,809	62,569	115,001	144,521
Ivory	568	966	27,575	46,375
Mapures :—				
Guano	2,937	2,421	25,621	16,665
Bones.....	4,444	2,574	20,858	12,728
Paraffin.....	29,884	21,435	37,712	24,989
Linen rags.....	4,341	3,104	52,290	50,124
Esparto, &c.	32,207	16,074	153,556	79,843
Pulp of wood	11,658	10,497	57,132	63,492
Rosin.....	108,569	93,481	22,274	17,335
Tallow and stearin ..	92,104	103,187	105,727	131,517
Tar	18,118	59,273	8,797	33,358
Wood and timber :—				
Hewn	248,382	287,853	556,389	808,883
Sawn	704,577	909,715	1,540,914	2,261,512
Staves	20,918	18,593	61,311	62,386
Malogany	3,614	2,200	50,293	21,149
Other articles.... Value £	..	..	831,837	822,898
Total value .....	..	..	4,079,247	4,985,328

Besides the above, drugs to the value of 80,386*l.* were imported during the month, as against 69,332*l.* in August 1888.

EXPORTS OF METALS OTHER THAN MACHINERY FOR
MONTH ENDED 31ST AUGUST.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Brass.....	6,196	9,882	£ 29,392	£ 39,984
Copper :—				
Unwrought	70,804	47,918	261,462	106,779
Wrought.....	5,463	35,389	24,969	100,099
Mixed metal	10,324	29,216	36,956	72,192
Hardware .....	..	..	250,916	220,984
Iron and steel.....	377,577	383,337	2,349,771	2,459,212
Lead	3,577	2,944	50,573	41,870
Plate wares....	..	..	32,756	31,782
Telegraphic wires ..	..	..	110,923	46,452
Tin	12,417	6,672	58,372	31,250
Zinc	18,447	4,421	12,849	3,945
Other articles .. Value £	..	..	150,504	171,914
Total value .....	..	..	3,381,848	3,329,443

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDED 31ST AUGUST.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Alkali..... Cwt.	485,698	594,369	£ 122,961	£ 134,331
Bleaching materials ..	134,151	112,037	50,341	40,318
Chemical manure (% Foss)	..	38,714	168,787	174,359
Medicines..... Value £	..	..	78,750	74,036
Other articles ... ..	..	..	215,873	230,318
Total value .....	..	..	635,812	657,452

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDED 31ST AUGUST.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Explosives:—			£	£
Gunpowder.... Lb.	943,700	604,600	24,363	14,212
Other kinds .. Value £	..	..	85,183	84,967
Candles..... Cwt.	606,209	1,231,003	12,067	21,547
Caoutchouc Value £	..	..	106,659	95,180
Cement..... Tons	53,420	38,404	165,195	74,504
Earthenware ... Value £	..	..	169,311	173,853
Stoneware ..... "	..	..	94,72	12,037
Glass:—				
Plate..... Sq. Ft.	367,679	219,717	21,428	16,084
Flint..... Cwt.	11,849	8,402	23,936	19,488
Bottles..... "	79,543	75,251	33,728	35,295
Other kinds.... "	18,116	15,598	13,611	11,132
Leather:—				
Unwrought "	16,233	9,825	121,495	91,195
Wrought Value £	..	..	3,496	31,122
Seed oil..... Tons	5,765	4,057	114,927	110,986
Floor cloth Sq. Yds.	1,500,630	1,218,300	68,350	60,824
Painters' mate- rials Value £	..	..	128,839	121,339
Paper of all kinds. Cwt.	97,513	74,143	166,518	126,684
Rags..... Tons	4,143	4,069	32,149	31,947
Soap..... Cwt.	41,656	33,616	38,550	36,333
Total value of exports of miscellaneous articles	..	..	2,623,172	2,488,679

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

- 13,058. C. W. Guy. Evaporating apparatus. August 19.
 13,086. W. Burns. Arrangement for economising waste heat, and for consuming smoke from furnaces. August 19.
 13,212. R. Reichling. Evaporating apparatus, applicable for cooling or heating liquids, and for charging gases with vapours. August 20.
 13,239. W. A. Carlile. Blowers and exhausters. August 22.
 13,343. H. H. Lake.—From Kalle and Co., Germany. Improvements relating to the preparation of chemical compounds. August 22.
 13,363. J. Nicholas. Evaporating liquids. August 24.
 13,549. H. Bower. A certain new and useful process for facilitating chemical reactions. Complete Specification. August 27.
 13,584. J. R. Burgess and A. S. Williams. Pumps and pipes for chemical purposes and the like. August 28.
 13,598. H. McPhail, E. Simpson, and C. H. Simpson. Method and apparatus for generating steam and evaporating various liquids. August 28.
 13,761. J. Wach. Improvements in thermostats and apparatus operated by differences in the thermal expansion of metals. Complete Specification. August 31.
 13,814. W. Young. Apparatus for boiling brine and the like under a vacuum. September 2.
 13,815. W. Young. Apparatus for boiling brine and the like under a low heat in vacuum. September 2.
 13,816. W. Young. Apparatus for boiling brine and the like in a vacuum. September 2.
 13,875. A. Brimetti. Freezing apparatus. September 3.
 13,925. A. Crosbie and H. J. Mitchell. Carboy hampers. September 4.
 13,929. W. Bergh. Centrifugal apparatus for separating fluids of different specific gravities. September 4.
 14,229. H. H. Lake.—From T. G. B. de Ferrari di G. B., Italy. Method and apparatus for burning petroleum, naphtha, and other fuel in boiler and other furnaces. September 9.
 14,338. C. A. Sahlström and J. C. Bromfield. Furnaces for burning liquid fuel. September 11.
 14,381. F. Brighman. Bunsen burners. September 12.
 14,416. F. Radcliffe. Furnaces for melting and other purposes. September 12.

COMPLETE SPECIFICATIONS ACCEPTED.*

1888.

14,683. R. Free and H. J. Pierce. Thermometers. September 18.

15,563. J. L. Stevenson. Improved valve for Siemens' gas furnaces. September 4.

1889.

900. Fleming's Oil and Chemical Co., Lim., and G. H. Fenner. See Class XII.

3705. R. Hollingdrake. Chilled firebars for burning smoke in all kinds of furnaces. September 11.

7203. H. Roeske. Improvements in filters. September 18.

9975. A. J. Boulton.—From P. Varin. Filters. September 11.

10,251. T. Gentzen and A. Wegener. Filters. August 28.

10,288. H. H. Lake.—From O. B. Peck. See Class X.

10,955. J. Johnston. Apparatus for heating, drying, &c. September 11.

11,466. H. H. Chapman.—From J. Donaldson. Attachment for indicating pressures and levels of fluids in vessels. September 4.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

13,129. C. B. Harris. An improved method of making incandescing elements for gas burners. Complete Specification. August 20.

13,143. G. Bower. Means or apparatus for carburetting air or gas. August 20.

13,195. W. F. K. Stock. Improvements in the manufacture of coal gas. August 20.

13,390. W. Fritsch. Improvements in coke ovens. August 24.

13,402. T. Blandford. Increasing the heating properties of fuel in furnaces for generating steam or heating and melting metals or other minerals. August 26.

13,436. P. Tyrer and L. Breeze. Heating water or other liquids noiselessly by the aid of direct contact of steam, to be called "Breeze's silent water-heater by steam." August 26.

13,653. W. P. Thompson.—From P. Marx and M. Notkin, Russia. A new or improved process for the purification of mineral oils, and for producing alcohol. August 29.

13,712. R. D. Bowman. Improved process for the production of oxygen gas. August 30.

13,763. E. Tatham. An improved gas, usable as an explosive, and, in admixture with other gases, as an illuminating and heating gas. Complete Specification. August 31.

13,933. R. B. Helliwell. Improvements in firelighters. September 4.

13,999. O. Brown.—From G. A. Goyder, Australia. Improvements in the manufacture of gas adapted for use in motor engines and otherwise, and in apparatus applicable for employment in such manufacture. September 4.

14,031. J. Loves. Improvements in apparatus for carburetting gas or air. September 4.

14,060. F. N. Mackay. Improvements in separating tar and ammonia from gases, and in apparatus therefor. September 6.

14,287. M. A. Morse. Improvements relating to the manufacture of gas, and to apparatus therefor. Complete Specification. September 10.

14,291. S. Pitt.—From C. B. Harris, United States. Apparatus for the manufacture of gas. Complete Specification. September 10.

14,424. H. Williams. Improvements in the manufacture of the gas commonly styled "water-gas," and in apparatus employed in such manufacture. September 13.

14,425. H. Williams. Improvements in carburetting gas, and in apparatus therefor. September 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

8559. The Gas Patents Syndicate, Ltd. Apparatus for the manufacture of gas. September 18.

14,105. W. T. Sugg. Improved mode of lighting by gas. September 4.

15,393. H. H. Lake.—From F. Honnay. Preparation of tar for use in the manufacture of artificial fuel. September 11.

15,410. L. W. Leeds and The Leeds Patent Floor Warming Stove Co., Ltd. Stoves for burning gas or liquid fuel. September 11.

1889.

90. S. G. Rhodes. Fireballs for use as artificial fuel. August 28.

1414. L'Agence Maritime Anglaise, Ltd.—From C. Audony. Apparatus for manufacturing artificial fuel blocks. August 28.

1637. J. Ewing. Combustion and economy of fuel, and bar preservation. September 11.

6659. J. von Langer and L. Cooper. Manufacture of water-gas. September 18.

7044. A. Harkness and W. T. Harkness. Method and apparatus for effecting the complete combustion of fuel in heating furnaces, and the abatement of smoke nuisance. September 18.

11,610. W. Hubbard. Manufacture of compressed fuel blocks. August 28.

11,899. C. Huelser.—From G. Kassner. Preparing plumbates of calcium, barium, and strontium, and employing the same for oxidising purposes and for producing oxygen, &c. September 18.

12,092. A. Weber. Coke ovens or furnaces. September 4.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATION.

13,861. A. H. Allen and W. W. Staveley. Improvements in the treatment of oils to be used for creosoting, pickling, or preserving timber. September 3.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

13,217. H. H. Lake.—From A. Leonhardt and Co., Germany. Improvements in the manufacture of colouring matters. August 20.

13,266. O. Imray.—From The Farbwerke vorm. Meister, Lucius, and Brüning, Germany. An improved manufacture of basic colouring matters. August 22.

13,299. J. H. Chaudet. Improvements in and relating to the preparation or combination of aniline dyes and other like substances, and their application to dyeing animal or vegetable textile materials. August 23.

13,386. The Clayton Aniline Co., Ltd., H. Bull, and J. Hall. Improvements in the manufacture or production of colouring matters. August 24.

13,558. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in and connected with the manufacture of colouring matters suitable for dyeing and printing without the use of a mordant. August 27.

13,665. B. Willcox.—From The Farbenfabriken vorm. F. Bayer and Co., Germany. Improvements in or connected with the manufacture and production of colouring matters or dyestuffs. August 29.

13,710. O. Imray.—From The Farbwerke vorm. Meister, Lucius, and Brüning, Germany. Production of azo-colouring matters from dioxynaphthabimmonosulphonates. August 30.

14,207. The Clayton Aniline Co., Ltd., P. Brunner, and J. Hall. Improvements in the manufacture and production of colouring matters or dyestuffs. September 9.

14,222. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture and production of diazo-colouring matters. September 9.

14,230. B. Willecox.—From The Farbenfabriken vorm. F. Bayer and Co., Germany. Improvements in the manufacture, production, and application of colouring matters. September 9.

14,294. H. H. Leigh.—From R. G. Williams, United States. Improvements in dye colours. September 10.

14,303. A. G. Green and T. A. Lawson. The production of new azo-colouring matters. September 10.

14,304. A. G. Green and T. A. Lawson. The production of new azo-colouring matters. September 10.

14,388. R. Ashton. Improvements in the method of preparing colours for making writing inks. September 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

15,121. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture of derivatives of alizarin-green for dyeing and printing. August 28.

15,258. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture of diazo dyestuffs. August 28.

15,259. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture of the sulpho-acids of a red basic naphthaline dyestuff. September 18.

15,260. B. Willecox.—From The Farbenfabriken vorm. F. Bayer and Co. Production of colouring matters from alizarin mono-sulpho acids. August 28.

15,849. A. G. Green. Manufacture of a β -naphthylamine sulphonic acid. September 18.

16,325. O. Inray.—From The Farbwerke vorm. Meister, Lucius, and Brünig. Manufacture of induline colouring matters soluble in water. September 18.

16,393. C. D. Abel.—From The Farbwerke vorm. Meister, Lucius, and Brünig. Production of colouring matters resembling the indulines. September 18.

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

13,127. W. Latimer. Improvements in and relating to a new and useful fibre produced from the leaves of needles of *Pinus Australis* and other coniferous trees. Complete Specification. August 20.

13,173. J. Holden and J. R. Jepson. Improvements in or relating to the manufacture of felt. Complete Specification. August 20.

13,237. E. Ogden. Improvements in means for ornamenting textile fabrics. August 22.

13,626. A. Ambler, S. Ambler, and F. Ambler. Improvements in the cleansing or washing of wool and like animal fibres, and in apparatus employed therein. August 29.

14,316. J. Grumbut, E. Gonty, and F. B. Gonty. A new or improved process for waterproofing materials or fabrics and the like. Complete Specification. September 11.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

13,299. J. H. Chaudet. See Class IV.

13,370. J. Murgatroyd. A new mordant for dyeing black and other colours. August 24.

14,246. A. Ashworth. Improvements in the production of an indigo vat. September 10.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

13,264. J. Farmer. Improvements in or connected with the manufacture of acetic acid, and in apparatus therefor. August 22.

13,398. F. M. Lyte. Process for the separation of sodic chloride from magnesic or calcic chloride. August 24.

13,543. R. B. Grüneberg. Improvements in apparatus for absorbing and rendering harmless the waste gases from the "Chance" sulphur recovery process. August 27.

13,575. M. N. D'Andria. Improvements in treating liquid acid residues containing iron to obtain products therefrom. August 28.

13,697. H. Grüneberg, H. Fleming, and W. Siepermann. Improvements in the preparation of cyanogen alkalis, and in apparatus therefor. August 30.

13,726. E. de Cuyper. An improved process for recovering valuable substances from the mother-liquor resulting from treatment of copper ores. August 30.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

12,236. J. Werber and G. Hendry. Rectification and concentration of acetic acid, and apparatus therefor. August 28.

14,333. M. Camon. Manufacture of acetic acid. August 28.

14,977. H. H. Leigh.—From F. T. Roniguières. Manufacture of caustic alkalis and their carbonates by means of their chlorides; applicable also to the dissociation of alloyed metals. September 4.

15,063. H. W. Deacon and F. Harter. Manufacture of chlorine. August 28.

15,173. C. F. Claus. Obtaining carbonic acid gas from mixtures with other gases, obtaining and utilising the residual gases, and production of carbonates of ammonia. August 28.

15,624. G. H. Bolton and J. R. Wyld. Concentrating caustic alkali and other liquors by multiple effect or Yaryan plant for preventing deposit in the tubes. September 18.

16,166. T. Turner. Treating waste liquors containing chloride of iron or chloride of iron and hydrochloric acid, and extracting therefrom oxide of iron and hydrochloric acid. August 28.

16,349. G. E. Davis. Construction of ammonia stills. September 18.

1889.

3338. A. Collingridge.—From V. Cornet and A. Jones. Manufacture of common salt, and apparatus therefor. August 28.

6118. H. H. Lake.—From J. L. Alberger, H. Williams, and L. R. Alberger. Apparatus for the manufacture of salt. September 11.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

13,036. A. Taylor. Improvements in the method of and apparatus for building up the inside of kilns for burning enamelled bricks and tiles. August 19.

13,051. J. Peirce and T. F. Luther. Enamelled metallic tessellated plates for hearths and floors. August 19.

13,128. A. G. Neville. Improvements in and relating to the construction of glass pots. Complete Specification. August 20.

13,262. H. Dudley-Cooper and J. Selby. An improved construction of connexions for glass or porcelain lined metal tubing. August 22.

13,197. J. Ferguson. Improvements in utilising and ornamenting rolled cathodal and all other rolled glass, and machinery for same. August 27.

13,577. M. Sugar. — From C. Lasalle and C. Mautter, France. Improvements in treating or ornamenting glass and glass-ware. August 28.

13,611. J. B. Goes and T. Evans. Annealing ovens. August 29.

13,880. M. W. Griswold and W. B. Atterbury. Improvements in the manufacture of sheet or window glass. Complete Specification. September 3.

13,994. S. Washington. Improvements in finishing glass-ware, and in apparatus therefor. September 4.

14,156. The Coalport China Company (J. Rose and Co.) and T. J. Bott. Improvements in ornamenting china, earthenware, glass and like ware. September 7.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

14,990. J. Colton and J. H. Lambert. Glass mosaic work. August 28.

15,485. J. Armstrong. Method of rolling glass, and apparatus therefor. September 4.

15,944. A. D. Brogan and A. M. Malloch. Apparatus for imparting surface ornamentation to glass. September 18.

1889.

3673. H. M. Ashley. Apparatus for manufacturing bottles and other hollow glass-ware. September 4.

3686. H. M. Ashley. Machinery for making bottles and like hollow glass-ware. September 4.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

13,050. T. Hyatt. Improvements in pavements and paving materials. August 19.

13,749. H. Aitken. Improvements in treating timber, more particularly such timber as is used for mining purposes. August 31.

13,888. P. Champion. An improved process and apparatus for the manufacture of "boiled plaster of Paris." September 3.

13,937. B. Mertelmeyer. Process and apparatus for producing an airless substance for artificial stones. September 4.

13,979. W. Darling. Improvements in and relating to the calcining of carbonaceous minerals for cements and other purposes. September 4.

14,281. S. Jørgensen. Improvements in the process of heating cements and hydraulic lime. Complete Specification. September 10.

14,343. W. A. Dixon. Improvements in the preparation of wood paving for streets. September 11.

14,515. A. J. Paris. Improvements in fireproof plaster cloths for ceilings, walls, partitions, and the like. Complete Specification. September 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

11,286. J. W. Ransome. Manufacture of artificial stone and concrete blocks. August 28.

14,853. G. Pankhurst. Improved brick, tile, or slab for building. August 28.

16,234. J. W. H. James. Apparatus for calcining cement materials, hydraulic lime, plaster of Paris, &c. September 18.

16,323. A. V. Bouvier and J. Billoré. Manufacture of bricks, tiles, &c. September 11.

16,110. F. W. S. Stokes. Revolving furnaces for burning, calcining, or roasting cement, lime, ores, &c. September 18.

1889.

11,444. M. J. Adams. Roofing tiles; and formation of iron and other sheets or plates for roofing purposes. August 28.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

13,061. H. Ritter von Dahmen and A. Strauss-Collin. An improved method of extracting aluminium from its oxide, silice, and fluorine bases, such as corundum clay, bauxite, kaolin, eupolite, and the like. August 19.

13,063. H. Ritter von Dahmen and A. Strauss-Collin. An improved method of producing metallic sodium, potassium, and magnesium. August 19.

13,138. H. H. Lake. — From G. W. Cummins and J. H. Coleman, United States. An improved process for treating iron, steel, and other metals to prevent oxidation thereof while in a heated state. Complete Specification. August 20.

13,175. J. Appletree. A substance to join steel with iron and also other different metals together. August 20.

13,277. M. Gledhill. Improvements in the manufacture of cast metal ingots, projectiles, and the like, and in machinery or apparatus therefor. August 22.

13,301. W. Deighton. Improvements in and connected with steel-making and other "water-gas" furnaces. August 23.

13,312. D. Colville, jun. Improvements in or connected with regenerative melting furnaces. August 23.

13,420. G. W. Clark. Improvements in obtaining aluminium. August 26.

13,432. T. K. Rose. Improvements in filtering or separating gold from liquids containing the same in solution. August 26.

13,635. H. H. Jones. Improvements in blast furnaces. August 29.

13,659. W. L. Wise. — From M. Kramer, Germany. Method of hardening steel tubes internally. August 30.

13,717. A. M. Clark. — From La Société en participation Bourbonze et Cie., France. A solder for aluminium and other metals. August 30.

13,718. A. M. Clark. — From La Société en participation Bourbonze et Cie. The production of a new metal or alloy. August 30.

13,787. G. C. Frierer. Preparing iron and steel sheets and other metallic bodies for coating with tin, zinc, and other metals. September 2.

13,830. A. G. Greenway. Improvements in the manufacture of zinc or other metals from hard spelter and other alloys of said metals with iron. September 2.

13,839. H. J. Allison. — From The Great Western Aluminium Smelting and Refining Co. (Incorporated), United States. Method or process for obtaining aluminium. Complete Specification. September 3.

13,986. J. Hansen. Improvements in apparatus to be applied in the smelting of cast-iron borings, turnings, and shavings. Complete Specification. September 4.

14,226. A. J. Boulton. — From M. Castelneau. Improvements in or relating to the treatment of ores and other substances. September 9.

14,235. C. Schreiber and H. Knutsen. An improved process for the treatment of auriferous and argentiferous antimony ores. Complete Specification. September 10.

14,357. E. Dodé. Improvements in refining and separating precious metals. September 11.

14,462. A. J. Campion and J. E. Tenison-Woods. Improvements in processes for cleansing and welding impure scrap iron. September 13.

14,466. I. Butler and T. J. Rickard. Improvements in and connected with machines for coating metal plates with tin, terne, or other metal. September 13.

14,473. M. A. Howell, jun. Improvements in and apparatus for the manufacture of soft back steel. Complete Specification. September 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

12,343. B. J. B. Mills.—From J. D. Bennett. Obtaining aluminium. September 4.

13,718. C. Meissner. Improved method of working mines. September 18.

14,331. H. Havemann. Manufacture of lead from its ores or compounds. September 11.

15,172. R. J. Atcherley and A. E. Sarti. Copper amalgamating plates. August 28.

15,314. A. Seddon. Apparatus for manipulating ingots and other forms of steel or iron. September 4.

15,572. W. Feld and G. von Knorre. Production of silicium copper. September 11.

15,607. T. K. Cavill. Apparatus for holding and turning ingots and other masses of metal. September 11.

15,708. M. Yglesias. Treating the effluent waters of mines, or other waters holding metals in solution. September 4.

16,061. H. J. Smith. Improvements in steel and iron. September 4.

16,489. Davies Bros. and Co., Lim., and Davies. Preparing iron and steel plates previously to galvanising them. September 11.

16,499. H. B. Fulton. Treatment of quartzose or silicious and sulphuretted ores containing gold, silver, or copper. September 18.

16,569. H. Schneider. A manufacture of steel alloyed with copper. September 18.

17,406. H. H. Lake.—From P. Manhes. Treatment of nickel and cobalt. September 11.

17,410. H. H. Lake.—From P. Manhes. Treatment of nickel and cobalt, and apparatus therefor. September 11.

18,024. H. A. Hunnicke. Extraction of zinc from its ores. August 28.

1889.

3169. F. Ellis. A new or improved metallic alloy. September 4.

8038. H. H. Lake.—From E. Thomson. Welding, soldering, or brazing metals, and apparatus therefor. August 28.

9821. J. Shears. Extracting metals from ores and slags, and the débris of smelting and other works. September 18.

10,288. H. H. Lake.—From O. B. Peck. Apparatus for decomposing chemical compounds and metallic salts, and for desulphurising ores. September 11.

11,406. E. Norton and J. G. Hodgson. Apparatus for manufacture of sheet metal. September 4.

11,686. C. U. Fisher.—From H. F. Lord. Compound for use in welding, tempering, and otherwise treating metals. September 18.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

13,480. W. P. Kookogey. Apparatus for charging storage batteries and other purposes. Complete Specification. August 27.

13,636. F. Hughes.—From E. J. McDonald, East Indies. Improvements in the manufacture of indigo by the application of electricity. August 29.

13,795. P. von Knoblosch. An invention to turn artificial and natural light, even plane atmospheric light, into an electrical current. September 2.

13,818. V. H. Ernst. Improvements in secondary batteries. Complete Specification. (Date applied for 12th February 1889, being date of application in the United States.)

13,864. S. C. C. Currie. Apparatus for automatically charging secondary batteries or accumulators. Complete Specification. September 3.

13,926. E. G. Rivers. The construction of vessels for containing chemical liquids for battery cells and other purposes. September 4.

13,993. G. E. B. Pritchett and H. R. Low. Improvements in electrical safety fuses. September 4.

14,148. J. Kunze. Improved method of manufacturing pipes, tubes, and other articles of metal by galvanic deposits. September 7.

14,155. C. A. McEvoy. Improvements in primary batteries. September 7.

14,162. A. de Méritens. See Class XVII.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

12,264. F. E. Elmore and A. S. Elmore. Preparing metallic surfaces for the reception of non-adhesive electro deposits. September 4.

15,433. T. J. Handford.—From L. Dnncan. Plates or electrodes for secondary batteries, and method of making same. September 11.

15,626. P. Schoop. Electric batteries. September 4.

16,140. E. Tyer. Charging secondary batteries from primary batteries, and apparatus therefor. August 28.

1889.

12,402. W. P. Kookogey. A galvanic battery solution. September 11.

12,731. W. P. Kookogey. A plate for secondary batteries. September 18.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

13,700. C. Billing. A new or improved manufacture of soap. August 30.

14,364. E. Mansfield. Improved apparatus for and method of extracting oleaginous and other added matters from fibrous spun textiles and other analogous substances. September 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

9796. J. M. McCallum. An improved soap powder, and method of manufacturing same. September 11.

15,558. H. C. Foulsham. An improved soap powder. September 4.

1889.

900. Flemings Oil and Chemical Co., Ltd., and G. H. Fenner. Moulds for casting rectangular slabs of naphthalene, &c. August 28.

11,660. H. Schuster. Producing hard soap from vegetable or animal fats, or a mixture thereof, and caustic alkaline solutions, without employing carbonates of alkalis or chloride of sodium. September 11.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

13,345. W. P. Thompson.—From P. Leonard and P. Zen, Italy. An improved anti-corrosive composition for protecting iron vessels or the like. August 24.

13,540. K. P. H. Labenow. Improvements in the composition and method of making up bronze colours ready for use. August 27.

13,792. J. J. Carr. An improved material for making whitewash, colour-wash, and water-colour paints. September 2.

14,150. S. Kenyon. Improvements in the treatment of india-rubber for the purpose of dissolving it or rendering it soluble. September 7.

14,479. J. Hanson. An improved furniture polish. September 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

15,564. T. Baynes, W. H. Doughty, and H. T. Greaves. Paint or composition for coating ships' bottoms, and process of manufacturing same. September 1.

16,035. S. Challoner. Lacquers and varnishes. September 11.

16,185. A. J. Smith. Apparatus for dressing white lead and other colours. September 18.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

13,126. P. Jensen.—From D. Pierson, jun., United States. Improvements in and relating to a new and useful process of chrome tanning leather, and in and to the article produced thereby. Complete Specification. August 20.

13,269. M. J. A. Dargelos. An improved process for tanning skins. August 22.

13,542. R. C. Want.—From G. Mitchell and R. W. Rutherford, New Zealand. Improved means and process for preparing skins and hides for tanning. August 27.

14,535. M. Heslop. Improved process of and apparatus for treating hides, kips, and skins preparatory to the tanning operation. September 14.

XV.—AGRICULTURE AND MANURES.

COMPLETE SPECIFICATION ACCEPTED.

1888.

13,303. R. Nicholls. Apparatus for drying certain farm produce. September 18.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

13,555. R. Raeymaeckers. An improved process and apparatus for the treatment of saccharine and other solutions. August 27.

14,209. G. F. Redfern. From M. Weinrich, United States. Improvements in purifying sugar and other solutions. September 9.

COMPLETE SPECIFICATION ACCEPTED.

1888.

15,815. R. H. Steedman. Treating a product obtained from seaweed. September 11.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

13,054. L. Meyer. Improvements in the method of producing ferments. August 19.

13,231. V. R. Taylor. An improved sparger. August 22.

13,427. E. Craddock. An improved treatment of grain for the production of malt, and apparatus therefor. August 26.

13,454. D. R. J. J. G. Morel. Apparatus for mixing water with malt for supply to mash tuns. Complete Specification. August 26.

13,653. W. P. Thompson.—From P. Marix and N. Notkin. See Class II.

14,162. A. de Méritens. Improvements in treating and rectifying or ageing alcohol or alcoholic liquors or the like by electricity. Complete Specification. September 7.

14,174. A. Savigear and T. J. Scrutton.—From J. Poivet, Nancy. Fermenting liquors. September 9.

14,406. J. Hutchison. Improvements in and relating to the treatment of alcoholic liquors. September 12.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

13,438. C. A. Coombe. Improvements in treating brewers' grains and manufacturing feeding cakes and biscuits therefrom. August 26.

13,439. C. A. Coombe. An improved cattle feeding cake. August 26.

13,652. W. P. Thompson.—From E. Mérian, France. Improvements in the manufacture of oleomargarine. August 29.

13,822. E. Larsen. A method of preparing human and cattle food from cereals or from refuse of manufactured cereals. September 2.

B.—Sanitary Chemistry.

13,279. J. Arnold. Improved apparatus for oxidising sewer gas and deodorising sewage. August 22.

13,280. J. Arnold. Improved apparatus for disinfecting and deodorising sewer gases and noxious matters in soil pipes, drains, and cesspits. August 22.

13,746. W. P. Buchan. Improvements in deodorising or disinfecting rivers and estuaries or other sewage, or other wise polluted collections of water. August 31.

14,128. A. Turley. The manufacture of carbon from town and other refuse, and the purification of sewage and other foul waters. September 7.

14,292. J. Procter. An improved oxidising agent, applicable especially to disinfecting sewage and other waters, and in the mode of preparing the same. September 10.

14,500. T. Jones and J. Jones. Filtering or purifying sewage water or polluted water from works or manufactures. September 14.

C.—Disinfectants.

13,203. J. T. MacMahon. A composition for arresting or preventing decay in wood. August 20.

14,032. J. G. Flower and D. W. Macdonald. An improved disinfecting, deodorising, and preserving compound. Complete Specification. September 4.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1889.

1201. W. Gerbel. Manufacture of milk powder and effervescent beverages. September 4.

B.—Sanitary Chemistry.

1889.

7630. J. Davis. Means for purifying water. September 4.

12,405. H. W. Whiting. Refuse burning furnaces. September 11.

C.—Disinfectants.

1888.

15,676. J. E. Reynolds. Improvements in disinfectants. September 11.

16,463. J. E. P. Meyer. Composition for developing ozonised oxygen. September 18.

18,620. J. Ascough. Antiseptic washing and cleansing compounds. September 18.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

13,246. T. Mitchell. Improvements in or applicable to the manufacture of linoleum and like floor cloths. August 22.

13,425. C. Weygang. Improvements in the manufacture of waterproof boards, paper, and such like material. August 26.

13,657. M. Frisch. Improved press copying paper. August 29.

14,491. T. Volstorff. Improvements in the method of and apparatus for straining paper pulp. Complete Specification. September 14.

14,508. J. A. Causton and J. Challis. Improved process of applying luminous preparation to the surface of paper or other substances. September 14.

COMPLETE SPECIFICATION ACCEPTED.

1888.

16,932. G. Tidcombe. Rolls for pulping fibres for the manufacture of paper, &c. September 18.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

14,327. A. H. Allen. Improvements in the methods of colouring poisonous substances. September 11.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

13,523. W. P. Thompson. — From C. Spiro, United States. Improvements in or relating to mixtures or solutions for developing or fixing the latent images on photographic plates or sheets. August 27.

13,739. W. H. Phillips. Improvements in photographs, and apparatus for effecting the same. August 31.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

13,486. C. O. Lundholm and J. Sayers. Improvements in making and applying explosives. August 26.

13,907. H. H. Leigh. — From La Compagnie Forate, France. Improved apparatus and process for the manufacture of nitro-glycerin. September 3.

14,073. W. Clayton. The production of whistling fire-works. September 6.

14,362. I. G. Gomez and P. Franco. A new or improved manufacture of matches of the vesta type. Complete Specification. September 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

12,871. W. Balch. Shells for signalling at sea, and apparatus for discharging them. September 11.

1889.

11,102. W. H. A. Kitchen and J. G. A. Kitchen. A new explosive called "Cycene," for blasting and other like purposes, and for use in shells for ordnance. August 28.

14,665. W. Schuckher. Manufacture of smokeless gun-powder. August 28.

XXIII.—ANALYTICAL CHEMISTRY.

COMPLETE SPECIFICATION ACCEPTED.

1888.

16,697. N. G. K. Huseberg. Means of determining the percentage of fat in milk. September 18.

THE JOURNAL

OF THE

Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 10.—Vol. VIII.]

OCTOBER 31, 1889.

[Non-Members 30/- per annum; Members 21/- per Set of extra or back numbers; Single Copies (Members only) 2/6.]

The Society of Chemical Industry.

Past Presidents:

Sir H. E. Roscoe, M.P., LL.D., V.P.R.S.	1881—1882.
Sir Frederiek Abel, C.B., D.C.L., F.R.S.	1882—1883.
Walter Weldon, F.R.S.	1883—1884.
W. H. Perkin, Ph.D., F.R.S.	1884—1885.
E. K. Muspratt	1885—1886.
David Howard	1886—1887.
Prof. James Dewar, F.R.S.	1887—1888.
Ludwig Mond	1888—1889.

COUNCIL FOR YEAR ENDING JULY, 1890.

President: Sir Lowthian Bell, Bart., F.R.S.

Vice-Presidents:

R. Forbes Carpenter.	S. H. Johnson.
Prof. F. Clowes, D.Sc.	Ludwig Mond.
Sir J. Neilson Cuthbertson.	Dr. Hugo Muller, F.R.S.
Prof. James Dewar, F.R.S.	Dr. W. H. Perkin, F.R.S.
Jas. Duncan.	Dr. Edw. Schunck, F.R.S.
Dr. John Evans, F.R.S.	Prof. W. A. Tilden, F.R.S.

Ordinary Members of Council:

L. Archbutt.	B. E. R. Newlands.
S. B. Boulton.	Jno. Pattinson.
Jno. Brock.	Jno. Spiller.
Jno. Calderwood.	E. C. C. Stanford.
Alexander M. Chance.	J. C. Stevenson, M.P.
A. E. Fletcher.	A. Norman Tate.

With the Chairmen and Secretaries of Sections.

Honorary Treasurer:

E. Rider Cook, East London Soapworks, Bow, E.

Honorary Foreign Secretary:

Dr. Ferdinand Harter.

General Secretary: Charles G. Cresswell.

Offices:

Palace Chambers, 9, Bridge Street, Westminster, S.W.

THE JOURNAL.

Publication Committee:

The President.

Sir F. A. Abel, F.R.S.	Prof. A. K. Huntington.
A. H. Allen.	F. Hurter, Ph.D.
G. H. Bailey, D.Sc., Ph.D.	Ivan Levinstein.
Joseph Bernays, M.I.C.E.	Prof. R. Meldola, F.R.S.
H. Brunner.	Ludwig Mond.
W. Lant Carpenter.	E. K. Muspratt.
Prof. Frank Clowes, D.Sc.	B. E. R. Newlands.
W. Y. Dent.	C. O'Sullivan, F.R.S.
Prof. Jas. Dewar, F.R.S.	John Pattinson.
John Heron.	W. H. Perkin, Ph.D., F.R.S.
D. B. Hewitt, M.D.	Sir H. E. Roscoe, M.P., F.R.S.
David Howard.	John Spiller.
Prof. J. J. Hummel.	A. Norman Tate.
	Thomas Tyrer.

Editor:

Watson Smith, University College, London, W.C.

ASSISTED BY THE FOLLOWING STAFF OF

Abstractors:

T. L. Bailey, Ph.D.	F. S. Kipping, D.Sc.
G. H. Beckett.	Chas. A. Kolm, Ph.D.
D. Boudix.	F. W. T. Krohn.
E. Bentz.	T. A. Lawson, Ph.D.
Jos. Bernays, M. Inst., C.E.	J. Walter Leather, Ph.D.
E. E. Berry.	A. Liebmann, Ph.D.
E. J. Bevan.	D. A. Louis.
Bertram Blount.	W. Macnab.
Arthur G. Bloxam.	N. H. J. Miller, Ph.D.
C. H. Bothamley.	J. M. H. Munro, D.Sc.
W. Lant Carpenter.	H. S. Pattinson, Ph.D.
E. G. Clayton.	H. T. Pentermann.
Julius B. Cohen, Ph.D.	S. G. Rawson, D.Sc.
C. F. Cross.	A. Rée, Ph.D.
A. R. Davis.	F. W. Renaut.
W. W. Haldane Geo, B.Sc.	Edward Simpson.
C. Napier Hake.	A. J. Smith, B.Sc.
Oswald Hamilton.	Oscar J. Steinhart, Ph.D.
John Heron.	A. L. Stern, B.Sc.
Bertram Hunt.	D. A. Sutherland.
F. Hurter, Ph.D.	Bertram Thomas.
C. C. Hutchinson.	Eustace Thomas.
D. E. Jones, B.Sc.	V. H. Veley, M.A.
W. E. Kay.	R. Lloyd Whiteley.
A. J. King, B.Sc.	A. Wingham.

NOTICES.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. FYRE and SCOTTIS-WOOD, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January 1883, and January, February, and April 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once, stating price required, with Mr. Cresswell. The stock of all other numbers is at present sufficient for the Council's requirements.

Post Office Orders in payment of subscriptions should in all instances be made payable at the General Post Office, London.

LIST OF MEMBERS ELECTED, 23rd OCTOBER, 1889.

Allen, R. L., Roseleigh, Heaton Chapel, near Stockport, assistant analyst.
 Ballantyne, H., 260, Renfrew St., Glasgow, analyt. chemist.
 Bechel, Lezin A., McCall Post Office, Parish of Ascension, Louisiana, U.S.A., sugar engineer and chemist.
 Bond, Louis W., Ensley, Ala., U.S.A., engineer and chemical student.
 Brock, Arthur, Messrs. C. T. Brock & Co., South Norwood, S.E., firework maker.
 Brown, Robt., Beech Mount, Warrington Hill, Northwich, engineer.
 Cochrane, Chas., Green Royde, Pedmore, near Stourbridge, ironmaster.
 Cornish, Vaughan, Ivy Cottage, Newcastle, Staffordshire, science master.
 Craven, Chas. E., Hawthorne Cottage, White Cote Hill, Bramley, near Leeds, chemist and dyer.
 Dawes, J. T., Cefn Mawr, Mold, Flintshire.
 Drummond, Hon. G. A., Montreal, Canada.
 Edwards, Walter N., 4, Herne Hill Road, Loughboro' Junction, S.E., analytical chemist.
 Field, Leopold, Upper Marsh, Lambeth, S.E., candle and soap manufacturer.
 French, Harry B., 1001, Market Street, Philadelphia, Pa., U.S.A., wholesale druggist.
 Friese-Greene, W. E., 92, Piccadilly, W., photographer.
 Fuerst, Jos. F., 4, Copthall Buildings, E.C., drug and chemical merchant.
 Gerrard, A. W., 1, Cantlowes Rd., Camden Sq., N.W., chemist.
 Haines, Reuben, 201, South 5th Street, Philadelphia, Pa., U.S.A., analytical chemist.
 Handy, Jas. O., 95, Fifth Avenue, Pittsburgh, Pa., U.S.A., chemist.
 Hauff, Julius, Feuerbach, Stuttgart, Germany, chemical manufacturer.
 Hennin, Alphonse, Springfield, Ill., U.S.A., metallurgical chemist.
 Hunt, Alf. E., 95—97, Fifth Avenue, Pittsburgh, Pa., U.S.A., metallurgical engineer.
 James, Alf., Cassel Gold Extracting Co., 13, West Scotland Street, Kinning Park, Glasgow, mining engineer.
 Kemp, D. S., 27, Coverdale Road, Shepherd's Bush, W., chemist.
 Kenyon, Thos., Beechwood, Eccles, near Manchester, manufacturing chemist.
 Langenbeck, Karl, 110, West Ninth Street, Cincinnati, Ohio, U.S.A., analytical chemist.
 Lee, J. W., Richmond, Villamanin, Prov. de Leon, Spain, mining engineer.
 Leeds, Dr. Albert R., Stevens Institute of Technology, Hoboken, N.J., U.S.A., professor of chemistry.
 Maconochie, J. R., 1, East India Avenue, E.C., hardware merchant.
 Margetson, J. Chas., Avonside, Melksham, Wilts, india-rubber manufacturer.
 Merck, Dr. C. E., 9, Breite Allee, Darmstadt, Germany, manufacturing chemist.
 Nash, Jno., 122, Mansfield Road, Haverstock Hill, N.W., terra cotta manufacturer.
 Rintoul, Wm., 48, Carnarvon St., Glasgow, analyt. chemist.
 Robinson, Chas. E., Richmond Lodge, Torquay, M. Inst. C.E.
 Sanz, Don Mariano, Fabrica de productos quimicos, Leon, Spain, chemical manufacturer.
 Seymour-Jones, A., Cambrian Leather Works, Wrexham, leather manufacturer.
 Shepard, Dr. Chas. U., 68, Meeting Street, Charleston, S.C., U.S.A.
 Shuttlewood, W. B., 106, Fenchurch St., E.C., export merch.
 Spies, Adolph, 102, Fenchurch St., E.C., chemical merch.
 Spies, Hermann, 102, Fenchurch St., E.C., chemical merch.
 Swinburne, G. W., 245, Broadway, Newport, R.I., U.S.A., civil engineer.
 Wilson, A. E., c/o Ferguson Syndicate Co., Waiorongomai, Te Aroha, New Zealand, assayer.
 Wright, Alf., 8, Bentinck Crescent, Elswick Road, Newcastle-on-Tyne, pharmaceutical chemist.

CHANGES OF ADDRESS.

Babington, P., 1/o Manchester; c/o Percy Hirst, Elmfield, Rotherham, Yorks.
 Barbour, T. F., 1/o Edinburgh; 26, Robertson Street, Glasgow.
 Barnes, Jos., 1/o Avenue Parade; Marl Terrace, Accrington.
 Fuller, C. D., 1/o Braddock; Latrobe, Westmoreland Co., Pa., U.S.A.
 Gillman, G., 1/o Callejon del Caldero; 8, Calle del Angel, Granada, Spain.
 Greenway, T. J., 1/o New South Wales; Port Pirie, South Australia.
 Gregory, Wm., 1/o Lichfield; Walmer Brewery, Kent.
 Hastings, Hugh, 1/o Consterdine Place; 39, Malvern Terrace, Kidderminster.
 Kitamura, Y., 1/o Tokio; bei Herrn Busse, Pawel Strasse III. Brunswick, Germany.
 Lloyd, Jas. D., 1/o Sandwich; 6, Camp Street, Providence, R.I., U.S.A.
 Markham, A. D., 1/o Enfield; St. Nicholas Road, Sutton, Surrey.
 Melville, D., 1/o North Woburn; P.O. Box No. 1, Woodmere, Wayne Co., Mich., U.S.A.
 Sandon, R., 1/o Kentish Town; 21, Archibald Road, Tufnell Park, N.
 Soward, A. W., 1/o Peckham; 144, Friern Road, East Dulwich, S.E.
 Steel, R. Elliot, 1/o Bradford; Hawthorn House, Baildon, near Shipley, Yorks.
 Sumner, R. M., 1/o Liverpool; 53, Stevenson Street, San Francisco, Cal., U.S.A.
 Thompson, G. E., 1/o Smethwick; Morningside Lodge, Kidderminster.
 Timmins, A., 1/o Stanley Villas; Argyll Lodge, Higher Runcorn.
 Wilson, Gordon, jun., 1/o Kirkintilloch; Crestone, Saguache Co., Colorado, U.S.A.

CHANGES OF ADDRESS REQUIRED.

Dempster, A., 1/o Rose Mount, Elland, Yorks.
 Johnson, Geo., 1/o Grange Metal Works, Jarrow-on-Tyne.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	R. Messel.
H. E. Armstrong.	B. E. R. Newlands.
W. Lant Carpenter.	B. Redwood.
W. Crowder.	T. Royle.
W. J. Dibdin.	John Spiller.
C. Graham.	Wm. Thorp.
S. Hall.	C. R. Alder Wright.
C. C. Hutchinson.	

Hon. Local Sec. and Treasurer:

Thos. Tyrer, Garden Wharf, Battersea, S.W.

SESSION 1889-90.

Nov. 4th.—Mr. C. Napier Hake. "An Account of a Borax Lake in California."

Dec. 2nd:—

Mr. Watson Smith. "Some Notes on Variations in the Products of the Destructive Distillation of different Gas Coals, heated separately in the same retort and under similar conditions."

Mr. J. Hauff. "Cresotinic Acid and its Applications." 1890.

Jan. 6th.—Mr. C. T. Kingzett. "Peroxide Hydrogen. Its Preservation and Commercial Uses."

Feb. 3rd.—Messrs. A. H. Allen and W. W. Staveley. "On the Properties and Applications of Metallic Compounds of the Phenols."

Notices will be found in the Journal and other Scientific Papers.

Liverpool Section.

Chairman: F. Hurter.

Vice-Chairman: A. Norman Tate.

Committee:

J. Campbell Brown,
H. Brunner,
E. Carey,
H. Denoon,
T. Fletcher,
H. Gaskell, jun.

F. Gossage,
S. Hamburger,
W. D. Hornum,
D. McKechnie,
G. Shack-Sommer,
Henry Tate.

Hon. Treasurer: W. P. Thompson.

Hon. Local Secretary:

Dr. C. A. Kohn, University College, Liverpool.

Nov. 6th.—Dr. F. Hurter. Presidential Address on "The Condensation of Hydrochloric Acid."

Dec. 14th.—H. T. Carr. "The Dinsmore Process for the Manufacture of Coal Gas."

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Nottingham Section.

Chairman: Sir John Turney.

Vice-Chairman: L. Archbutt.

Committee:

Jno. R. Ashwell,
F. Clowes,
J. B. Coleman,
W. A. Curry,
H. Forth,
E. Francis.

J. M. C. Paton,
S. J. Pentecost,
C. Spinkman,
H. J. Staples,
J. T. Wood.

Treasurer: S. V. Holgate.

Hon. Local Secretary:

R. L. Whiteley, University College, Nottingham.

First Meeting, Wednesday, November 6th.

1. Address by the Chairman.

2. Mr. L. Archbutt. "Laboratory Notes."

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Communications.

THE PRESENT POSITION AND PROSPECTS OF THE CAUCASIAN PETROLEUM INDUSTRY.

BY PROFESSOR D. MENDELÉEFF.

THE following communication has been addressed from St. Petersburg to Ludwig Mond, Esq., as past President of the Society of Chemical Industry, by Professor Mendeléeff:—

"Having observed that the Berlin correspondent of the 'Standard' of July 25, 1889, as well as the 'Morning Post' of August 7, have spread abroad in England a rumour to the effect that the natural supply of crude oil in Baku is coming to an end, and that consequently a lapse in the production of Russian naphtha was to be expected, I conceive that it will be of great importance that the correct state of affairs should be known as regards the present and future of the naphtha industry of the Caucasus. To this end it will be necessary in the first place to mention that even four years ago, and in Baku itself, these rumours as to exhaustion of supply were freely set up and circulated.

"These rumours then strangely resolved themselves into a variety of proposals to the Government with regard to means, which might in or one other way be adopted to prevent the expected misfortune. Messrs. Nobel and Ragosin proposed then that a tax should be imposed on the crude oil, and a demand was made for powers to expend an enormous sum in experimental and exploratory borings in the outskirts of Baku for the purpose apparently of finding some source which might compensate for that now supposed to be fast approaching exhaustion. In order to obtain light as to the actual state of the naphtha industry at Baku, the Government, which is deeply concerned

in its successful development, firstly, ordered that the practical geological investigations in that region should be vigorously pushed on; and, secondly, sent me in the summer of 1886 to collect authentic intelligence.

"One of the results attained in 1887 by the exploration under the Department of Mines (Engineer Torokin, the reports of Professor Meller, &c.) was that there had never been the least reason to suspect the exhaustion of the naphtha springs in Baku. In a special report (1866) to the Minister of Domains, Michael Nikolajewitch Ostrowsky (The Baku Naphtha Industry in 1866), I stated that the rumours in question were due partly to entire ignorance as to the symptoms of exhaustion of the naphtha (these symptoms have been well studied in Pennsylvania), and also doubtless partly to the intrigues of certain parties, who supposed it to be to their interest to propagate such statements. "The study made in 1886 of the Baku industry, familiar to me since 1863, has proved:—

(1.) That not one single trustworthy symptom of exhaustion of the Baku naphtha region has presented itself.

(2.) That not having the means to store large supplies of naphtha which suddenly appear, a large quantity of the oil is lost (flowing into the lakes and sea). This is specially the case when oil springs burst forth, and leave no time for preparations for collection and storage. The cessation of the profitable yield of some of the wells has been proved to be owing to the obstruction of access to the same by the naphtha, for the new borings made close beside them very often yielded naphtha in abundance. But the upper layers, especially near Balakhani, which have been worked for a long period, proved to be almost exhausted. At the same time, however, in the direction of the village of Romany, exploration was commenced at a later period, and now promises to yield enormous quantities of crude oil, the layers here being situated deeper (not, of course, because the exploitation was begun later). The region of Beybat (where the wells of Messrs. Tagieff, Djajely, and others are to be found) yields naphtha in abundance, and is situated close to the town of Baku. It is, so to say, cut off from the Balakhani-Sabondeli naphtha region, and suggests the belief that besides the principal naphtha fields of the Baku regions, there are many other outlying and isolated naphtha regions like the region of Beybat. The precipitate conclusion as to exhaustion has more frequently been based upon the results of the wells lying near the village.

"Balakhani figures are put down *ad libitum*, quite forgetful of the existence of the Beybat region. In order, however, to show how unfounded is the judgment as to the exhaustion even of the region of Balakhani, I give here the figures taken from the reports of Messrs. Benkendorf and Mauramtzef (Group XVII.) on the Balakhani region. These I verified in 1886, and I may say that the entries are made more correctly than on the other spots. There were in 1866 in all five wells, and these remain until now (1886). At the beginning the wells were worked slowly, and very often became obstructed.

The yield was in:—

	*Poods.		*Poods.
1876.....	727,000	1881.....	2,286,000
1877.....	1,250,000	1882.....	1,404,000
1878.....	1,200,000	1883.....	2,455,000
1879.....	1,066,000	1884.....	6,498,000
1880.....	1,150,000	1885.....	6,250,000

"The very pumping of the naphtha from the existing wells is not regularly conducted, but increases during the summer months, when the demands are greater, and at times ceases altogether during the winter. The third result of my study in 1886 was (3), that the wells which yield daily less than 200 poods of naphtha are not worked at all, or at all events only when prices rise. (4.) That the highest possibility of the annual supply from the Baku region is far from being attained yet, judging of the small number (about 170) of wells now at work, and taking into consideration the large space of land covered, undoubtedly containing naphtha, but not used for exploitation by the owners (as Mirsoieff and Kokoreff) for want of the required capital, and the lands belonging to the Government, which are also left unexploited owing to the requests of the

* 1 Pood = 36·03 lb. avoirdupois.

owners of the wells, who are afraid of new competitors. (5.) That the highest degree of productiveness as regards crude oil in the Baku region is only attainable when the pipe line to the Black Sea is constructed. (6.) That, even admitting the possibility, in the far future, of the exhaustion of the Baku oil-bearing region, still other regions of the Trans-Caucasus will be available, and by means of the then existing pipe line will be able to afford ample supply both to the Black Sea and the Caspian Sea. (7.) That in consequence of the relative geological recency of the formation of naphtha in the Caucasus, and of the continuation of the activity of the mud volcanoes, it would be quite unsafe to say that even at the present time those underground processes do not continue the result of which is a replenishment of the oil, this being very likely forced up by internal pressure through layers of superficial sands. (8.) That the principal expedient for counteracting exhaustion must be considered to be the increase of the utility of the naphtha; in other words, it ought to be worked up into more valuable products, as benzene, heavy oils, vasclin, and tar, in addition to the products only now obtained, viz., kerosine and lubricating oil; for the residues (astatki), which are used now as fuel, can with great profit to the country be substituted by coal, since the exploitation of the abundant seams of that mineral to be found on the Donetz, Ural, and in the environs of the Moscow district, &c., would be an easy matter. Owing to the above-stated reasons I am decidedly inclined to consider the construction of the Caucasian pipe line an absolute necessity for the prosperity of the naphtha industry in the Caucasus. This view has been hitherto strongly held by the Minister, M. N. Ostrowsky, who still continues to hold it, notwithstanding the strong opposition of the Baku people, because of their supposed personal interests—supposed interests which would nevertheless directly oppose themselves to the general interest of Russia, and more or less to that of the world at large. For further details I must refer you to my book, which I have the honour to transmit, together with this letter.

"The clearest proofs of the correctness of the opinion that in Baku there are no signs of exhaustion, are to be found in two circumstances: (1.) At the end of the year 1886, and in the following year, when comparatively very few new borings had been made, such large flows of naphtha took place, that, until that time, their like was never before observed, never either in America or in Baku; and (2.) during the years following, the productiveness in the same region, just as before, increased from 116,000,000 poods (about 1,900,000 tons or about 12,000,000 barrels), as in 1885, to 180,000,000 poods, as in last year, 1888.* However, when exhaustion occurs, as in the Pennsylvania region, the productiveness of the said region falls off very quickly, and the naphtha fountains disappear there, and are replaced by water or only gas fountains. According to information received recently from Baku (during 1889), from the 1st January to the 1st August, about 125,000,000 of poods of crude oil have been already extracted, and several powerful fountains have been spouting up their contents this very year.

"Particularly productive was the flow of Mr. Kotscheieff's spring, and the greater part of its crude oil ran into the lake of Romanino, as is almost always the case under similar circumstances in Baku. Consequently, without any doubt, there are no signs of exhaustion of the crude oil in the Baku region up to the present time.† I will not attempt

any examination of the different forms of ignorance or duplicity which prompt the framing of such calculations or commercial speculations as those referred to. They are based on the foibles of human nature, and are of but ephemeral stability.

"I will try now to offer some definition of the connexion between the geological or physiographical position of the springs, and the supply of material, in accordance with the personal acquaintance I have formed with the subject. As the Alleghany Mountains—in the geological sense—have served to indicate the Pennsylvania issues of naphtha, just in the same way the mountains of the Caucasus—between the Black and Caspian Seas—served to indicate in that district the naphtha there. Respecting the reason of connexion between the mountains and the issue of naphtha, I will not speak here, because I desire to remain on practical ground without entering upon that of hypothesis.‡ But the connexion of the mountains with the naphtha-beds is clear from the fact that the districts facing or fronting the mountains are the regions where naphtha is obtained. They lie, indeed, parallel to the direction of the mountain range. The Devonian and Silurian sand strata of Pennsylvania are similar in this respect to the naphtha sands in the new tertiary strata of the Caucasus. The former are, however, geologically old—the latter are recent. Here is the fundamental distinction between the American and Caucasian naphtha deposits. With them are probably united two other fundamental distinctions. *Firstly*, the naphtha in Pennsylvania has been found only on the western side of the Alleghanies, but the Caucasus is full of naphtha from the north, south, and on both sides, at the Black and Caspian Seas. This must be explained in the following manner:—The old beds had many natural opportunities of getting opened, of letting out their naphtha supply, of getting washed away and becoming lost for the use of the people, but the younger naphtha deposits of the Caucasus had less chances of this. *Secondly*, near the Alleghanies and near the naphtha wells of Pennsylvania there are no mud volcanoes, which are to be found very often in Baku, in Tamany, and generally near the Caucasus, and form, so to say, the natural satellites of naphtha. They are evidently the breathing holes of the terrestrial interior, which evolve mud, water, and steam, and let out the burning gas. In Pennsylvania, long ago this process terminated, which thus still continues in the Caucasus. We find naphtha here and there in similar conditions with regard to space, but the conditions of geological periods in both countries are very different. Comparing Pennsylvania with the Caucasus we must constantly bear in mind these differences. Ignoring them, we fail to explain peculiarities which become very clear after comparing Pennsylvania with the Caucasus. As regards the Caucasus, so long ago as in biblical times, and, indeed, long time before the Russians came there—the inhabitants of the place used the naphtha which came then to the surface as illuminating oil.§ To give the names of these naphtha-bearing districts surrounding the Caucasus on all sides, would serve no other object than filling several lines with names. But the question arises, why does working only take place in Baku? Why is naphtha not obtained in Tamany, Gury, on the Terek, Chemakhy, and such other localities of the Caucasus, in such large quantities as near

* In Russia, all the reports with regard to naphtha represent the weight, and not the volume. 1 pood = 16·38 kilos., or a metrical ton is about 61 poods (or puds). In America, all the reports of naphtha are given in the measure of capacity, viz., in casks and barrels. A normal barrel contains 42 gallons, but accounts are more often given of barrels of 42 gallons. One cask contains 4·54 kilos. of water, consequently, at the specific gravity of about 0·8 as for the light varieties of American naphtha, each barrel (42 gallons) will average about 152 kilos., or contain about 94 poods, of naphtha. For such comparatively heavy kinds of naphtha as are usual in Baku, and having the specific gravity of about 0·86, 42 gallons must be reckoned as about 164 kilos., or about 10 poods of naphtha.

† The upper layers in the smallest part of the now-worked region show a diminution in abundance of crude oil (they yield less than before per day), and from these layers the gas has already escaped; but the deeper layers are as yet full of crude oil saturated with gas, and in the very depths of the same, that is to the very lowest layers, there was no need to go, because up to the present the depth of the ordinary wells at Baku does not exceed 700–900 ft., whilst in America the depth of the same often exceeds 1,500–2,000 ft. As regards some dry holes which never did yield any crude oil, and

some wells which diminished their yield, as well as the diminution in abundance of crude oil in the upper layers whilst the local productiveness gradually increases, these clearly cannot be taken as signs of exhaustion, they are but normal conditions of ebb and flow, which are determined by the natural conditions of the layers of naphtha. By the naphtha exhaustion of a given place must be understood the cessation of so far profitable yields from all the wells conjointly (taking the old as well as the new wells) of the given locality. One well may yield more naphtha than hundreds of unsuccessfully chosen borings, and if the general quantity of supply increases, especially when at the same time the chances of a successful boring are favourable, and if there are besides naphtha-bearing regions, as yet untouched, which undoubtedly will yield rich supplies (such regions are near the village of Romanyn, in the environs of Baku), then there is no foundation whatever for talk about exhaustion.

‡ My hypothesis of the origin of naphtha explains this connexion. It is explained in my work: "The Naphtha Industry in Pennsylvania and in the Caucasus, 1877." Also, in the "Revue Scientifique," 1878, and "Jahrbuch d. K. K. Geol. Reichsanstalt (Wien)" Bd. 29, 1885.

§ The people then held the Baku naphtha sources leasehold from the Persian Government, for commerce with the naphtha as an illuminating oil was highly developed near the Caspian Sea.

Baku? There are two essential reasons for this. The first is, that the Volga, even since ancient times, has formed the principal water-way to Baku, and along this same water-way the Russo-Asiatic commerce is still carried on. Near Baku there is a rock which bears the name of the robber Stenka Rasin, who is reputed to have gone there with his evil-minded comrades for the sake of plunder.

To Russians this road is well known. From Baku to Vischny, to Perm, and to the very heart of Russia, all the naphtha products go by water, and at such cheap rates that it is less costly to get over all this distance of many thousand versts (1 verst = 0.66 mile), than to transport the naphtha, even from Chemakhy, over a hundred versts by land. This is the principal reason of the prominence of Baku, which is also situated on the sea coast, and has developed its naphtha industry since the year 1860. The initiative in this direction was taken by Mr. W. A. Kokoreff, who wishes to supply Russia with illuminating oils. There was also another reason. Many borings have been made at Kuban (A. N. Novoseltzeff, Mr. Twedel, the French Society), and also near the Tzarskie Kolodtzy (Simence), but there, as in Pennsylvania and Virginia, the naphtha is not found in such abundance; there are very seldom springs to be found. The naphtha must be drawn or pumped, in order to collect it. Consequently the naphtha costs there almost the same price as in Pennsylvania, from 10 to 12 copecks per pood on the spot; but in Baku, the very first wells, especially in the years between 1870—80, yielded such an abundance of naphtha that wells which yielded less than 200 poods per day were not worked at all, for working expenses would not be covered. This is owing to the price of the crude oil on the spot in Baku, which very often, when there are no springs, is 2 copecks, and sometimes 3 copecks, per pood, or even more; but if springs burst forth, the naphtha of which goes to the lakes situated amidst the wells, then the price goes down very often to $\frac{1}{2}$ copeck per pood, provided that only a part of the 100,000 poods of crude oils yielded daily by the Baku springs can be gathered.*

* The price of the crude oil in Baku, much more than in America, where there are store reservoirs, changes very much in accordance with the demand, because this material is scarcely stored up at all, and the naphtha is sent direct to the refineries according to the periods of sale. Then, but especially in the summer, during the navigation on the Volga, the work at the wells is increased, as well as the distillation in the refineries. Thus the increase of prices of the crude oil, of which the English newspapers are now talking so much, and which corresponds with that of the prices of the crude oil in America, where the average price in 1877 was 67 cents per barrel, and was never lower in any year whatever. In 1888 the average price was 88 cents; and again, in June 1889, 84 cents, and in July 1889, from 90 to 102 cents on the spot, according to the quotations of the Pittsburg Exchange. This is by no means a sign of exhaustion, but merely that during this summer the demand for kerosine has increased. Owing to this, new borings have been commenced, and it may be anticipated, as it very often was in Baku and in Pennsylvania, that next year the supply will surpass all demands, and prices will go down. For my own part, I must remark that when the price for crude oil becomes 11 copecks per pood, there cannot be expected any development of the supply; there will be a stoppage, and not an increase of the business, although the owners of refineries have their profits in it.

The price of 5 copecks per pood, according to my opinion, is a desirable and a normal one, and one calculated to develop supply. Such a price being 3 or 4 times lower than American—(5 copecks per pood = 50 copecks per cask, or about 25 cents per barrel, according to the present exchange, but in Pennsylvania a cask or barrel costs on the spot now not less than 50 cents)—cannot act sensibly on the price of the naphtha products, which, owing to a simple speculation fluctuate a great deal more than from the fall or increase of the price of the crude oil in the above-mentioned proportions, viz., from 3 to 5 copecks per pood. Here I will make the remark that since the year 1857 the price of crude oil in the United States has risen from 67 to 95 cents per barrel, or per cask about 6 copecks, but the price at Baku for the same period did not rise more than 3 copecks per pood. If there were a possibility of competition of the Baku naphtha with the American, then the same possibility now remains. With the termination of the pipe line this possibility would be still more evident. Until now there has been no possibility of the export of large quantities of products, but then there would be; now there is no possibility of extracting large quantities of illuminating oils not presenting any danger with respect to risks from fire, but then there would be. Now the Americans with their numerous pipe lines fix the prices of the naphtha products all over the world, but then this can and will also be done by the Baku people; now there are no large profits left in Baku, but then would arise the possibility of making new borings in all the Trans-Caucasus, out of the profits derived from the naphtha.

I may state here that the price of the Baku naphtha products mostly depends on the use which is made of the naphtha, that is, to work up into products, also the residues (astatky or astatki), which remain after the kerosine has been got from the naphtha.

(1 copeck = $\frac{1}{100}$ th rouble, and the par value of a rouble = 38 $\frac{1}{2}$ pence English.—Ed.)

Such natural abundance of naphtha as occurs in the Baku region has not been discovered up to the present in any other parts of the Caucasus which have been as yet tested by borings, nor in Pennsylvania, nor in Canada, nor in any other part of the world. Very likely there is some connexion between this fact and that of the mud volcanoes, which are up to the present active, like those of Kyr-Maku, which are situated close to the naphtha region of Balakhani in the environs of Baku.

“There is a Russian adage: ‘From good no one will expect anything else but good to spring.’”

“This adage is well applied here. From the existing good in Baku there has been no need up to the present to look out for any other good thing. There are plenty of places on the Caucasus where naphtha may be sought for, and amongst them possibly might be discovered regions not worse than those of Baku, springs, equally powerful and recent, and certainly more durable than those of Pennsylvania, but there exists no motive, because in the very environs of Baku there is plenty of land, without any doubt, containing naphtha which has not yet been touched, owing to the following reasons:—The Government having sold, in the years following 1870 (according to the Rules of the 17th February 1872) one part of the naphtha-bearing lands, afterwards stopped the sale and the lease of such lands. Kokoreff and Mirsoieff were the principal buyers from the Government of large districts containing naphtha; each of them bought lands for 1,000,000 of roubles. They began and continue to work only on very insignificant parts of their large territory (because they have spent so much for the acquisition of land that they have little left for working capital), and now wait until the lands and naphtha rise in price and value. The Government does not allow the local peasants to sell or to lease their lands for the purpose of getting naphtha. Consequently the district worked years ago in the environs of Baku is the same district now.† And one’s astonishment is excited that on so small a spot, altogether about 5 square kilometres, people continue until now to make new borings, continually pump the naphtha, and still continually get springs bursting forth. It is not at all strange, that formerly the depth of the wells was only a few sagues (1 sague = 7 feet), later on the workers had to go deeper to 40—80, and afterwards to 100—120 sagues. We do not observe anything like this in Pennsylvania.‡ In the geologically young Baku, people have remained all the time on the same spot, on the same 5 square kilometres, and have continued to pump only such wells as yield every day on the average not less than several hundreds of barrels. In Pennsylvania the number of working wells during the time of the highest period of supply, which was in 1882, attained 19,000 wells, and 30,000,000 barrels of naphtha have been got in a single year.§ consequently

† Whilst in the United States from the year 1860 and upwards (on account of the rapid exhaustion of each region) people were obliged continually to go over to new regions in search of supply of naphtha, and tens of thousands of borings were made (from 1876 to 1886 no less than 31,707) on a surface of hundreds of square kilometres, whilst all this time operations were confined rigidly to the already mentioned 5 square kilometres in Baku.

‡ In those geological periods, amounting to thousands of years, during which were formed the naphtha beds of Pennsylvania and the Caucasus, the naphtha seems to have risen to the surface, become oxidised and evaporated, and was thus lost for exploitation. If the naphtha had not got out by itself from the underlying beds, people would never have known of its existence. During these long geological periods a small stream of the outflowing naphtha could empty a very rich layer a great deal better than hundreds of bored wells. Owing to this, every naphtha-field in the Caucasus is more to be relied upon with regard to the quantity of naphtha to be obtained than similar fields in Pennsylvania. For this reason also, ideas as to the approaching exhaustion of the working region in the Caucasus based upon signs manifesting themselves in America, cannot be entertained. Besides, there is nothing to prove, as yet, that the formation of naphtha in the Caucasus is completed. The mud volcanoes here give vent still in very strong eruptions.

§ The daily receipt of crude oil in the United States from that time diminished very greatly.

	Barrels
In 1882 the daily yield was	82,393
1883 " " "	63,393
1884 " " "	67,484
1885 " " "	59,921
1886 " " "	70,729
1887 " " "	59,061
1888 " " "	46,760

(Continued on p. 756.)

every well yielded per day only $4\frac{1}{2}$ barrels on an average, or taking (light naphtha) a barrel of 9 poods—about 40 poods. Now at Baku there are at work about 200 wells (the exact number is very difficult to state, there do not exist as yet proper statistics, but there are such wells, and only pumped when the demand for crude oil increases), and during seven months there have been received about 125,000,000 poods,* and consequently per day on an average every well yields about 2,800 poods or a barrel of 42 gallons, containing about 10 poods (we include the heavy naphtha), the average daily receipt of naphtha in Baku is, at the present time, 280 barrels from each well. In February 1886, of which period I have full reports, there were in operation about 170 wells, and the daily average yield was 446,000 poods or, per well on the average, about 2,600 poods per day, consequently an increase and not a decrease in the supply is visible. Let us take for comparison the figures of the last Stowell's Petroleum Reporter, Pittsburgh, Pa., United States of America (August 1889). During the seven months (up to August 1st, 1889) the average daily yield of naphtha from all the wells in the United States of America was about 56,000 barrels, or about 510,000 poods, whilst in Baku it was about 580,000 poods per day. These figures are very close one to another, although eight years ago the supply in Baku was six times less than in America. During the seven months of 1889, in the United States of North America, 2,800 new borings were made, and during last year (1888) 1,515 borings, whilst in Baku all the time from the beginning of the years of 1860 until the present time, the number of borings are much below any of these figures. Let us suppose that now there are working in the United States only those wells which have been made during the last four years,† the average number of them will be about 11,200 wells, against 200 wells in Baku, consequently the average daily supply of each well in the United States is 45 poods or 5 barrels, whilst in Baku it is 2,800 poods or about 280 barrels. The daily average of the yield of the new borings in America (June and July 1889), does not surpass 16 barrels or 150 poods of naphtha. Such wells not one of the Baku naphtha-owners would be willing to work, because at the price of 3 cop. per pood, the 150 poods of naphtha would give an income of about 4 rs. 50 cop., but the maintenance of the steam-power, ropes, and workmen, amount, per day, to about 6 or 7 rs. Even at the price of 5 cop., 150 poods would not cover the working expenses and the cost of the boring, at the existing prices of the same in Baku. Consequently there is nothing astonishing that on the spot where naphtha is received in the United States of America, the price for naphtha is much higher than in Baku. In America about 90 cents per barrel or about 18 cop. per pood is the figure, while in Baku from 2 to 5 cop. per pood or about 10 to 25 cents per barrel.

"If in Baku there should be anything like the state of the North American wells with regard to their quantity or their

But in Baku at the same time the supply greatly increased, giving the quantities in barrels (1 barrel = 10 poods), the general average was:—

	Barrels.
In 1882 the daily yield was	13,838
1883 " "	16,541
1884 " "	24,653
1885 " "	31,851
1886 " "	32,889
1887 " "	41,500
1888 " "	50,312

here we must call attention to the fact, that out of 37 million barrels, which were in stock in the United States of North America in 1884, now there are only 14½ millions. But in Russia the stock increases from year to year, because people have begun to construct reservoirs. When the pipe line is constructed, this stock will no doubt still further increase.

* It is known that figures separately taken (and not conjointly) of the statistics very often are not sufficiently exact. But if we take that the supply during the seven months of this year in Baku was really 125,000,000 poods, then it will be easily understood why the prices for crude oil went up, because the refineries demanded more than in former years. Besides at the present time the price for the crude oil in America went up, and Baku must be already considered as a rival of America. All the rumours of the exhaustion in Baku began when the pieces of crude oil went up. This is a matter of commercial transactions, but the exhaustion is a matter of nature; here does not exist a direct connexion.

† In former times Stowell's Reporter gave the number of working or active wells (for instance, in 1885, as 23,586 wells), but now it does not exhibit these figures, which are very difficult to prove.

supply, or with regard to the extension and changes of regions or even with regard to the prices of naphtha, then it would be possible to speak about the exhaustion of the Baku region. But even then there would be left the lands belonging to the Government, to the peasantry, to Kokoreff and Mirsoieff, which are until now untouched, and are quite near to Baku, without reckoning the neighbouring lands, and the whole of the north and the south of the Caucasus, where the making of borings is not prohibited, but where it would be insanity to begin borings when in Baku: (1) The pumping is going on when there is a demand; (2) When not all the land has been investigated; (3) Before there really are observed any signs of exhaustion; and (4) When there are no great pipe lines, which could at a low price convey the naphtha to the Black and Caspian Seas.

"But why is the working of the lands not allowed for those who desire to operate them? Why is the pipe line not constructed? All this, combined with the rumours of exhaustion, form very complicated questions, principally owing to the manner in which the local people act. About this, however, I may say something on another occasion. Suffice it to say, I do not know of a single sign of the incipient exhaustion of naphtha in the Baku region. But suppose I admit the fullest exhaustion of the naphtha in Baku, let us see what may follow next in the Caucasus, supposing at the same time that the pipe line there from Baku to Batoum is finished.‡

"Along the pipe line there are plenty of naphtha springs, not only from Baku to the south and west, but also in the interior of the country, near Tzarskie-Kolozetz, near Tiflis, near Kutais, in Gouria, &c.

"These places, when the pipe line exists, will be united by pipes with the Caspian Sea, as well as with the Black Sea, and will consequently be, with regard to commerce, exactly in the same position in which the North American naphtha regions are.

"At Philadelphia, New York, Buffalo, &c., &c., the refineries will be at the sea shore, but the naphtha wells will be on the continent at a distance of 100 versts. And if even in one of the districts of the Trans-Caucasus there will be found naphtha in abundance, this will be at a low price conveyed to the sea, but at all events, on the sea-shore it will not be dearer than the American naphtha, for the Caucasian naphtha is young, whilst the American is old. Nowhere, not even when borings are made by hand, and the naphtha is got out by baling, does the naphtha cost in the Caucasus the 18 cop. per pood which are paid on the places of supply in the United States of America. Owing to the present means of boring, and the knowledge people have acquired of this business in the Caucasus, and thanks to the Baku supply, one can be sure that the average price of naphtha on the spot in the whole Caucasian district will be always one-half or one-third cheaper than at present American prices. The pipes of the Caspian Black Sea pipe line will offer then a conveyance to this naphtha which does not exist now, because in the Trans-Caucasus there is only one road—the railway—the only line which is bound to convey all the risky products of this country.

"And notwithstanding that there is against the pipe line a powerful intrigue, the latter cannot succeed in changing the real state of the business. The nearer the period of exhaustion approaches, the more powerful becomes the cause of the pipe line.

"For the present, besides the local use of the Caspian region, there are only two ways for exterior sale: the Volga, which is frozen during the winter, and the Trans-Caucasian railway. By the Volga the naphtha products go to Russia, and only a small part of them abroad (by a very dear, and tedious system of conveyance (Nobel's), by the Volga, and then by rail to Liban, &c.).

‡ Without the pipe line, then of course the naphtha business in the Caucasus will be at an end, Russia itself will get the naphtha products from America. Where the construction of pipe lines is unhindered, Europe and Asia will pay America for the naphtha, that which the Standard Oil Company will demand, and the use of the cheapest naphtha illuminating oil will considerably diminish, because with the Virginia and Ohio naphtha much cannot be done. From this it is plain who will have the best of the exhaustion at Baku, if there is no pipe line.

"In this way about 25 millions of poods of refined oil are conveyed.* And about the same quantity can be sent by the Trans-Caucasian railway to the South of Russia and abroad. This is all that can be sent from Baku at more or less profitable prices out of the 180—200 millions of poods of the naphtha gained. It is clear that a great quantity of naphtha is left and this is a kind of cheap merchandise (astatki), which is used as fuel, instead of coal, of which there are immense supplies in the Don and Ural. Meanwhile out of this astatki can be got, as experience has proved (and this has been demonstrated in the Physico-Chemical Society), together with kerosine, a safe illuminating oil (point of inflammation higher than 40 °C.), which I named Baku oil. At present it cannot be produced, although 50 to 60 per cent. of it can be got out of the Baku naphtha (besides benzene, lubricating oils, vaselin, and tar), and consequently could be obtained from it now at Baku to the extent of 100 millions of poods. But at present there are only means for the transport of 50 millions of poods of illuminating oils. But when the Baku crude oil can be conveyed by the pipe line to the Black Sea then there will be great profit in producing similar safe oils, which will increase the use of naphtha illuminating oils.

"Consequently all rumours of exhaustion of the Baku naphtha regions must not stop the English and Russian people who have commenced operations with Caucasian naphtha. The naphtha will suffice for the whole world, for all purposes.

"If there should arise new and still more artful and insidious arguments in order to delay foreign transactions with the Russian naphtha products, as I have some reason to believe will arise, then please have the kindness to inform me, that I may render such further explanation as may be necessary. The substance of the matter is, that Russia itself uses so little of the illuminating naphtha oils (about 20 millions of poods annually), and the abundance of the Caucasian naphtha is so great, and the expense of getting the naphtha so slight, that the exterior commerce with the naphtha producers is on the one hand an important help for Russian industrial interests, and on the other gives to the world the cheapest naphtha products, and thus leads to mutual benefit.

"To everything that will be purposely stated against this affirmation I am ready to reply, for the sake of the interests of my country and of the universal development of peaceful commercial relationships, and transactions. I consider it of great importance that our country is able to supply the world with an illuminating oil, safe as regards risks from fire, which is more than can be said of the American kerosine, which it is bound to replace ultimately."

August 27 (September 8), 1889.

THE MANUFACTURE OF PRUSSIAN OF POTASH (FERROCYANIDE OF POTASSIUM).

A paper read before the British Association, Newcastle-on-Tyne, 1889,

BY J. B. READMAN, D.S.C., F.R.S.E., F.C.S., EDINBURGH.

As far as I am aware very few thorough investigations have been conducted during late years with the view of arriving at a more economical method of producing this important commercial salt.

There is perhaps no chemical operation carried on on the large industrial scale which is so wasteful and so scientifically imperfect. The wear and tear of apparatus, the loss of nitrogen, the excessive consumption of coal, and the loss of potassium by volatilisation, lixiviation, and recovery, are each and all so abnormal under the present process of

manufacture, that it is matter for surprise the process has so long survived in an age characterised by rapid strides of progress in almost every other branch of chemical industry. During the last decade or more a very great deal of attention has been paid to the recovery of ammonia from blast-furnace gases and coke ovens, and to increasing the yield of ammonia during the destructive distillation of coal and of shale, but little or nothing has been done in the direction of saving or utilising the ammonia or the nitrogen evolved in the manufacture of ferrocyanide of potassium.

It has been stated that out of every 100 parts of nitrogen existing in the animal matters employed in this manufacture, only 45 to 50 parts are utilised, and that the remaining 50 to 55 parts are lost, passing off, not as ammonia to any great extent, but principally as free nitrogen.

Yellow prussiate of potash is, commercially at least, the starting point of the manufacture of the cyanides and ferrocyanides, and although much of its importance, especially as a means of preparing blue pigments, has gone, it is still a substance of considerable manufacture.

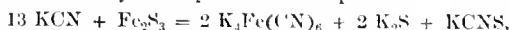
Before giving a short review of the history of prussiate, and of the methods that have been proposed or practised to improve the process of manufacture, it may be well, in the first place, briefly to describe the process at present in use in this country.

Present Mode of Manufacture.—It consists in introducing dry nitrogenous animal matter, such as horns, hoofs, woollen rags, leather, &c., into molten carbonate of potash contained in a small, but very thick and heavy (15 cwt.) cast-iron pot, heated externally by a strong fire. The pot is provided with an iron agitator, which is kept constantly in motion during the operation. The nitrogenous material is introduced into the pot slowly, and in small quantities at a time. The carbon and nitrogen combine together, forming cyanogen, which in turn combines with the potassium, forming, some authorities say, cyanide, others, ferrocyanide of potassium.

The mouths of the pots are practically open to the air, and at each addition of nitrogenous material a flame shoots forth carrying with it a large proportion of the nitrogen. It is at this stage of the process that the chief waste of nitrogen takes place.

The iron required for the formation of the salt is derived wholly from the cast iron of the pots and agitators, and this wear, aggravated by the presence of sulphur in the organic matter, and by the high temperature at which it is necessary to conduct the operation, renders the working life of the prussiate pots a very short one.

The fused mass after the nitrogenous matter has all been introduced (called "metal") is ladled out of the pots. It is then allowed to cool, and is lixivated much in the same way as black-ash is treated in the Leblanc soda process. The "metal" contains cyanogen equivalent to about 16 per cent. to 20 per cent. of ferrocyanide of potassium, which may exist, as before remarked, as cyanide, but on lixiviation becomes ferrocyanide by double decomposition—



and about 60 per cent. of carbonate of potash in excess called "return alkali," the remainder, 20 per cent. to 24 per cent. being insoluble matter, chiefly carbon.

The clear liquor from the lixiviating vats is boiled down, and a first crop of crystals of yellow prussiate is thereby obtained. These crude crystals are then recrystallised at least once to fit them for the market. The mother-liquors obtained from the first crystallisation are evaporated down and put through the process again. Afterwards, when they become very foul from accumulation of sulphides and other salts, they are evaporated to dryness and put through the black-balling furnace for recovery as carbonate of potash.

The insoluble residue from the lixiviation of "metal," consisting largely of carbon derived from the animal matters, was formerly a waste product; but it has recently become of value as a substitute for animal charcoal in the decolorising of paraffin wax.

Historical.—It appears that Prussian blue was first produced in this country in 1724, by Woodward, who obtained it by deflagrating a mixture of nitre and argols, and calcining the product with dry blood. Further

* Of course in this way a great deal more could be conveyed; astatki as well.

investigations were made by Scheele, some years later; also by Berthollet in 1787; Porret in 1814; and by Gay Lussac in 1815, who discovered cyanogen.

Attention was paid to the manufacture of prussiate by Muspratt in 1820, and by Kuhlmann in 1838, who was the first chemist to propose the making of cyanogen by passing ammonia over red-hot carbon and condensing the cyanogen so formed in alkaline solution.

Lewis Thompson, of Newcastle-on-Tyne, about 50 years ago, was the first to draw attention to the production of cyanogen when coke, iron, and potash were ignited in free access of air.

Bramwell and Hughes about this time (1844) started the process in Newcastle of producing cyanides by passing air over a dried mixture of carbon saturated with potash and heated to a high temperature.

Bunsen and Playfair detected cyanogen in the gases of the Alfraton iron furnaces a little above the tuyères, and Bunsen proposed the erection of a potash blast furnace, with air blast, for the production of cyanide of potassium. At the meeting of the British Association held in Cambridge in 1845, a "Report on the Gases evolved from Iron Furnaces," by Professor Bunsen and Dr. Lyon Playfair, was read. The following extracts are taken from the Report:—

"It will be observed that the gases from the inferior parts of the furnace contain cyanogen." * * * * *

"This gas appears immediately over the point of entrance of the blast, and again disappears at a small elevation above it, so that at the top of the bushes only small traces of it are observed."

It appears from the report that a hole was bored over the front of the furnace, 2 ft. 9 in. above the level of the tuyère, and as soon as the perforation was complete a gas issued from it, possessing strong illuminating powers, and burning with a yellow flame, from which came abundant vapours of white smoke. An iron pipe was introduced into this hole, and the gases which poured out of the tube, under a pressure of several feet of water, were so richly laden with cyanide of potassium that precautions had to be taken in approaching it that the experimenters should not suffer injury from this poisonous material.

Some Woulff's bottles were arranged and connected to the pipe, in the first bottle which was originally empty, a rich white sublimate of dry cyanide of potassium was deposited, while water contained in the second bottle became a tolerably strong solution of the same salt.

The potash, on further investigation, was found to come from the calcined iron ore and from the coal employed. The experiments proved (1) that the nitrogen of the cyanide was not derived from the nitrogen contained in the coal, as the temperature at that part of the furnace must have previously deprived the coal of all its nitrogen; and (2) that cyanide of potassium is volatile at high temperature.

More recent suggestions.—Patents for improvements in the manufacture of cyanides or ferrocyanides have been taken out in this country during the last 20 years. Some of the claims are for the employment of baryta as the base, and air as the source of nitrogen;* others are for the extraction of cyanides from the spent oxide or waste lime of gas works; others are for improved apparatus for producing cyanides where air is employed as the source of nitrogen. Besides these, many minor modifications not only of the apparatus employed but of the materials have been proposed. For example, the employment of reverberatory furnaces have been proposed in place of the cast-iron pots. A preliminary carbonisation of the organic matters has also been suggested, but as far as I am aware none of these proposals appear to have been adopted in this country. The process I have described still seems to stand firm as the only one here practised.

Experiments by the Author.—With the object of ascertaining to what extent cyanides can be produced by passing dry ammonia gas over carbon saturated with potash and other substances while heated to redness, I made the following preliminary laboratory experiments, using potash, soda, lime, and baryta as the bases. The results of these experiments I have tabulated, to show at a glance the yield of cyanide from a given material. I may say that the respective salts were added† to the wood charcoal and iron filings, and the mixture was thoroughly dried before being strongly heated to form cyanogen compounds with the gaseous ammonia. The furnace employed in these experiments was at first an ordinary laboratory combustion furnace heated by a row of Bunsen's burners, and the tube into which the saturated dry wood charcoal was placed was made of malleable iron $\frac{1}{2}$ in. internal diameter.

* Since this paper was written, Mr. Mond's interesting experiments in this direction have been made public in his presidential address to the annual meeting of Society of Chemical Industry in London, 1889. (This Journal 1889, 505–510.)

† These salts that were soluble were added in concentrated solution, and these that were not were mixed with the charcoal along with water and dried.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Carbonate of potash	100	100	100	100	100	100	100	..	50	33.3	..	..	..	100
= K	56.5	56.5	56.5	56.5	56.5	56.5	56.5	..	28.2	18.8	..	..	..	56.5
Carbonate of soda .....	..	..	..	..	..	..	..	100	50	66.6	..	..	..	..
Baryta (BaO) .....	..	..	..	..	..	..	..	..	..	..	100	..	..	..
Lime, CaO, H ₂ O .....	..	..	..	..	..	..	..	..	..	..	..	100	..	..
Soda-lime .....	..	..	..	..	..	..	..	..	..	..	..	..	100	..
Chloride of ammonium	50	50	50	50	37.5	25	20	50	50	50	100	100	25	20
= N	13	13	13	13	9.8	6.5	5.2	13	13	13	26.1	26.1	6.5	5.2
Iron filings	50	25	50	None	12.5	50	50	12.5	12.5	25	100	100	15	None
Wood charcoal	250	200	250	200	200	250	250	200	200	200	400	400	100	250
Dry saturated charcoal	400	325	407	300	296	387	379	295	282	287	600	600	225	340
Weight of insoluble on lixiviation	319	266	314.5	273	256.5	304.5	334	266	242.5	205	500	510	223	191
Weight crystallised = K ₄ Fe(CN) ₆ obtained	20.6	31.6	36.1	28.8	33	29.2	26.5	9.6	16.2	16.2	None	None	Trace	26.1
= N in do.	4	6.2	7.1	5.7	6.5	5.7	5.2	1.9	3.4	3.4	..	..	..	..
= K in do.	7.6	11.6	13.3	10.6	12.2	10.7	9.8	3.5	5.9	5.9	..	..	..	..
Per cent. K used up	13.4	20	23.5	18.7	21.5	18.9	17.3	..	..	..	..	..	..	..
Per cent. K recoverable	86.6	80	76.5	81.3	78.5	81.1	82.7	..	..	..	..	..	..	..
Per cent. N used up	20.7	48	54.9	43.8	66.3	87.6	100	14.6	26.1	26.1	None	None	Trace	100
Per cent. N lost not recoverable	69.3	52	45.1	56.2	33.7	12.4	None	85.4	73.9	73.9	All	All	All	None

Crystallised salt contains in 100 parts :—

K	37.63
Fe	13.25
C	17.04
N	19.89
H ₂ O	12.79
	100.00

The experiments were further continued in a malleable iron pipe 4 ft. long by 2 in. in diameter, heated in a furnace with coal fuel. The ammonia gas derived from dry chloride of ammonium and slaked lime, was generated in an apparatus heated to the temperature required to expel all the ammonia, and was connected by a tube to the pipe containing the saturated charcoal. It is evident from the experiments—(1.) That whatever affinity barium may have for cyanogen at very high temperatures it has no power to attach itself to the latter at temperatures at which cyanide of potassium can be readily produced. (2.) If a large excess of potash be present in proportion to the nitrogen the whole of that element contained in the ammonia is resolved into cyanides. (3.) That the same amount of cyanogen is formed whether iron filings are added to the saturated wood charcoal in the first place or not. (See Experiments Nos. VII. and XIV.)

In addition to the experiments that are tabulated, trials were made with air passed over the saturated charcoal under similar conditions to the other experiments, but the result showed that no cyanides were produced.

As stated previously, these experiments are only preliminary ones. It is my intention to follow them up on a larger scale, and at the same time using higher temperatures.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

New or Improved Means and Apparatus for Producing Cold. E. Bazin, Paris, France. Eng. Pat. 10,361, July 17, 1888. 8d.

In this invention the pressure at which water is ordinarily supplied to houses in town is utilised for compressing air, which, in expanding, produces cold for cooling, freezing, and preserving purposes. Two methods are shown. Water from the main pipe enters a vertical receiver under pressure, and compresses the air in the upper part, and forces it through a cooling coil extending the whole length of the chamber. The lower end of this coil is connected by a tap with a second coil contained in a horizontal cylinder, through which the air also passes and enters a refrigerating box, in the "jacket space" of which it expands and produces intense cold. The water escapes from the receiver by a pipe at the bottom, and its height is regulated by a gauge. Or the water enters the upper part of the receiver through a series of holes, in the form of rain. The enclosed

air is thus cooled and compressed, and is still further cooled by being brought in contact with ice in a receiver, and from which it passes into the refrigerating chamber. There are six claims and two sheets of drawings.—E. S.

Improvements in Multiple Evaporating Apparatus. T. Slater, London. Eng. Pat. 10,493, July 20, 1888. 11d.

This invention consists in evaporating and concentrating fluids by passing them over open trays heated by steam, the trays and steam-supplying passages being fixed in a cylindrical chamber, in which a vacuum is maintained by means of an air-pump.

For details the drawings attached to the specification must be consulted.—E. S.

Improvements in Condensing Apparatus. E. Theisen, Cologne-on-the-Rhine, Germany. Eng. Pat. 11,268, August 3, 1888. 11d.

This invention is intended to provide a simple and efficient condenser for steam and other vapour. To effect this, the condensing chamber is constructed with a very extensive surface in a small space, by arranging a number of annular vessels concentrically one within the other, their entire surface being kept constantly wet by means of jets "preferably of warm water." A fan acting upon this surface causes very rapid evaporation, which withdraws the heat from the condensing chamber and causes the rapid condensation of the enclosed vapour. To prevent the steam or other vapour from passing too quickly through the condenser, a tortuous course is given to it by providing the vessels internally with inclined or spiral divisions. Several modifications of the apparatus are shown in the five sheets of drawings. There are four claims.—E. S.

Improvements in Cold Air Refrigerating Machines. W. Garden, Dalston. Eng. Pat. 12,327, August 27, 1888. 11d.

In this invention, intense cold for refrigerating purposes is produced by the compression of air, which is afterwards cooled and expanded. The compression and expansion cylinders are mounted on opposite ends of the bed-plate, the pistons of both being worked from a common crank. The cooling-chamber is placed beneath the bed-plate, and is provided with a number of perforated screens, over which the water from the circulating pump is caused to run, as the air is forced through them. The compressed air then passes to the expansion cylinder, which is surrounded by a jacket, around which the dense air circulates before passing into the cylinder by a hollow slide-valve, which works on rollers, and is kept close to the cylinder by adjustable levers. "In this way, the cylinder being surrounded by a body of dense air at a uniform temperature, irregular contraction of the walls of the same, and consequent undue friction on the piston is avoided." Ports in the valve correspond with others at each end of the cylinder, and allow the air to pass alternately to either side of the piston to be expanded, the same ports in the cylinder acting as discharge passages when the hollow slide-valve uncovers them.

There are four claims, and the specification is accompanied by four drawings.—E. S.

An Appliance or Device for Introducing or Injecting Gases into Liquids contained in Casks or other Vessels. The Brin's Oxygen Company, Limited, Westminster, and P. B. W. Goble, Dartford. Eng. Pat. 13,723, September 22, 1888. 8d.

The object of this invention is to prevent loss in introducing gases into liquids contained in casks or other vessels. A tubular main has an elastic seating at its lower end, over which is a chamber which carries a plug, and a spring to press it forward. Above this chamber the main is screwed, and provided with a nut having handles for rotating it, and so raising a collar with lateral eyes for the attachment of

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	3d.
Above 8d., and not exceeding 1s. 6d.	1d.
" 1s. 6d., " " 2s. 4d.	1d.
" 2s. 4d., " " 3s. 4d.	2d.

a chain, which passing round the cask keeps the whole apparatus securely in position. The upper part of the tubular main is connected with the gas inlet pipe. A hollow rod (except at the upper end) passes through the tubular main, and on pressing the knob at the upper end it drives the bung before it and enters the cask, at the same time that an opening corresponding with that of the gas inlet allows the gas to flow in. The cask being filled the rod is drawn upwards, when the plug mentioned before is driven forward into position, and a blow on the top of the rod forces it into the bung-hole and closes the cask, when the apparatus can be removed. There are four claims and one sheet of drawings.—E. S.

Improved Means for Fixing the Glass Tubes of Syphons.
E. R. Vaughan, Belfast. Eng. Pat. 15,200, October 23, 1888. 6d.

THE improvement consists in the means of fixing the glass tubes of syphon-vessels containing aerated waters and other beverages, and which can be easily detached, instead of being rigidly "fast" as heretofore. A cap-piece of any suitable non-metallic material has an internal screw. A short tube or collar of india-rubber is fitted over the glass syphon tube which is slightly enlarged at the upper end to retain the collar in position. The cap-piece is then screwed over the collar and forms a flexible but hermetically sealed joint. The advantages of this improvement are: (1.) Preventing the enclosed liquid from coming in contact with the under-surface of the cap; and (2.) In retaining its utility should the glass tube be broken. There are two claims.—E. S.

Improvements in Machines for Grinding White Lead, Paint, Printing Ink, and other similar Substances or Compounds. H. Clark, London. Eng. Pat. 16,034, November 6, 1888. 8d.

THE machine consists of five rollers of granite or other suitable material having bearings capable of adjustment in slots in the frame which carries them, so that the distance between any consecutive pair of rollers can be varied at will. Power is communicated by a shaft with fast and loose pulleys to the rollers by toothed wheels and pinions, of such sizes that each roller is driven at a speed about one-third greater than that of the previous one, and thus the surfaces of each pair of rollers have motion relative to each other. The substance to be ground is fed on to the first roller and is received from the last by a shoot provided with a scraper. The bearings of the rollers are not rigidly fixed in the slots mentioned above, but are cushioned by spiral springs, which allow them to yield in the event of any hard lump of material being accidentally introduced into the machine.

—B. B.

Improvements in Apparatus for the Discharge of Gases Stored under Pressure. G. Vincent, London. Eng. Pat. 130, January 3, 1889. 6d.

THE improvement relates to apparatus for simplifying the conversion and discharge of nitrous oxide (N_2O) from a liquid to a gaseous condition for the purposes of inhalation; also for similarly converting and discharging oxygen gas for use in oxyhydrogen lanterns, and for other gases.

Two iron bottles containing the gas in a liquid form are securely fixed in a horizontal position to a flat board or tray). In front of each bottle are two upright brass supports, carrying a spindle, which ends in a loose socket, into which the nozzle of the bottle fits. On the top of the spindle is placed "a roughened foot bracket pedal-piece," which when moved in a "to and fro" direction revolves the spindle, and carrying with it the socket which is fitted into the nozzle, gives the operator control over the escape of the gas. There is one claim and one drawing.—E. S.

Improvements in Means or Apparatus for Use in Filtering.
J. E. Warren, Cumberland Mills, U.S.A. Eng. Pat. 9204, June 4, 1889. 8d.

THE improvement consists in providing a filter in which the sedimentary matter held in suspension by the fluid may be effectually removed from it and the filter. A circular tank is divided by suitable walls into a central chamber, and an annular space round it is divided into chambers by vertical walls, and constitutes the outlet chamber of the filter. The central chamber contains the filtering material, which rests on a perforated plate. A pipe, forming a well, extends through the filter bed to its upper surface, and is provided with outlet and inlet pipes, both of which are controlled by valves. The fluid to be filtered is acted upon by a revolving agitator, consisting of an arm having fingers with blades attached to them, and is rotated by a shaft, which has also a vertical motion which is regulated by automatic mechanism. The heavier impure particles gravitate towards the centre and are precipitated at the bottom of the well, while the lighter particles gravitate towards the walls of the chamber, where they are collected in a peripheral gutter connected by pipes with the well. There are five claims, and the specification is accompanied by two sheets of drawings.—E. S.

Improved Method of and Apparatus for Distilling Sea Water and other Liquids. G. W. Hovgaard, Copenhagen, Denmark. Eng. Pat. 9815, June 14, 1889. 6d.

THIS invention refers to a mode of distilling water or other liquids. Reference is made to Normandy's double-distilling condenser, in which the boiler steam is condensed in a vessel surrounded by the sea water (this Journal, 1887, 813). In this improvement the boiler steam is first caused to perform work in compressing the secondary steam, and the latent heat of the secondary steam instead of being thrown away in the water of circulation is used for evaporating the water. A steam compressor, which is a reciprocating double-acting pump, is driven by any suitable means, and after drawing steam from the evaporator and compressing it, drives it into an annular condenser. The exhaust steam from the cylinder is led to a central condenser, both condensers being cylindrical and multitubular in construction, and the annular condenser is placed outside the central one. A perforated screen placed immediately above the level of the evaporating sea water checks ebullition and prevents salt water being carried over in the annular condenser by priming. The steam which is forced into this condenser is at a higher temperature than the water surrounding it; heat will therefore pass through the shell of the condenser to the boiling water in the evaporator, and the steam will condense and give off its latent heat to the water in the evaporator. In this way fresh water is formed in the annular condenser. The patentee claims greater economy, no deposition of scale, and no priming as the advantages of his improvements. There are two claims and one sheet of drawings.—E. S.

Improvements in Filters. T. Gentzen and A. Wegener, Berlin, Germany. Eng. Pat. 10,251, June 24, 1889. 6d.

IN this filter a combination of sand, coal, and asbestos is used. A cylindrical vessel has a large flange at either end for the attachment of the top and bottom raised covers, an india-rubber diaphragm being placed between the cylinder and the covers. To the lower diaphragm two metal rings are attached, the upper one forming a case in which small pieces of coal are placed, and kept in position by a fine wire sieve, and underneath and lying above the diaphragm is a layer of asbestos. The whole of the cylinder is filled up with fine sand up to the upper diaphragm. In the middle of the cylinder is a cock and pipe for letting off the impurities, a fine wire gauze at the inner end of the cock preventing the sand from passing out. The water to be filtered enters through the upper cover and flows out at the bottom. The filter has a flange at each end by which it may be attached to any convenient place. There are two claims and one drawing.—E. S.

Improvements in Hydrometers and in Apparatus in Connection therewith. J. V. Davis, Treloue, Bohemia. Eng. Pat. 10,123, June 27, 1889. 6d.

This invention is intended to render hydrometers and similar instruments more suitable for large establishments, where the observer is exposed to heat, noxious gases, and the steam and vapour of the liquids to be tested. A lever having the fulcrum at one end carries at the other end a metallic float, which is enclosed in the vessel carrying the fluid to be tested, which is kept in constant circulation and at the same level. As the float rises or falls it moves a pointer on a dial, which can be observed at a distance, or being connected with suitable apparatus supplies a continuous and self-registering record. There are four claims and one drawing.—E. S.

II.—FUEL, GAS, AND LIGHT.

Gaseous Fuel. Sir Lowthian Bell. A paper read at the Paris Meeting of the Iron and Steel Institute, 1889.

For obvious reasons, when power is once generated, the sooner it is applied to the duty it has to perform the better. In like manner, that form of motion known as heat, does its work most economically when the same rule is observed. Of course, it often happens that a sacrifice has to be made in order to meet the circumstances of particular cases. A steam-engine of moderate size is often seen storing up its energy in a hydraulic accumulator, in order to transmit it when wanted to a purpose far beyond the power of the prime motor directly applied. Again, for the Siemens furnace 15 to 30 per cent. of the heat of the coal is devoted to convert it into the gaseous form, in order that the latter, and the air required for its combustion, may be made to serve as vehicles for returning heat to the work to be performed. This is done because, without this stimulus, the temperature obtained by burning coal in the ordinary way would not suffice for the object in view. In the hydraulic accumulator and in the Siemens furnace there is a considerable sacrifice, but it is one which, for the reasons given, is quite justifiable.

I have been led to make these introductory remarks in consequence of having been requested by the Council of the Iron and Steel Institute to prepare a paper on a gaseous fuel known as water-gas. The compound nature of water was discovered by Cavendish and Lavoisier towards the end of the last century, and already in 1801 Fourcroy mentions the fact of hydrogen being separated from it by contact with heated charcoal. Eighty-five years afterwards the product of this reaction has been brought largely under public notice, and it is because the natural laws to which I have briefly alluded, have been, to some extent, lost sight of in the recommendations advanced in favour of water-gas, that I have complied with the wishes of my colleagues.

The gaseous fuel used in the Siemens furnace is known under the name of "producer-gas," and the manner of its manufacture is too well understood to require any description on the present occasion. It varies in composition somewhat according to the kind of coal employed. For my purpose, it will be assumed, in making it, that we have to deal with a specimen of coal consisting of 70 of fixed carbon, 16 of coal-gas, accompanied by 14 of ash, oxygen, and nitrogen.

The producer-gas so obtained will consist by weight of 16 parts of coal-gas, 163·3 carbonic oxide, and 222 of nitrogen. Using the centigrade unit in the calculation, 7,200 calories will be taken as the heat equivalent of the coal employed for the gas I am about to examine, and it will be assumed that the latter is received at the regenerators of the Siemens furnace after being cooled.

We have then to consider—		Calories.
100 of coal × 7,200 calories, equal to		720,000
By the combustion of the producer-gas there is as follows:—		
16 of coal-gas × 10,000 calories		160,000
163·3 of carbonic oxide × 2,400 calories .		391,920
		<hr/> 551,920
Difference		<hr/> 168,080

which difference is loss, and represents 23·3 per cent. of the whole.

In a recent publication dealing with the question we are considering, it is stated that "gas as an economical fuel has come among us, and that it has come to stay." In support of this opinion we are reminded of the immense service which the natural gas, in the United States, has rendered to industry.

Gaseous fuel, however, is not the stranger, at all events to the members of this Institute, which might be inferred from this language. I mention this, after calculating that something like 4,000 million cubic feet of gases are daily consumed at the blast furnaces of Great Britain. As regards the American gas, which I saw in use so long ago as 1876, at Pittsburg, any comparison between it and a factitious gas is, in my judgment, entirely illusory. In Pennsylvania a mere hole is bored in the ground; this taps the subterranean store, which rushes to the surface under a pressure of 200 to 300 lb. on the square inch, and the gas is then impelled along a pipe by its own elasticity to the very furnaces at which it is to be consumed. To obtain producer- and water-gas, a much larger and infinitely more expensive hole or holes have to be dug and fitted with costly and powerful machinery. Besides the coal, worked at great cost, vast volumes of air and great weights of water have to be set in motion. The coal has then to be transported, often for many miles, along a railway, and converted into gas, which, instead of being an almost perfectly pure combustible substance like that found in America, is mixed with an enormous volume of inert hydrogen.

It will be convenient here to describe in brief terms the process recommended for making water-gas. A capacious cylinder of iron is lined with fire-brick, and provided with the necessary apparatus for introducing the fuel, resembling in principle the cup and cone of our blast furnaces. The fuel employed is recommended to be in the form of coke, into which, after being lighted, a current of air is forced, until the whole mass is brought to a high temperature. The blast is then stopped, the orifice for charging is closed, and a jet of steam is passed through the now highly-incandescent carbon. The steam is decomposed, its oxygen burns the carbon into carbonic oxide, setting free the hydrogen, and this mixture constitutes the so-called water-gas, which is stored in gas-holders such as those used in ordinary gas-works. It consists of one volume of hydrogen and one volume of carbonic oxide, the weights being in the proportion of 1 to 14. A gas of this composition, where a very intense temperature is required, is for certain purposes very valuable, because of all substances with which we are acquainted, hydrogen gives out, when burnt, the largest quantity of heat. As an example, while a unit of carbon, in forming carbon dioxide, affords 8,000 calories, one unit of hydrogen generates 34,200 calories, in the formation of water.

Now, if by burning one unit of carbon we could generate one unit of hydrogen, the exchange effected in the water-gas apparatus might be a very profitable one. Such a condition of things would, however, be directly opposed to the known facts of the case.

Chemically, the change in producing this water-gas is expressed by $\text{H}_2\text{O} + \text{C} = \text{H}_2 + \text{CO}$. Now, the heat required to tear away hydrogen from its associated oxygen in water is not less than that which is evolved when these two gases unite; hence, $2 \times 34,200 = 68,400$ calories. The weight of the combining equivalent of the carbon required to effect the change is 12 times that of the two units of hydrogen, and the heat generated by this quantity of carbon being burnt to carbonic oxide is $12 \times 2,400 = 28,800$. Thus something more than 14½ units of weight of carbon will be required to generate one unit by weight of hydrogen.

Now, as only six units of carbon are being burnt in the cylinder for this quantity (one unit) of hydrogen, it will easily be understood that the incandescent carbon, which has served to generate the water-gas, is very speedily cooled below the temperature required for the decomposition just described. When this point is arrived at the steam is shut off, and air is turned on again, in order to obtain a store of heat ready for a further production of water-gas. Thus, it will be seen, the operation consists in alternately making producer-gas, which, when using coke, is a mixture of carbonic oxide and

nitrogen, and water-gas, with which we are now more immediately concerned. In calculating the amount of heat required to supplement that generated before commencing to make the water-gas, all we need to know is the quantity of carbon burnt to the condition of producer-gas, and that which enters into the composition of water-gas. According to the work I have already quoted, 25 per cent. only of the actual carbon used enters into the latter, the other 75 per cent. being converted into producer-gas, containing 68 per cent. of inert nitrogen. From 25 parts by weight of carbon there will be generated of water-gas 62.50 parts, containing 4.16 of hydrogen and 58.34 of carbonic oxide. The producer-gas from the remainder (75 parts) of the carbon will weigh 551.19 parts, of which 376.19 will be incombustible nitrogen and 175 carbonic oxide. The following estimate contains the full quantity of heat these two gases are capable of generating by their combustion:—

Water-gas:—	Calories.
4.16 of hydrogen from steam	$\times 29,400 = 122,304$
58.34 of carbonic oxide	$\times 2,400 = 140,016$
	<hr/> 262,320
Producer-gas:—	
175.00 of carbonic oxide	$\times 2,400 = 420,000$
276.19 nitrogen	
551.19	<hr/> Calories..... 682,620

Had the 100 parts of carbon been burnt direct, the heat generated would have been 800,000 calories.

Hence the loss is 14.68 per cent. Inasmuch, however, as coke was used, and the 100 parts may be taken to represent 150 of coal, we have this quantity to multiply by 7,200 calories, rather a low product for coal, which gives 1,023,780 calories, thus bringing up the deficit to 37 per cent.

In employing coke as a material in the gas generator, there is not only the loss of combustible matter which is incurred at the coke-oven, but the labour, &c. in conducting the process of coking. It is obvious, therefore, that if coal can be employed, it is in that form that the fuel should be used—i.e., if ever a large demand for water gas was to arise. I have been fortunate enough to receive an account from a Moravian work containing the particulars of making 6,041,155 cubic metres of water-gas, in obtaining which 29,734,731 cubic metres of producer-gas was generated, in order to heat the contents of the apparatus in the manner described. It would thus appear that each metre of water-gas is accompanied by 4.92 metres of producer-gas. The analysis of the coal is not given; on this account, and for the purpose of more exact comparison with what has already been said, I will assume its composition to be that of the specimen already mentioned, viz., 16 of coal-gas, 70 of fixed carbon, and 14 of ash, oxygen, &c.

In the metre of water-gas, consisting of equal volumes of hydrogen and carbonic oxide, we have:—

Litres.	Grms.
500 hydrogen	= 44.8
500 carbonic oxide	= 625.0 = carbon 267.8

The producer-gas consists of—

Litres.	Grms.
370 coal gas distilled in heating the carbon	= 206.83
1,440 carbonic oxide distilled in heating the carbon	= 1,805.19 = carbon 773.6
8,110 nitrogen oxide distilled in heating the carbon	= 3,921.23
4,920	<hr/> 5,933.25

Solid carbon..... 1,041.4.

In this, the nitrogen is about 63.2 per cent. of the total volume, and 61 per cent. of the weight. The carbon in the coal-gas amounts to 109.52 grms., which is considered to remain unchanged in the producer-gas. The carbon thus burnt for the producer-gas is 2.88 to 1 for that in the water-gas, instead of 3 to 1, as allowed in the description when coke was employed.

From these figures it follows that we are concerned with 1,041.4 grms. of carbon as carbonic oxide in the two gases, added to 109.52 grms., contained in the 370 litres, or 206.83 grms. of coal-gas.

The heat capable of being produced by these two substances is—

$$\text{Carbon, } 1,041.4 \times 8,000 = 8,331,200 + 206.88 \text{ coal gas} \times 10,000 = 2,068,800 = 10,400,000.$$

When converted into water- and producer-gases, we have to deal with the following quantities of heat by their combustion:—

Water gas containing—	Grms.	Calories.
Hydrogen from steam	44.8 $\times 29,400$	= 1,317,120*
Carbonic oxide	625.0 $\times 2,400$	= 1,500,000
		<hr/> 2,817,120
Producer-gas containing—		
Coal gas	206.83 $\times 10,000$	= 2,068,800
Carbonic oxide	1,805.19 $\times 2,400$	= 4,332,456
Nitrogen	3,921.23	—
		<hr/> 6,401,256
		<hr/> 9,218,376

These two sets of numbers show therefore a loss of 11.36 per cent. in gasifying the coal.

It is, perhaps, worth comparing the assertion made in general terms in the pamphlet of the relative proportion of carbon received in the form of water-gas and as producer-gas—

In the equation $\text{H}_2\text{O} + \text{C}$, we have $\text{H}_2 + \text{CO}$ for water-gas.

In the equation $\text{O}_2 + \text{C}$, we have 3 CO for producer-gas.

The weight in the two equations of H is 2, and that of carbon 48, or 1 of H to 24 of carbon. Of oxidised carbon, in the example just examined when using raw coal, there was in the gases 44.8 of hydrogen and 1,041.51 or 23.24 of carbon for 1 of hydrogen. Now the heat of 24 parts, by weight, of carbon burnt to carbonic oxide means 57,600 calories, which have been expended to obtain 1 part of hydrogen, which, when burnt to steam, is worth 29,400 calories—the loss being therefore nearly 50 per cent. of the heat generated in order to obtain the single unit of hydrogen.

Hitherto I have only spoken of the loss of heat involved by gasifying the fuel before using it, and as the coal is cheaper than coke, we may confine ourselves to that as the material to be used. It is, however, not coal but gas that we have finally to deal with, and we must consider the cost of conversion. According to the return I have received from Germany, each ton of coal treated cost, in its gasification, no less than 12s. 2½d., made up by the following items:—

	£	s.	s. d.
Labour	1,686	14	2 11½
Steam	1,286	12	3 6½
Fire-bricks and clay	79	14	0 2½
Stores	113	16	0 3½
Repairs	369	8	1 0
Sundries	34	10	0 1
Interest and redemption	1,560	0	4 1½
	<hr/> 4,480	<hr/> 14	<hr/> 12 2½

It is not our usual practice in this Institute to consider purely commercial questions, but the substitution of coke or coal by gaseous fuel is one which seems to involve some reference to the question of cost.

In the pamphlet to which I have more than once referred, the expense of converting coke into the two gases is such that it works out per ton of the coke used:—

s. d.
1 0.84 for labour.
1 5.17 interest and depreciation.
0 2.17 sundries.
<hr/> 2 8.18

The labour and other expenses at the Moravian work appears to me very high, and with this observation I must leave the question of cost to be decided by members themselves.

It is stated that solid fuel, under ordinary circumstances, only gives a useful effect of 20 and 25 per cent. of the total

* Hydrogen burnt to water gives 34,200 calories, and to steam only 29,400 calories.

heat units capable of being afforded by coal, whereas as high as 90 per cent. can be had from gas, qualified, however, by the statement that it must have a high percentage of combustible gas and a great calorific intensity. This, of course, must mean the water-gas alone, for the producer-gas contains, as we have seen, 63 per cent. of inert nitrogen and very little pure hydrogen, but it must be remembered that this less important combustible gas represents something like 68 per cent. of the heating power of the two gases, against 32 contained in the water-gas.

I am, however, at a loss to understand whence this inference is drawn as to the inefficiency of solid fuel. The raising of steam and smelting the ores of iron may certainly be included within the category of "ordinary circumstances," and yet it is no uncommon thing for fuel to evaporate 60 per cent. of its theoretical quantity of water, and, as regards our blast furnaces, having regard to the chemical conditions to be observed, 90 per cent. of the full power of the fuel is accounted for by the duty performed.

To account for a supposed inferiority of solid fuel, it is assumed by the author, from whom I am quoting, that it is imperfectly oxidised. I have to do with a large number of boilers fired with coal, and at the Clarence Works we frequently consume 120 million cubic feet of blast-furnace gas per day. I am prepared to assert that oxidation, in my experience, is as complete with the one kind of fuel as with the other. The quantity of heat evolved by each is, of course, easily ascertained, and the only disturbing cause in any comparison between the two is the quantity and temperature of the gases resulting from combustion. In this particular no doubt the net loss is in favour of water-gas, because the exchange of carbonic oxide for hydrogen necessarily reduces the weight of the chimney-gases passing away.

I propose now briefly to summarise the results in the following manner:—

1st. A specimen of coal containing 70 per cent. of fixed carbon, 16 per cent. of coal-gas, and 14 per cent. of ash, nitrogen, &c., will be examined in a calorific point of view, and its power stated when simply burnt in an ordinary furnace.

2nd. Producer-gas as supplied to the open-hearth steel furnace obtained from the same coal, and its heating power also ascertained.

3rd. The same coal converted into water-gas and producer-gas by the processes described, and the united power of these two products calculated as before, on the supposition that for 1 of carbon in the water-gas 3 of carbon is found in producer-gas.

1. Coal as burnt in an ordinary furnace:—	Calories.
100 parts, yielding 7,200 calories per unit =	720,000
Chimney-gases, estimated after making the necessary allowance for oxygen in the coals, 1,129 units	
× 427° C. × 24 Sp. heat =	115,700
Loss in this case by chimney-gases is equal to 16·07 per cent.	

2. Producer-gas from the same coal as that used in Siemens furnaces, without the addition of steam:—

	Calories.
70 of carbon will give 133·33 of carbonic oxide × 2,400 =	391,992
16·00 of coal-gas × 10,000 =	160,000
Sensible heat transmitted to furnace.....	62,411
	<u>614,403</u>

Heat in chimney-gases, 1,129 × 377° C. × 24 S. heat = 102,151
Loss at chimney equal to 16·61 per cent.

In the former statement respecting producer-gas, no note was taken of the sensible heat, because it was wished to compare the heat evolution with the water-gas process, where the gases are cooled.

3. Water-gas and its accompanying producer-gas:—

Water-gas—	Calories.
17·5 of carbon = carbonic oxide, 40·83 × 2,400 =	97,992
Hydrogen from steam, 2·928 × 29,400.....	86,024
	<u>184,016</u>
Producer-gas—	
22·5 of carbon = carbonic oxide, 122·5 × 2,400..	294,000
Coal-gas, 16 × 10,000	<u>160,000</u>
	454,000
Sum of heating power of water-gas and producer-gas.	<u>638,016</u>

Heat in chimney-gases assumed to be of the same temperature as that when burning ordinary producer-gas.

779·7 × 377° × 24 S. heat = 70,547 calories = 11·05 per cent.

These figures intimate that each 100 units of the three kinds of fuel burnt there is afforded by—

Coal.....	83·93
Ordinary producer-gas.....	71·14
Water-gas and its producer-gas	78·80

Of course, it will be readily understood that these results are not given as effective; but the loss, at the same description of work, say for raising steam, being considered identical, the relative value of each is assumed to be as above stated.

In cases, however, where an intense temperature is required in order to do the work in hand quickly, water-gas may be highly advantageous. Some years ago I had an opportunity of seeing such an application at Essen in the welding of corrugated boiler tubes, and the work was admirably done.

A very important application of water-gas is mentioned, viz., for illuminating purposes. For this object the gas, itself destitute of any value in this direction, is made to heat filaments or stems of magnesia. These become so brightly incandescent as to vie, it is alleged, with the electric light, and in consequence, the water-gas is largely used in the United States, instead of coal-gas.

I have nothing to guide me in forming any trustworthy idea of the relative quantity of water-gas required in comparison with ordinary gas for a given amount of light. In the pamphlet already named, 9,000,000 tons of coal is given as the yearly consumption among gasworks in this country; and upon one occasion it was mentioned that a volume of coal-gas, which would require a 36-inch pipe for its transmission, might, in the event of water-gas being employed, be conveyed in one of 14-inch. If this be true, it means that water-gas, supposing the friction to be the same in each case, which is far from being the fact, is at least 810 times as powerful as coal-gas, which is probably a mistake.

A good deal of stress is laid on the application of water-gas to the manufacture of open-hearth steel. I doubt whether, in an operation where a more moderate heat suffices, it can be worth while to seek to obtain one of a more intense character. At one steel-work with which I am concerned, the ingots were formerly heated in Siemens furnaces. These were abandoned, and ordinary coal-fed fires used in their place, and the saving of fuel effected by the change has been very marked. I should, therefore, be somewhat surprised if, with longer experience, there will be found any material advantage in using the water-gas in open-hearth steel furnaces.

It would appear from the figures used for representing the relative values of ordinary producer-gas, compared with water-gas and its accompanying producer-gas, that the sum of the latter gives a better result than the former, viz. 78·80, as against 71·14. The difficulty, however, will be, when the richer gas is wanted, to find a market or use for the poorer, which, it must be remembered, represents 71 per cent. of the heating power of the whole. Looking at the question broadly, it seems clear that nothing can be gained in a calorific point of view by the proposed gasification of our fuel, and that to the loss in this respect has to be added a very sensible amount by the cost of this operation. This observation has reference to the general application of heat, and to that only. The limit, therefore, to the use of gaseous fuel will be the opportunities in which a more expensive form of intensely hot fuel like water-gas is wanted, and where to this extent there will probably be opportunities enough of utilising the producer-gas. For general use, however, I think solid coal is not likely to be superseded by any form of factitious gaseous fuel.

POSTSCRIPT.

Since referring to certain information concerning the manufacture of water-gas in Moravia, I have received from my friend, Mr. Paul Kupelwieser, the director of the establishment at Witkowitz, permission to use his name as my authority for certain statements contained in this communication.

I find I was in error in supposing that coal had been used in the generators, the fuel employed being small coke valued at 10s. per ton, whereas in a letter to our secretary it is given at 13s. 5 $\frac{1}{4}$ d. Coke (from gasworks) is also recommended to English water-gas makers; but if ever the day should arrive when, for heating purposes, gaseous has to take the place of solid fuel, and water-gas has to displace ordinary coal-gas, either raw coal must be employed in the generators, or the great waste of heating-power, already mentioned in coking the coal, must be incurred.

Mr. Kupelwieser properly observes that the cost of water-gas must largely depend on the value which is attached to the producer-gas, and he divides the expense in the following manner:—

	Florins.
29,734,731 cubic metres of producer-gas at '18 kreutzers per metre.....	53,522
6,041,155 cubic metres of water-gas at '673 kreutzers per metre.....	40,653
Total cost.....	94,175

Now, the total weight of combustible matter, viz., carbon, in the producer-gas is, by calculation, 5,898 tons, and its value, based on the price of the cubic metre, is 18s. 1 $\frac{3}{4}$ d. per ton.

The above quantity of water-gas is estimated to contain:—

	Tons.
Carbon	1,619
Hydrogen.....	270
	1,889 valued at 43s. per ton.

If we take 1,000 kilos. as being equal to one ton, the heat from this quantity of carbon, as it exists in the producer-gas, viz., as carbonic oxide, may be stated as representing (1,000 \times 5,600 calories) 5,600,000 calories.

This quantity of heat could be obtained by the combustion of 700 kilos. of carbon (700 \times 8,000) being 5,600,000 calories.

Now this carbon may be taken as probably equivalent to 800. kilos of the small coke, and costing therefore about 8s. against 18s. 1 $\frac{3}{4}$ d. for the same amount of heating power in the form of producer-gas.

The water-gas contains in 1,000 parts:—

	Calories.
857 of carbon, which \times by 5,600 =	4,799,200
143 of hydrogen " \times by 32,180 =	4,633,200
	9,432,400

To produce this quantity of heat from pure carbon we should require $\frac{9,432,000}{8,000} = 1,179$ kilos. of this substance.

If we assume this quantity of carbon to represent 1,350 kilos. of the small coke, this, at 10s., amounts to 13s. 6d., which appears capable of affording the same quantity of heat as 857 of carbon and 143 of hydrogen, costing 43s.

From what has preceded, I have calculated that if a given quantity of heat from coke burnt direct costs 100; that from water- and producer-gases, according to Mr. Samson Fox's estimate of 2s. 8d. for gasification, will be about 120, and, according to Mr. Kupelwieser's, of 13s. 2 $\frac{1}{2}$ d., about 200.

These calculations are my own, worked out upon the figures given by Mr. Kupelwieser, and they both tend to show how largely the cost of fuel was increased at Witkowitz by the process of gasification. This gentleman then goes on to observe that, according to his experience, gas obtained from coal in good producers gives perfectly satisfactory results in open-hearth furnaces, and that in nearly all cases such furnaces are worked more economically with ordinary producer- than with water-gas. At the same time he allows, that which I previously admitted, viz., that for some purposes water-gas may be profitably employed.

From another friend I learn that for each metre of water-gas, four metres of producer-gas have to be made. He would not consider it advisable to convert coal into gaseous fuel for the purpose of raising steam. The producer-gas obtained in manufacturing the water-gas is used in puddling furnaces and in heating large blocks of metal weighing as much as 50 tons. In the open-hearth steel furnaces a mixture of the two gases is employed, and for steel, intended for castings, this mode of treatment is considered very good, because the high temperature afforded by the water-gas, he says, enables the workmen to have the metal so fluid that it runs with ease into castings, however intricate.

(An abstract of the discussion on this paper will appear in the next number of this Journal.)

A New Form of Siemens Furnace, arranged to Recover Waste Gases as well as Waste Heat. John Heald, F.G.S., M. Inst. C.E., and P. Pouff, Ingenieur. A paper read at the Paris Meeting of the Iron and Steel Institute.

BEFORE referring to the special subject of this communication, and in order that it may be the better understood, it is necessary to call attention very briefly to the great advance which has been made in heating and metallurgical operations, as the result of the labours of the late Sir William Siemens and of Mr. Frederick Siemens in connexion with the regenerative gas furnace.

The first idea of applying the regenerative principle for industrial purposes appears to have occurred to the mind of the Rev. Robert Stirling in 1817, who, with his brother, James Stirling, invented a regenerative air engine bearing their name, which worked economically at the Dundee Foundry, and was found to be quite as efficient as the steam-engines of that day. They also foresaw the possibility of applying the regenerative principle to metallurgical furnaces. A more complete form of furnace of the same kind was devised in 1837 by Mr. J. Slater. According to this arrangement, as well as in the earlier form proposed by the Stirlings, only the air supplied to the furnace was to be heated, and solid fuel was intended to be employed. Neither of these proposals, however, led to any practical result, so that they can only be looked upon as mere philosophical ideas or suggestions. The same remark applies also to the later proposal of Mr. R. Laming, who, in 1847, took out a patent for a regenerative furnace embodying the then novel principle of first converting solid fuel into gas, to be burnt in a furnace in combination with air heated by means of the waste products of combustion. This was a further step in advance in furnace construction; but as Laming's invention was proposed for heating gas retorts, and coke was in consequence the fuel intended to be employed, the attainment of only a relatively low temperature was contemplated.

By the light of present knowledge, it is clear that none of these proposals were susceptible of useful application without considerable modification, and there is no evidence of any application of these furnaces having been made before the Siemens furnace was introduced; in fact, it is only recently that the existence of these earlier proposals to apply the regenerative principle to furnaces has been made known; and in spite of them, or perhaps on account of these proposals never having been carried out, Mr. Frederick Siemens and the late Sir William Siemens will ever be regarded as the true inventors of the regenerative gas furnace. They were the first to show, by means of philosophical reasoning, what really could be effected by the application of the regenerative principle to furnaces, and having a clearly defined idea in their own minds of the capability of the valuable apparatus with which they were dealing, they perfected that wonderful invention which may justly be said to have revolutionised the construction of furnaces for high temperatures.

Messrs. Siemens were the first to heat the gas as well as the air supplied to a furnace, utilising its waste heat for that purpose, and to provide for reversing the direction of the

flame in the furnace chamber whereby uniformity of heat and the highest temperatures are attained. They thus rendered possible the carrying out of processes which, until the introduction of their furnace, had only been foreshadowed by chemical research. The great economical idea embodied, and carried out in the regenerative gas furnace, is perhaps best illustrated by comparison with such a meritorious invention as Neilson's hot blast stove. In this case the temperature of the blast was raised by means of fuel separately burned for that purpose, but in the case of the Siemens regenerative gas furnace, the heat below the temperature of the work carried on in the furnace is impounded in the regenerators, and applied to heat up the gas and air supporting combustion. In high temperature furnaces, the heat below the temperature of the work to be performed therein is by far the largest proportion of the total heat produced, and previously to the introduction of the Siemens furnace this heat had been lost by being allowed to pass away with the waste gases to the chimney. This circumstance was clearly explained by Lord Armstrong at the meeting of the British Association at Birmingham in 1865. By heating the inflowing gas and air, the temperature of the flame in a furnace may be raised to almost any extent; in fact, the heat attainable under these conditions is only limited by the power of resistance of the materials of which the furnace is built, and thus the highest temperatures required in metallurgical operations are obtained with facility by the expenditure of a moderate amount of fuel, especially since the introduction by Mr. Frederick Siemens of the method of heating by radiation, by which means the durability of the furnace has been also much increased.

In considering the details of construction of this ingenious apparatus, it occurred to Mr. E. Biedermann and Mr. E. W. Harvey, who are on Mr. Frederick Siemens' technical staff (the former having entered the service of the late Sir William Siemens about thirty-four years ago), that possibly further economy in fuel might be realised by a re-arrangement of some of the parts of the regenerative gas furnace. Their attention was directed to the conversion of solid fuel into gas in the producer, and to the relatively high temperature at which the products of combustion passed from the furnace into the regenerators, as also to the chemical composition of these products, which temperature and gases they thought might be utilised in the gas producer.

In an ordinary gas producer the production of carbonic oxide is effected in two operations; on the grate carbonic acid is formed, in the ordinary course of combustion, and this carbonic acid is afterwards converted into carbonic oxide by taking up another equivalent of carbon, whilst passing through the incandescent fuel in the upper portion of the producer, and in this condition it flows on to the furnace with the other gases distilled from the coal during the process of gasification. It should be remembered, however, that the production of carbonic acid on the grate of the ordinary gas producer is attended with the development of heat; whereas the conversion of carbonic acid into carbonic oxide, in the upper portion, is carried on at the expense of heat.

In the new Siemens furnace, the gaseous products of combustion from the heating chamber of the furnace are delivered under the grate of the producer, these gases consisting of intensely hot carbonic acid, water in the gaseous state, and nitrogen, the production of carbonic acid in the producer may therefore be dispensed with; but in this case the heat attending the production of carbonic acid in the producer has also to be dispensed with. It had therefore to be ascertained whether the products of combustion from the heating chamber would contain a sufficient amount of heat for insuring their conversion into combustible gases. This has been found to be the case in practice with furnaces working regularly for the past six months—a satisfactory result that is probably due to the presence of a large quantity of heated nitrogen in the products of combustion, which, passing through the producer without undergoing chemical alteration, maintains the heat of the fuel. The economy of fuel resulting from the conversion of carbonic acid into carbonic oxide is diagrammatically illustrated by means of the accompanying sketch (Fig. 1) of a gas producer.

Assuming that the producer contains only coke in the incandescent state, this coke if fed with oxygen will produce carbonic acid in the lower zone, which will be converted into carbonic oxide in the upper zone; but if fed with hot carbonic acid, instead of oxygen, one-half the fuel, comprising the lower zone, may be dispensed with, and an economy in weight of fuel to the same extent will be realised.

The furnace about to be described must be clearly distinguished from that class of regenerative gas furnace before referred to as having been first suggested by Mr. R. Launing in 1847, where conduction air regenerators alone are employed. The latter form of furnace is necessarily wasteful in working, inasmuch as in theory it can only utilise about one-half of the total heat contained in the gases leaving the furnace chamber, this being the ratio of the air for combustion to the amount of gases made from coal entering the furnace, and in practice it would fall short of this saving, owing to the class of regenerator employed, in which the heat from one current to another had to be transmitted through brickwork. In the new Siemens furnace, on the contrary, the waste gases are directed, partly through an air regenerator, and partly under the grate of the producer, there to be reconverted into combustible gases, and to do the work of distilling hydrocarbons from the coal; in fact, the gas producer in this case absorbs or utilises the heat formerly deposited in the gas regenerators of furnaces; and in doing this transforms spent gases into combustible gases. It is held as an axiom, and the construction of the new furnace is based upon this consideration, that, besides air regenerators, gas regenerators, or their equivalent in the form of a converter producer, must be provided for absorbing all the heat contained in the gases leaving the furnace chamber. In the converter, the fuel absorbs the waste heat from a portion of the products of combustion leaving the furnace, and at the same time carbonic acid and water-vapour are converted into carbonic oxide and hydrogen. Disregarding the small proportion of water-vapour they contain, the products of combustion from a furnace may be taken as consisting of:—

CO₂, 17 per cent.; O, 2 per cent.; N, 81 per cent.

The 17 per cent. of CO₂, also the 2 per cent. of O, are converted into CO, whilst the nitrogen simply passes through the fuel without change, and serves the useful purpose of maintaining its heat for the conversion of the other gases.

For the propulsion of the gases through the converter, a steam blast is employed. This steam is superheated by the waste gases from the furnace, and mixing with them, forms a very hot blast indeed under the grate. The annexed diagrams (Figs. 2 and 3) show the relation which exists between the ordinary and the new type of Siemens furnace. As will be seen by examining them, the function in both is the same. In the first case, the waste gases are partly directed through two regenerators, while, in the second case, the waste gases are partly directed through an air regenerator and partly through a converter producer. In both cases the waste heat from the furnace is entirely utilised, and the gas and air reach the furnace in an intensely heated condition. In both cases, again, there is a reversal of the direction of the flame in the furnace, which ensures uniform heating of the furnace chamber and the materials contained in it.

This furnace may be constructed in various forms, the one shown in the accompanying diagrams (Figs. 4—8) having been used with success for heating and welding iron. It is a radiation furnace, heated by means of a horseshoe flame; this form of flame offers advantages in this as in ordinary regenerative gas furnaces, but its adoption is not obligatory, as the flame may be made to traverse the heating chamber from end to end in the usual manner. The same letters indicate the same parts in all the figures. AA' are reversible regenerators for air, on the top of which is built the gas producer or converter B, of which FF' are the charging hoppers and XX' the grates. The heating chamber E adjoins the producer resting on the ground, or in some cases a pit may be provided below it. CC' are the flues leading the combustible gas to the furnace chamber E, the passage of the gas in these flues being controlled by the valves DD' at the two ends of a rocking-

beam, so that the outlets are opened and shut alternately to convey the gas to one or other of the ports GG¹ of the heating chamber E. HH¹ are the air ports of the heating chamber, communicating through the flues KK¹ with the regenerators AA¹. II¹ are steam jets placed in the return flues for directing a portion of the waste products of combustion to the grates of the converter. J is the valve for reversing the direction of the air flowing into the furnace, and of the products of combustion through the regenerators to the chimney flue. OO¹ are hinged caps for alternately admitting and shutting off the products of combustion from the heating chamber to the converter. These caps are worked automatically by means of connexions attached to the rocking beam, the same movement which closes D opening O¹, and that which closes D¹ opening O. Qq are doors for giving access to the grates of the converter for clearing them.

The *modus operandi* of the furnace is as follows:—Gas from the converter B passes through the flue C¹ and the valve D¹ to the gas-port G¹, and into the combustion chamber h¹ g¹. Air for combustion passes through the regenerator A¹, the air-flue K¹, and the air-port II¹ into the combustion chamber, where it meets the gas from the converter, and combustion ensues. The horseshoe flame sweeps round the heating chamber E, the products of combustion passing away by the second combustion chamber h, g, and going partly through the regenerator A, and reversing valve J into the chimney flue, and partly down the flue G, whence they are drawn by means of the steam jet I through the capped inlet L under the grates XX¹ of the producer B, there to be converted into combustible gases. From time to time the direction of the flame in the furnace is reversed by manipulating the rocking beam, carrying the valves DD¹, and the reversing valve J in the usual manner of working regenerative gas furnaces. An auxiliary steam jet is provided for the purpose of supplying

atmospheric air to start the producer, when the furnace is first heated up.

The new form of regenerative gas furnace has been applied in this country to the heating and welding of iron, to which uses its application is being extended in England and abroad, whilst furnaces are in course of construction to apply it for puddling iron and for copper and steel melting. Altogether ten furnaces for these purposes are in course of construction, in addition to two furnaces already at work for heating iron.

The first furnace of this kind was constructed at the Pather Iron and Steel Company's Works at Wishaw for welding iron, and much credit is due to the proprietors for having had the enterprise and public spirit to make the first application of this improved regenerative gas furnace. The working has been eminently satisfactory from the commencement. The success of this first application of the furnace proves the correctness of the principle upon which it is constructed, and the means adopted for carrying it out.

The results of working during the past six months have shown an average saving of 5 per cent. in waste on the weight of the iron heated, and a saving of upwards of two-thirds of the weight of coal used, and a greater money-saving, owing to the inferior quality of the fuel employed as compared with that used in their other furnaces fired with solid fuel. From the total saving thus realised should, however, be deducted the cost of raising steam, for which purpose the waste heat of the old furnaces is utilised. Allowing for separate boilers, the saving effected by the use of the new system in a furnace heating eight tons of iron per shift is nearly 18 tons of coal per week, and the money-saving in iron and coal exceeds 1,000*l.* per annum.

This new furnace has also been recently applied for heating billets by the United Horse-Shoe Company, of London, and in this case the results are quite as satisfactory or even better than those just given, as is shown by the accompanying table:—

Date.	Number of Charges per Shift.	Duration of each Shift.	Average Time required for Heating to Welding.	Weight of Billets Heated (30" × 2½" × 2½").	Coal.		
					Weight Used.	Used per Ton of Billets.	Quality.
1889, Sept. 13	11	A.M. P.M. 5.45 to 5.25	21	Tons. Cwt. 8 16	Cwt. 17½	Cwt. 1.9	Newcastle small.
Sept. 14	6	6.0 to 12.15	20	4 16	8	1.7	Newcastle cobbles.
Sept. 16	11	5.45 to 5.30	21	8 16	17½	2.01	{ ½ Newcastle small. ½ London screenings.
Sept. 17	11	5.45 to 5.30	26	8 16	18½	2.03	

It will be noticed from these results that in this furnace 11 charges are made in less than 12 hours, each weighing about 16 cwt., and yielding in the finished state as horseshoe iron 15 cwt., per charge, or 8.25 tons in the day. The amount of small coal used was about 18 cwt. per shift. This is equivalent to $\frac{18}{8.25} = 2$ cwt. per ton of iron heated, which, it will be admitted, is a most satisfactory result; in one case the consumption of coal was even reduced to 1.7 cwt. per ton, each billet coming out at a full welding heat and rolling into a sound bar. The coal used each day is indicated in the table.

The following are analyses of gas made in the converters at Pather and in London respectively:—

PATHER CO., from Wishaw Coal (nuts).		UNITED HORSE-SHOE CO., Newcastle Cobbles.	
CO ₂	4.6	CO ₂	4.5
O	nil	O	nil
CO	23.0	CO	22.5
H total	17.4	H	16.3
C vapour	1.5	CH ₄	2.6
N	53.5	N	54.1
	100.0		100.0

From these analyses it will be seen that the proportion of CO₂ in the gas made in the converters is not greater than that made in the ordinary Siemens producer.

Besides the advantages in the saving of fuel and metal, it is desirable to call attention to the simplicity of design of the new furnace, owing to which its cost of construction is not much greater than that of a solid-fuel furnace, while its cost of maintenance is very much less. The cost of construction of the new furnace is found to be about two-fifths of that of the old form of regenerative gas furnace of the same productive capacity, with separate gas producers and gas regenerators, and the space occupied below ground is also considerably reduced.

A saving of labour attends the employment of the new furnace, as, owing to the producer being connected with the furnace, the same men can attend to both, and the labour of firing is reduced in proportion to the reduced consumption of fuel.

In conclusion, the following advantages may be claimed for the new furnace, as compared with solid-fuel furnaces used for heating and welding iron, viz.:—

A saving in fuel, amounting to, say, two-thirds in weight, after allowing for raising steam in separate boilers, this saving being fully equal to 5 cwt. of coal per ton of iron heated.

A reduction in the waste of iron equal to 5 per cent. upon the weight of metal heated.

A saving in labour and repairs which will probably compensate for the extra cost of the new furnace.

NEW FORM OF

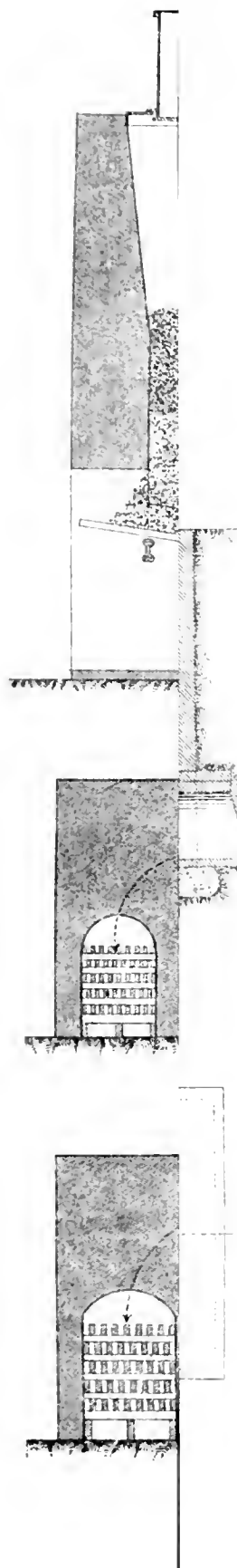


Fig. 6.

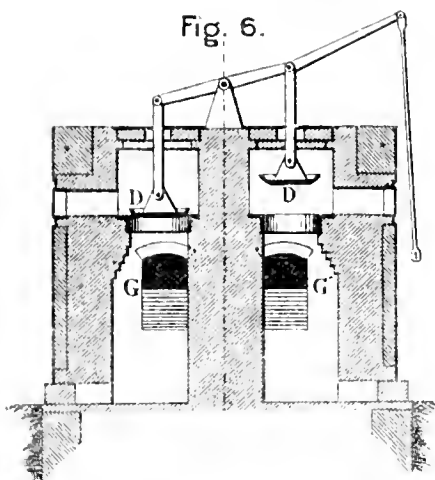


Fig. 7.

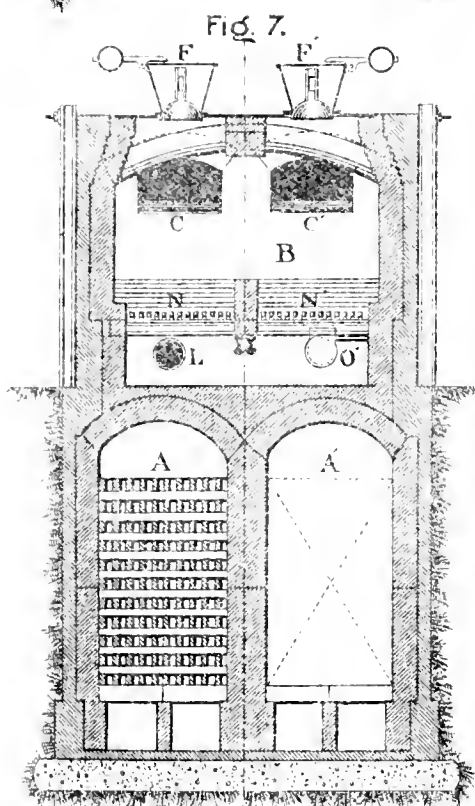
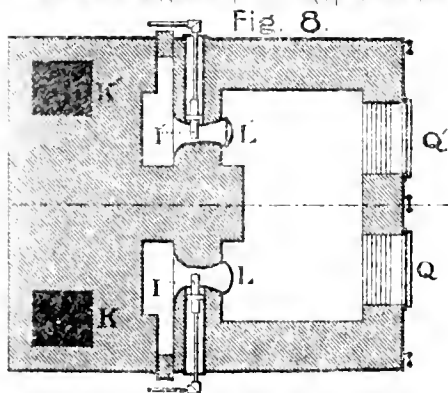


Fig. 8.



TO ILLUSTRATE MESSRS. HEAD AND POUFF'S PAPER ON "NEW FORM OF SIEMENS FURNACE."

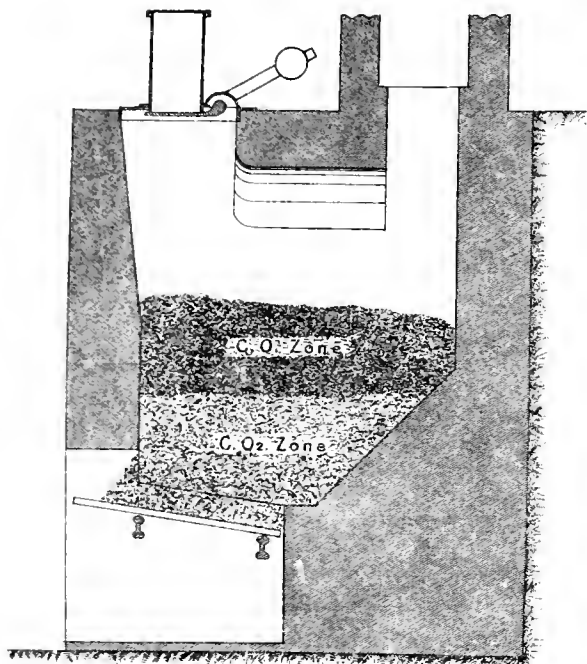


Fig. 1.

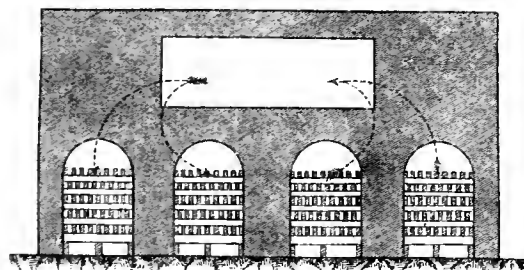


Fig. 2.

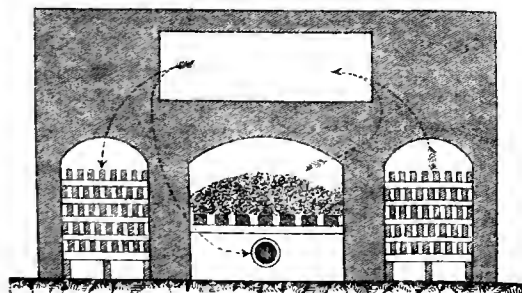


Fig. 3.

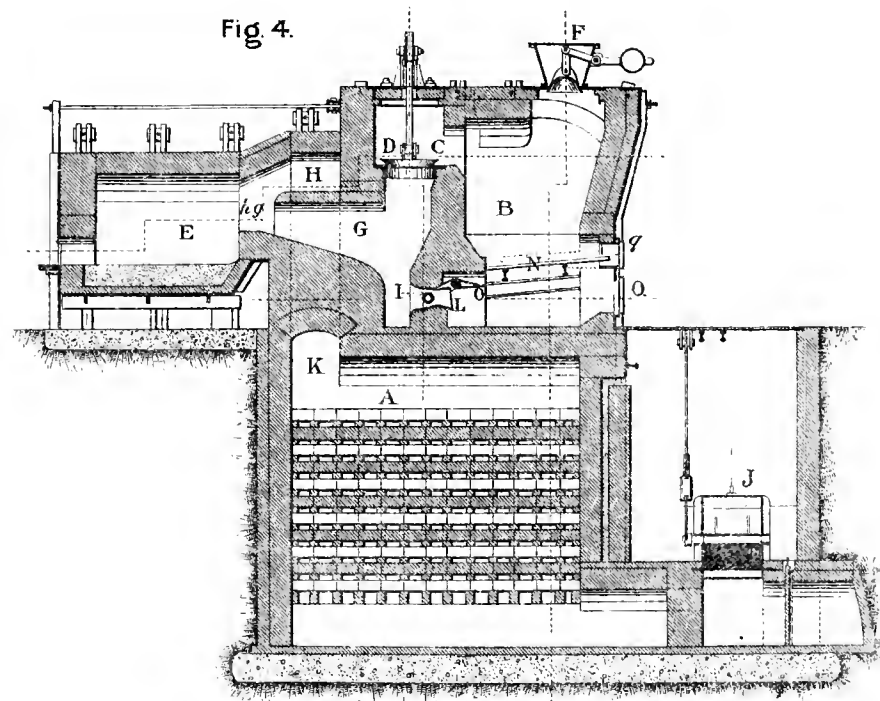


Fig. 4.

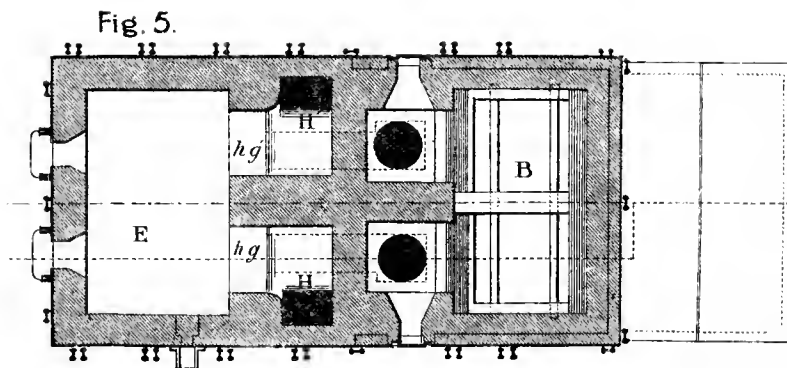


Fig. 5.

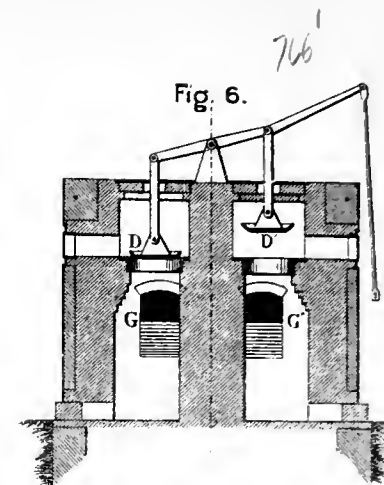


Fig. 6.

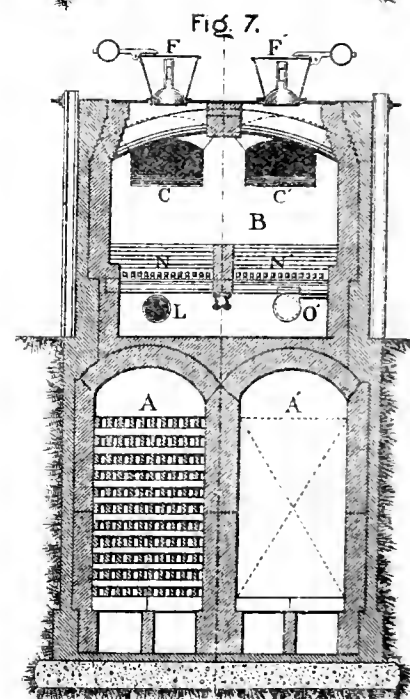


Fig. 7.

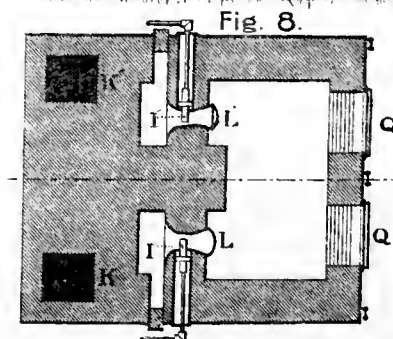


Fig. 8.

Taking a furnace to heat 10 tons of iron per shift, or 110 tons per week, the following calculation gives the money saving realised by the adoption of the new furnace:—

	£	s.	d.
110 tons iron at 5 cwt. per ton = 27½ coals saved at 6s.	8	5	0
110 tons iron at 5 per cent. = 5½ tons iron at 4l.	22	0	0
Being	30	5	0

per week, or say, 1,500l. per annum.

It may be added that the authors had hoped that the application of this furnace to the attainment of high temperatures, such as are required for steel melting, might have been included in the paper, but the furnaces building for this purpose are not yet completed. Should they, however, be working when the paper is read, information with regard to them will be given in the discussion.

PATENTS.

Improvements in Apparatus for Mixing Gases and for Regulating or Controlling the Pressure or Flow thereof. H. T. Hillischer, Vienna, Austria. Eng. Pat. 9150, June 28, 1888. 8d.

To counteract the differences of pressure caused by the varying height of the gas-holder, the inventor employs a running weight dipping in water and of the same sectional area as the dipping portion of the gas-holder. To regulate the supply of a gas under pressure the said gas is admitted by two openings into a cylinder carrying a hollow piston pressed downwards by a spring. One of the openings is entirely below the piston; the other communicates with its interior by a corresponding hole in the piston itself. It will be seen that the greater the pressure of the gas supply, the higher the piston will be forced against the spring, and the more constricted will become the communication between the upper gas inlet and the interior of the piston. The piston rod is also hollow and constitutes the gas outlet. An apparatus for further regulating the mixing of gases consists of a hollow plug formed at the end of a pipe and having two openings, which can be made to communicate in varying proportions with two corresponding openings in the plug casing. Drawings are appended.—A. R. D.

Improvements in or Relating to obtaining more Perfect Combustion in Steam Boiler or other Furnaces and Flues and in Apparatus thereof. A. Francis, Liverpool, and E. Manbré, Garston. Eng. Pat. 11,173, August 2, 1888. 8d.

At various points in the fire flue, jets of compressed air are made to play in a direction opposite to the flow of the gaseous current.—A. R. D.

Improvements in and Relating to Gas and Air Reversing Valves for Regenerative, Smelting, and other Furnaces or Purposes. J. Jardine, Motherwell, and J. Ferguson, Pollokshields. Eng. Pat. 12,318, August 27, 1888. 11d.

This specification is unsuited for useful abstraction. It is accompanied by three sheets of drawings.—A. R. D.

Improvements in Apparatus for Naphthalising or Carburetting Illuminating and other Gas. H. S. Maxim, London. Eng. Pat. 12,518, August 30, 1888. 8d.

The carburetter consists of a chamber fitted with trays, one above another, to contain the carburetting liquid, over-flow arrangements being provided at the periphery and centre alternately. The hydrocarbon is stored in a tank over the carburetter, and the supply is automatically controlled by a valve actuated by the rise or fall of a float situated in the lower portion of the chamber below the trays. The carburetter also contains a system of heating pipes for promoting the evaporation of the hydrocarbon as desired. The apparatus includes a density regulator, consisting of a drum suspended by a spiral spring in a chamber through which the carburetted gas passes on its way to the burners. The bottom part of this chamber is

also connected with the pipe supplying the yet uncarburetted gas by an opening into which fits a plug suspended from the float. When the gas is being over-carburetted, the increase of density causes the float to rise, which, raising the plug with it, admits a diluent in the shape of uncarburetted gas.—A. R. D.

Improvements in obtaining Hydrogen. L. Mond, Northwich, and C. Langer, London. Eng. Pat. 12,608, September 1, 1888. 8d.

If carbonic oxide or gaseous hydrocarbons be brought into contact with metallic nickel at a temperature of 350°—400° C., or with metallic cobalt at 400—450° C., decomposition takes place into carbon and carbonic acid or hydrogen, the carbon combining with the metal. If now steam, at a moderate temperature, be introduced, this carbon combines with oxygen to produce carbonic acid, with simultaneous formation of free hydrogen. These various reactions take place simultaneously when the steam is passed through the apparatus along with the carbonic oxide or hydrocarbon, the ultimate products being carbonic acid and hydrogen. The former can be eliminated by any suitable means, such as by washing with milk of lime. The cobalt or nickel surfaces may be obtained by impregnating pumice stone with a solution of the metal, and reducing.—A. R. D.

An Improved Manufacture of Artificial Fuel and other Moulded Blocks, and Apparatus employed therein. T. L. J. Quemesson, Chauny, France. Eng. Pat. 13,066, September 10, 1888. 11d.

The main feature of this invention is the employment of potters' clay or other plastic earth as the agglomerative agent in the manufacture of moulded blocks. Pitch, tar, resin, &c., may be used as well, but only to increase the combustible qualities of the artificial fuel. The specification also describes and illustrates a set of machinery suitable for forming fire-lighting briquettes.—A. R. D.

Improvements in Apparatus for the Purification of Gas. W. Kusnezoff, St. Petersburg, Russia. Eng. Pat. 13,074, September 10, 1888. 6d.

This apparatus consists of a rectangular metallic casing, divided by a horizontal partition into two compartments, communicating with each other by a vertical duct. The lower one is filled with vertical partitions crossing one another at right angles, forming a large number of vertical channels communicating with each other alternately at the top and the bottom. The upper compartment is also provided with a number of vertical partitions, but these are so disposed as merely to form a serpentine passage for the gas. The upper chamber is filled with water to one-third of its depth. Water stands in the lower chamber also, but not at such a depth as to interfere with the communication between the vertical channels. The apparatus is specially adapted for purifying gas made from crude petroleum.—A. R. D.

Improvements in the Reversing and Regulating Valves of Regenerative Gas Furnaces for Steel Melting and other Analogous Purposes. T. Beardmore, Bothwell. Eng. Pat. 13,770, November 1, 1888. 8d.

The valve is cylindrical with the lower extremity cut away at an angle of about 45°. Both valve and valve-casing have double walls, between which water is made to circulate. For details the drawings which accompany the specification must be consulted.—E. E. B.

Improvements in Producing Water-Gas, and in Apparatus therefor. G. H. Lloyd, Sutton Coldfield; A. L. Lloyd, Leamington; H. Bewlay, Moseley; and W. Seddon, Birmingham. Eng. Pat. 2216, February 8, 1889. 8d.

These improvements have reference to the ordinary process of making water-gas, i.e., by first raising a mass of fuel to incandescence with an air-blast, and then passing steam through the said mass. The producer-gas evolved during the first operation is caused to burn in a tubular-shaped combustion chamber, and then pass through an ordinary regenerator,

which is employed to superheat the steam required for the second operation. By employing a separate combustion chamber there is much less risk of trouble and damage, such as often occurs when combustion takes place in the regenerator itself. The air required for combustion is caused to pass through channels in the brickwork of the chamber, previous to its admission into the latter, at the end farthest from the regenerator.—A. R. D.

Improvements in Gas Producers, Apparatus and Appliances connected therewith, for the Manufacture of Water-Gas and other Gases. W. Deighton, Leeds. Eng. Pat. 6567, April 17, 1889. 8d.

ADJACENT to the producer is situated a space or chamber into which the water-gas is drawn as formed. This chamber may serve not only as a collecting space for the water-gas, but also as a supplementary superheater for the air supplied to the producer. The underside of the producer cover is provided with a kind of water-jacketed retort, through which the fuel is supplied, and where its volatile constituents are distilled off before it is let down into the producer proper. Suitable arrangements provide for the recovery of the tar, ammonia, &c. One of the claims refers to an improved regenerator. This consists of a chamber packed with checkered brickwork, but having a space left for a series of pipes also, through which pass the air and steam required, while the producer-gases play through the checkered brickwork.—A. R. D.

Improvements in the Manufacture of Hoods or Mantles for Burners used in Incandescent Gas-lighting. L. Paget and C. I. Kintner, New York, U.S.A. Eng. Pat. 6805, April 23, 1889. 6d.

THE improvements consist in electrically heating a metallic base or support immersed in a solution of a suitable oxide. The electric current is said to cause an expansion of the pores of the metal, and thus effect an absorption of the oxide. If desired the metallic base may be heated before immersion, and by other means than electrical. In this case the alternate heating and dipping are repeated till the required coating is obtained.—A. R. D.

Improvements in and relating to Machines or Apparatus for Manufacturing Gas. W. Clark, Philadelphia, U.S.A. Eng. Pat. 9288, June 4, 1889. 11d.

THE apparatus herein described is intended to produce a mixture of water-gas and ordinary coal-gas. Coal is carbonised in retorts sloping downwards from the front so that the resulting coke may be pushed backwards into a chamber, whence it passes directly to a generator to be converted into water-gas. The producer-gas obtained during the "blowing up" of the fuel is employed to heat the retorts externally, while the water-gas is allowed to pass through the interior of the retorts and mingle with the coal-gas evolved there. To secure regularity in the process it is preferred to have two sets of retorts and two water-gas producers.—A. R. D.

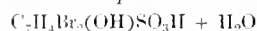
Improvements in Manufacturing Gas. A. J. Boulton, London. From W. G. Wood, Windsor, Canada. Eng. Pat. 10,256, June 24, 1889. 8d.

A CYLINDRICAL generator is filled with alternate layers of iron filings, zinc turnings, sulphate of copper crystals, and sponge. Dilute sulphuric acid and a suitable liquid hydrocarbon are then introduced, and a gentle current of air is caused to bubble through the apparatus from the bottom. The resulting mixture of carburated air and hydrogen is well adapted for both heating and illuminating purposes. It is advantageous to allow an electric current to circulate through the contents of the generator as the evolution of hydrogen is thereby promoted, and any sulphur that may be present in the hydrocarbon is prevented from passing over into the gas.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

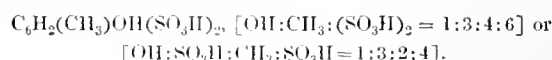
Meta-Cresol. A. Claus and A. Dreher. J. Prakt. Chem. 39, 366—373.

METACRESOLPARASULPHONIC acid treated with 1 mol. of bromine to 1 mol. acid yields a monobromo-compound; if in the proportion of 3 to 1, pure tribromo-cresol is formed. The authors, by using 2 mols. to 1 mol. acid, obtained diorthodibromometacresolsulphonic acid—



crystallising in white lustrous plates melting (anhydrous) at 170° (uncorr.) soluble in water and less so in alcohol.

The potassium, barium, copper, silver, nickel, and lead salts are described. The structure of the acid, i.e., the position of both bromine atoms in the ortho-position with regard to the hydroxyl group is proved beyond doubt by the oxidation of the acid to 2:6 dibromotoluquinone melting at 115° (uncorr.). A second metacresolsulphonic acid is obtained, distinguished by its crystallisation, from which an acid potassium salt is prepared by the action of bromine. This reaction points the formula for *m*-cresol-*o*-*p*-disulphonic acid showing—



—D. A. S.

Ozokerite and Petroleum in Galicia. Annales des Mines.

Ozokerite.—The deposits of ozokerite at Boryslaw were recently described by A. Kateau (*see abstract*, Vol. XXVII., pp. 55-56). In an area of about 250 acres, divided among about 1,200 owners, there are from 12,000 to 13,000 pits, of which about one-tenth are now working. The pits are from 3 to 8 yards apart, and each works an area of from 9 to 61 square yards. The pits are square, and ordinarily have a section of about 10 square feet, and when they encounter a vein or bed of ozokerite, a drift is driven on it, if possible into the adjoining property, until it closes by a fall.

The produce is drawn by a jack roll worked by a man or woman. The mortality from accidents is about 2 per cent. per annum.

Great danger arises from inflammable gases, which are inclosed in the strata under great pressure. Mueseler or Marsant lamps are in universal use.

The produce is either pieces of nearly pure ozokerite or earths rich in ozokerite. After the pieces of pure ozokerite are picked out by women, the earths containing 8 per cent. are treated with cold water, and the ozokerite separates, owing to difference of density. After this washing, the earths containing 4 to 5 per cent. are placed in casks and boiled with water, the ozokerite floating to the surface at a temperature of 212° F. It is proposed to treat the residue containing from 1 to 1½ per cent. of ozokerite with benzine, so as to remove the last traces, and remove the benzine by means of steam heating.

The pure ozokerite is melted and run into loaves weighing about 1 cwt. The cost of washing, &c., is about 18 cents per cwt.

Details are given as to cost of working, &c. In 1886, the selling price was from 100 dols. to 125 dols. per ton, and cost of production from 65 dols. to 75 dols., leaving a profit of from 25 dols. to 50 dols. per ton.

The annual production has varied from 4,000 to 18,000 tons, and in certain years the value has exceeded 1,800,000 dols.

Other deposits of ozokerite are found at Truskawiec, Starunia, and Dwniaez, always in Miocene formations.

Petroleum.—The most celebrated petroleum region of the Carpathians is at Slobodarungurska, about three miles from Kolomen. It is probable that oil issues from Eocene formations, although certain geologists consider that they are of Miocene age. The workings are concentrated in a clearing, in the bottom of a valley, and surrounded by the State forests.

Beneath the alluvial deposits of sandy clays, the boreholes traverse a series of beds of shales and sandstones, dipping toward the south-west. The sandstones are the only beds impregnated with the petroleum, and down to a depth of 300 yards there are three of these oil-bearing horizons; the petroleum is also found in the faults.

The mining area covers about 800 acres, and all pits sunk to a certain depth in this area are productive. The oil is worked by means of boreholes, which were first made by hand labour, but the Fabian and Canadian systems of boring are now universally adopted (full details are given of these two systems).

The mean produce of a well is from 25 to 30 barrels per day, and the life of a well is about two years. The holes are usually not less than 20 yards apart. The total production of a well is from 15,000 to 20,000 barrels. The annual production of the district is about 750,000 barrels.

The densities of the oils diminish in depth; when shallow it may be 38°, with 6 per cent. of paraffin; at some depth it may be 35°, with only 1 per cent. On distillation the oil yields—

Benzine	22
Lighting oils	56 to 60
Paraffin	1 to 6
Residues and loss	12

The royalty paid to the owner of the oil is usually 50 per cent. of the produce. The price of a barrel is about 2.50 dols. and in a well with an average output and duration, the gross produce will be worth from 37,500 dols. to 50,000 dols. The cost of boring (9,250 dols.), maintenance for two years (925 dols.), attendance (4,400 dols.), and sundry charges (1,925 dols.), may be estimated at 16,500 dols.

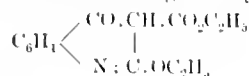
The royalty at 50 per cent. will vary from 18,750 dols. to 25,000 dols., and the net profit from 2,000 dols. to 8,500 dols.

IV.—COLOURING MATTERS AND DYES.

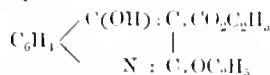
Quinoline Derivatives from Orthonitrobenzoylmalonic Ether.
C. A. Bischoff. *Annalen*, **251**, 360—384.

The author gives two improvements in the preparation of *o*-nitrobenzoylmalonic ether already described (Ber. **17**, 2796). The first consists in estimating exactly the amount of *o*-nitrobenzoylchloride contained in the raw product, by precipitating from the latter any *o*-nitrobenzoic anhydride with ether, weighing this and then calculating the amount of malonic ether (1 mol.) and sodium ethylate (2 mols.) necessary to combine with the chloride remaining dissolved in the ether. When the condensation is complete, the ether and alcohol are distilled off and the malonic ether crystallises out on the addition of dilute hydrochloric acid. The second improvement provides for the separation of the potassium salt from the oily mother-liquors of the crystals of the malonic ether by the addition of strong potash solution. The potassium salt, $\text{NO}_2 \cdot \text{C}_6\text{H}_4 \cdot \text{CO} \cdot \text{CK}(\text{CO}_2\text{C}_2\text{H}_5)_2$ crystallises from alcohol in small orange-yellow nodules, and when dissolved in water and precipitated with cold hydrochloric acid yields the ether melting at 54°. The addition of ferric chloride to a solution of the ether in alcohol gives a blood-red colour, and on adding water a brick-red powder separates which is decomposed by acids into the original ether. An aqueous solution of the potassium salt gives precipitates with solutions of most metallic salts. By reducing the ether or its potassium salt with zinc dust and acetic acid at 100°, saturating the solution with sodium carbonate, filtering, neutralising with hydrochloric acid and evaporating in a vacuum, crystals of pure dihydroxyquinoline were obtained of which the properties will be described later. By passing hydrochloric acid gas into a cold solution of the ether in alcohol, together with slips of zinc, it was

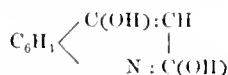
possible by fractional crystallisation to obtain a substance melting at 170°, which according to analysis was the body—



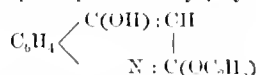
or more probably—



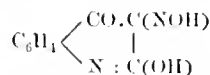
α-ethoxy-*γ*-hydroxy-*β*-quinoline carboxylic acid. The substance crystallises from alcohol in thin colourless needles, dissolves in ether and benzene, but is insoluble in water. In a dilute solution it gives a violet colouration with ferric chloride. No other product with a sharply-defined melting point was isolated in the reaction. The substance obtained from the mother-liquor commenced to melt at 139° and finally fused between 147°—150°. By altering the conditions of reduction a number of by-products were formed, the principal fractions melting at 150°, 163°, 167°, and 175°. Although these all crystallise in well defined forms, the author considers them as a mixture of substances of which the most stable decomposition product is dihydroxyquinoline. The preparation of this body is performed as follows:—20 grms. of *o*-nitrobenzoylmalonic ether are dissolved in 200 grms. of 96 per cent. alcohol, 208 grms. of hydrochloric acid of sp. gr. 1.16 are added, and finally 107 grms. of tin. The whole is then heated on the water-bath until the reduction is complete, evaporated and precipitated with water. The tin salt thus obtained is freed from tin by sulphuretted hydrogen in an alcoholic solution which, after filtering, yields dihydroxyquinoline on adding water. The substance has the constitution—



does not melt at 320°, and is identical with that prepared by the action of concentrated sulphuric acid on *o*-nitro-phenyl-propionic acid (Bayer and Bloem, Ber. **15**, 2151), and also by fusing *γ*-bromo- or chloro-carlostyrl with potash (Friedländer and Weinberg, Ber. **15**, 2683). In the preparation just described a small quantity of *α*-ethoxy-*γ*-hydroxyquinoline—

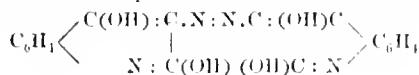


is formed. This crystallises in colourless needles melting at 228°, and is not coloured by ferric chloride. If dihydroxyquinoline be dissolved in cold concentrated sulphuric acid and sodium nitrite solution slowly added a nitroso-derivative is formed which is identical with the oxime obtained by the action of hydroxylamine hydrochloride on quinisatin and having the formula—

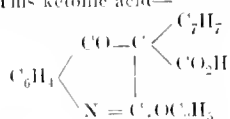


(Bayer and Homelka, Ber. **17**, 985).

When the oxime is treated with ammonia in an alcoholic solution, it turns green, and if this solution be warmed with alcoholic ammonium sulphide, the colour changes from pure blue to bluish-violet, then to a deep violet, and finally a brown powder separates. These solutions dye wool or silk dull bluish-violet shades, which are destroyed by acids. The violet solution is the most stable, and when it or the blue solution is evaporated in a stream of carbonic acid, a vermilion-red powder is formed. This can also be obtained by adding strong acetic acid to the violet solution, when a brown powder separates, which is transformed into the red by boiling with ammonia and precipitating with acetic acid. It was purified by treatment with dilute caustic soda, in an excess of which it is insoluble, acetic acid, and water, and finally washed with alcohol and ether, and gave numbers on analysis which corresponded to the formula—



The substance is a colouring matter, and a solution of its sodium salt dyes unmoirated cotton bright orange-yellow tolerably fast to acids. It is decolourised by stannous chloride. The author also mentions that a number of blue compounds may be prepared from dihydroxyquinoline. Their constitution has not yet been determined, but they are probably not allied to indigo, but are supposed to be metallo-organic compounds. He proposes to study the action of nitric acid on dihydroxyquinoline, by which a nitrodihydroxypyridine carboxylic acid is formed, and, further, the reduction of mono-substituted nitrobenzoyl-malonic ether is also to be investigated. By reducing benzyl-nitrobenzoyl-malonic ether, among other substances, an acid is obtained as a yellow flocculent precipitate, which melts at 147°. This ketonic acid—



is to be converted into a β -benzylated quinoline derivative.

—T. A. L.

The "Resinate" Colours. A. Müller-Jacobs. Dingl. Polyt. J. 273, 139—142.

SOME further particulars are given regarding the colour-lakes and varnishes patented by the author (see this Journal, 1887, 138). The lakes are prepared by dissolving 100 parts of pale-coloured resin in a solution of 33 parts of soda crystals in 1,000 parts of water. The mixture is boiled for an hour, after which it is cooled down to about 50° C. by the addition of 1,000 parts of cold water, and then the filtered solutions of such basic dyes as magenta, methyl-violet, brilliant green, auramine, &c. are added. The amount of dye used depends on the depth of shade desired, and varies between 5 and 15 per cent. on the amount of resin. The resin-soup solution must be of the right temperature and degree of concentration when the addition of dye is made, so as to avoid the separation of the colour-bases in the form of resinsates. A slight excess of a dilute solution of a metallic salt is added; in the case of zinc sulphate, 55 parts, dissolved in 1,000 parts of water, are used for the above quantities of resin, &c. The solutions of magnesium salts must be very dilute, since, otherwise, the lake becomes resinous on drying.

The lakes, which are not to be used in the paste form, are thoroughly dried at a temperature of 40° to 50°, or 70° in the case of magnesium lakes. The dried lakes are of an exceedingly fine bright colour. They are not affected by air or moisture, and boiling water fails to extract colouring matter. Weak alkalis and acids are also without action, and strong solutions of hypochlorites act very slowly on them, provided that light is excluded, but, in presence of light, oxidising agents act rapidly. Their solubility in alcohol depends upon the nature of the combined metallic base; magnesium lakes dissolve easily, calcium and barium lakes fairly easily, aluminium and iron lakes only slightly. Benzene, ether, chloroform, light petroleum, and other solvents dissolve them easily. Some of the lakes, those of aluminium for instance, are decomposed when their solutions are kept for a little time, the metallic base separating, but others, such as those of zinc and calcium, keep indefinitely. They resist light fairly well. Lakes made with brilliant green resist badly, but those coloured with auramine, methyl-violet, safranine, chrysoidine, and particularly rhodamine, resist very well. The colours bleach more easily when in combination with aluminium and chromium than with zinc and magnesium.

The action of light renders the lakes insoluble in benzene, liberating the colour-base, which may be extracted with hot water. The solutions of the lakes form good varnishes, whose elasticity and power of endurance are increased by the addition of a little india-rubber or gutta-percha. The following is an example of such a varnish:—30 parts of magnesium lake are dissolved in 80 parts of benzene and 20 parts of chloroform, and the solution obtained mixed with 150 parts of a clear solution of 1½ per cent. of india-rubber in chloroform and benzene.—E. B.

Quercetin and its Derivatives. J. Herzig. Monatsh. Chem. 10, 561—567.

LIEBERMANN and Hörmann obtained from Persian berries a glucoside which they considered to be pure Xanthorhammin. Were this the case, by treatment with acid the glucoside should be split up into isodulcite and rhamnetin, whereas the author finds that on decomposing that substance with acid, and preparing the acetyl derivatives of the dyes which separate, there is sometimes considerable divergence in the properties and composition of the latter from those of acetyl-rhamnetin. The composition of the new acetyl derivative lies between that of acetylquercetin and acetyl-rhamnetin. Now on saponifying the first-mentioned acetyl derivative it is split up into rhamnetin and quercetin, which are readily separated by alcohol, in which the latter is more soluble than rhamnetin.

Persian berries, therefore, contain either the glucoside of rhamnetin or a molecular combination of the glucosides of rhamnetin and quercetin, and this would explain why Schützenberger assumed the presence of two different glucosides in Persian berries which he named α - and β -rhamnin. The author proposes to call the real glucoside of rhamnetin xanthorhammin, and the double compound rhamnin.

Instead of macerating the berries before extracting with alcohol it is better to crush them gently in a mortar, then to filter through a narrow wire-gauze sieve, which retains the seed husks. These latter alone may then be extracted with alcohol, which greatly simplifies the operation. The yield is equally good as if the entire berries be taken, for the glucosides are not contained in the liquid which drains off.—A. R.

PATENTS.

Improvements in the Manufacture of Alpha-Naphthol-Disulpho Acid, and in the Production of Colouring Matters therefrom. H. H. Lake, London. From Leonhardt & Co., Mulheim, Germany. Eng. Pat. 11,318, August 18, 1887 (Reprint). 6d.

HITHERTO no disulphonic acid of α -naphthol has been prepared in a pure state, and the first part of this patent describes the preparation of such an one. One part of α -naphthol is heated with 2—3 parts of ordinary sulphuric acid of 65°—66° B. (containing about 93 per cent. H_2SO_4) for two hours to 125°—130°. The new acid is readily soluble in concentrated sulphuric acid, and is unaltered by boiling with dilute sulphuric acid (H_2SO_4 aq. = 1:3). Its salts are very soluble, and do not crystallise well. When combined with diazo-compounds, it forms colouring matters of orange, red, and violet shades. Nitrous acid produces a nitroso-compound, and this, when nitrated yields a yellow dyestuff. The preparation of this latter is as follows:—40 kilos. of α -naphthol are converted into the disulphonic acid as described above, and a slightly acid aqueous solution of it or of one of its salts is treated with sodium nitrite so long as nitrous acid is absorbed. The nitroso-compound so formed is nitrated by adding 100 kilos. of commercial nitric acid or the corresponding quantity of sulphuric acid and sodium nitrate. The conversion takes place at the ordinary temperature, or the whole may be carefully raised to 50°. The yellow colouring matter precipitates, especially after adding potassium carbonate, when it is filter-pressed and dried.—T. A. L.

A New Class of Derivatives of Alizarin-Blue. J. Y. Johnson, London. From "The Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 14,353, October 5, 1888. 8d.

By the action of sulphuric acid or sulphuric anhydride on alizarin-blue new substances are produced, some of which may be employed as colouring matters. The following names have been given to the products which are successively formed in this reaction. 1. Alizarin-blue sulphuric acid. 2. Alizarin-blue sulphonie acid. 3. Intermediate product. 4. Alizarin blue-green. 5. Alizarin green.

1. *Alizarin-Blue Sulphuric Acid*.—10 parts of dry and finely powdered alizarin-blue are slowly added to 20 parts of fuming sulphuric acid containing 23 per cent. SO_3 . The mixture is then agitated for five hours at 50°, and finally at 15° for a further 12 hours. The melt is then poured into water, filtered quickly, pressed, and the substance converted into its sodium salt. It decomposes readily in an acid solution into alizarin-blue and sulphuric acid when heated, and can be used for dyeing wool with the aid of a mordant.

2. *Alizarin-Blue Sulphonic Acid*.—By increasing the amount of sulphuric acid mentioned in the preceding example to 50 parts, and raising the temperature to about 130°, this sulphonic acid is formed. The melt is poured into water heated to boiling, cooled to 40°, and the product filtered off. It dissolves in alkalis, and also in the bisulphites of soda, potash and ammonia, and may be used similarly to alizarin-blue for dyeing and printing, giving somewhat greener shades.

3. *Intermediate Product*.—This substance is formed by increasing the amount and strength of the sulphuric acid, the temperature being finally raised to 50°. The product is extremely unstable, and the acid solutions when heated are rapidly changed into—

4. *Alizarin Blue-Green*.—This product can also be obtained directly from alizarin-blue by adding 10 parts to 100 parts of fuming sulphuric acid containing 70 per cent. SO_3 . Twice the weight of sulphuric acid of sp. gr. 1.84 is then added and warmed to 60°. The solution turns red, and the reaction is complete when a test with water gives a precipitate which dissolves in sodium carbonate with a blue colour, and forms a bright green solution with caustic soda. The bisulphite compounds may be used in cotton printing, and give greener shades than alizarin-blue or its sulphonic acid.

5. *Alizarin Green*.—This is obtained by the action of sulphuric acid of sp. gr. 1.84 on the preceding compound at about 130°. It is also produced by the prolonged action of sulphuric acid on alizarin-blue. Ten parts of dry powdered alizarin-blue are added to 100 parts of fuming sulphuric acid containing 70 per cent. SO_3 at a low temperature. The mixture is then raised to 50° for about six hours, when 200 parts of sulphuric acid of 1.84 sp. gr. are added, and the temperature raised to 125°. After eight hours the melt is poured into water, heated to boiling, cooled to 40°, and the precipitate of alizarin-green filtered, washed, and pressed. The substance forms fine bluish-grey needle-shaped crystals insoluble in cold water, slightly soluble in hot water, and in alkaline solutions. The salts are insoluble in an excess of a caustic alkaline solution. The bisulphite compounds are soluble, and may be employed in dyeing and printing, giving fast shades considerably greener than those obtained from alizarin-blue.—T. A. L.

New or Improved Manufacture of Azo Dyestuffs. B. Wilcox, London. From "The Farbenfabriken vorm. F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 14,412, October 8, 1888. 6d.

THE colouring matters described dye wool a deep black, and are produced by combining α -naphthylamine with the diazo-compounds of the disulphonic acids of aniline, toluidine, α - and β -naphthylamine, rediazotising the amido-azo-compounds so formed, and combining these latter with phenyl- or tolyl- α -naphthylamine. The following example shows the quantities employed. 23.3 kilos. of p -amido-benzene disulphonic acid are diazotised and treated with a hydrochloric acid solution of 20 kilos. of α -naphthylamine. A deep red solution of the amido-azo-compound results, and this is diazotised with 10 kilos. of sodium nitrite in 100 litres of water. The diazo-compound separates out, is filtered off, and added to an alcoholic solution of 35 kilos. of phenyl- α -naphthylamine. The whole is allowed to stand 20 hours, when the acid of the dyestuff is filtered off. By dissolving in an alkali it is converted into a salt which can be separated by salting out. The dyestuff, as already mentioned, dyes wool directly, with the addition of common salt, a deep black shade.—T. A. L.

The Production of a Yellow Colouring Matter from Carbazol. J. Y. Johnson, London. From "The Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 14,478, October 9, 1888. 6d.

THE colouring matter is produced by combining one molecule of diazotised diamido-carbazol with two molecules of salicylic acid. The quantities are given as follows: 50 kilos. of diamido-carbazol sulphate are mixed with 60 kilos. of hydrochloric acid of 1.16 sp. gr., 1,000 litres of water, and 1,000 kilos. of ice. This is then diazotised with 50 kilos. of sodium nitrite in 150 litres of water, and the whole is run into 2,000 litres of water containing 47.5 kilos. of salicylic acid and 150 kilos. of sodium hydrate of sp. gr. 1.38. The mixture turns an intense red, and after standing becomes yellowish-brown. It is then boiled, and the dyestuff precipitated by the addition of salt, when a brown crystalline precipitate is obtained. Hydrochloric acid precipitates the acid from solutions of its salts as a dark bluish-green precipitate, which dissolves in concentrated sulphuric acid with a bright bluish-purple colour. The dyestuff gives yellow shades on unmordanted cotton from an alkaline bath, and dyes wool from a neutral or acid bath with or without the use of mordants.—T. A. L.

The Production from Carbazol of a New Derivative to be Used in the Manufacture of Colouring Matters. J. Y. Johnson, London. From "The Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 14,479, October 9, 1888. 6d.

THIS patent describes the formation of dinitro-carbazol, which on reduction yields diamido-carbazol. 10 kilos. of carbazol and 50 kilos. of glacial acetic acid are warmed to about 80° and treated with 13 kilos. of nitric acid of sp. gr. 1.38, the whole being thoroughly agitated. The temperature is then raised and kept for half an hour at 100°. On cooling, dinitro-carbazol separates out as a yellow crystalline powder. For obtaining diamido-carbazol any reducing agent may be employed, but preference is given to zinc dust in presence of caustic alkalis. 65 kilos. of dinitro-carbazol are mixed with 300 litres of water and 100 kilos. of zinc dust. The mixture is heated to 50°, and 250 kilos. of sodium hydrate of sp. gr. 1.38 are gradually added. The temperature is then raised to 90° for about eight hours until the reduction is complete, or nearly so. 1,000 litres of water are then added and the undissolved residue, consisting of diamido-carbazol, zinc dust and oxide of zinc, is filtered, washed and treated with 500 kilos. of hydrochloric acid of 1.16 sp. gr. This forms a mixture of diamido-carbazol hydrochloride and its zinc chloride compound, which can be filter-pressed. It may be further purified by dissolving it in 1,500 litres of water, decolourising the solution with animal charcoal and adding sodium sulphate to the filtered solution. This precipitates diamido-carbazol sulphate in crystals which is almost insoluble in pure water, but readily soluble on the addition of a mineral acid. On adding an alkali the base is precipitated in silvery white laminae sparingly soluble in water, and not fusible at 250°.—T. A. L.

The Production of New Yellow Dyestuffs called Thioflavines. G. Pitt, Sutton. From L. Casella and Co., Frankfurt-on-the-Maine, Germany. Eng. Pat. 14,884, October 16, 1888. 6d.

WHEN p -toluidine is heated with sulphur it yields bases containing sulphur, and these when converted into their methyl, ethyl or benzyl derivatives give yellow colouring matters. The following example illustrates the method employed: 24 kilos. of the sulphur base from p -toluidine are heated in an autoclave with 30 kilos. of methyl alcohol and 12 kilos. of hydrochloric acid of 1.16 sp. gr. for 12 hours to 170°. The whole is then boiled with water, when part of the product dissolves, and after filtration is precipitated by the addition of salt. This forms a basic colouring matter which dyes cotton, mordanted with tannin and tartar-emetic, a bright yellow. It belongs to a group of colouring matters to which the name Thioflavine T is

given. 25 kilos. of the product insoluble in water are dissolved in 70 kilos. of sulphuric acid. 10–12 kilos. of sulphuric acid containing 60 per cent. SO_3 are added, and the whole raised to 80° . When the sulphonation is complete the melt is poured into cold water which precipitates the sulphonic acid. This is dissolved in an alkali and precipitated with salt and dried. The new colouring matter belongs to the group Thioflavine S, and dyes unmooranted cotton a bright yellow from an alkaline bath. Dyestuffs belonging to the Thioflavine S group may also be obtained by alkylating the sulphonic acids of the sulphur bases from *p*-toluidine.—T. A. L.

The Manufacture of Derivatives of Alizarin-green, suitable for Dyeing and Printing. J. Y. Johnson, London. From "The Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 15,121, October 20, 1888. 6d.

This is a continuation of the Eng. Pat. 14,353 of 1888, (page 770), and describes the production of alizarin-green sulphonic acid and alizarin indigo blue by the further action of fuming sulphuric at a high temperature either on alizarin-green or on alizarin-blue as already described.

—T. A. L.

Process for Production and Treatment of Oxidisable Derivatives of Orthonitrobenzylchloride. E. Fischer, Stuttgart, Germany. Eng. Pat. 15,179, October 22, 1888. 6d.

By treating *o*-nitrobenzylchloride with ordinary oxidising agents either no reaction takes place or the decomposition is carried too far, whereas when *p*-nitrobenzylchloride is so treated it is converted into *p*-nitrobenzaldehyde. If, however, the chlorine in *o*-nitrobenzylchloride be first substituted by boiling with sodium acetate and alcohol, the acetate so formed yields on oxidation *o*-nitrobenzaldehyde. This product has given the best result, but in place of sodium acetate, salts of benzoic acid, oxalic acid, formic acid, or thiosulphuric acid may also be employed. The following quantities are given for working the invention: 100 parts of *o*-nitrobenzylchloride, 60–70 parts of fused sodium acetate, and 360 parts of alcohol are boiled for about 80 hours with an inverted condenser. The sodium chloride which separates out is removed and the spirit distilled off, the residue being stirred up with a small quantity of cold water, when *o*-nitrobenzalacetate is obtained as a white crystalline mass, readily soluble in alcohol and ether, less soluble in cold benzene. To convert it into the aldehyde, 100 parts of the acetate are boiled with 250 parts of lead peroxide paste containing 51.3 per cent. PbO_2 and 250 parts of water. After boiling six hours 150 parts of 40 per cent. acetic acid are slowly added, and after further boiling for several hours the whole is filtered, when, on cooling, *o*-nitrobenzaldehyde separates out, and is purified by known methods. Other oxidising agents, such as manganese peroxide, potassium bichromate, or nitric acid may also be employed.—T. A. L.

Improvements in the Production or Manufacture of Diazo-Dyestuffs. J. Y. Johnson, London. From "The Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 15,258, October 23, 1888. 6d.

The colouring matters described, which may be considered as azo-derivatives of symmetrical diphenylurea, are obtained by the action of phosgene, thiophosgene, carbon bisulphide, aldehydes, ethylenedibromide, or the ethers of dibasic acids, such as oxalic acid, on *p*-amido-azo compounds, such as *p*-amido-azo-benzene-azo-salicylic acid. These compounds may be obtained by reducing the corresponding nitro-compounds, or amido-diazo-benzene (Griess, Ber. 17, 603) may be combined with salicylic acid. It is found, however, that the best result is obtained by starting with diazo-acet-anilide (Nietzki, Ber. 17, 343), according to the following example: 15 kilos. of finely-powdered acetyl-*p*-phenylene-diamine are dissolved in 45 kilos. of 32 per cent. hydrochloric acid, 200 litres of water, and cooled by the addition of 200 kilos. of ice. The solution is diazotised by adding 7 kilos. of sodium

nitrite dissolved in 21 litres of water. The diazo-solution thus obtained is run into 300 litres of water containing 15 kilos. of salicylic acid, 45 kilos. of calcined soda, and 150 kilos. of ice. The crystalline azo-compound separates after standing 24 hours, when it is filtered and pressed. Without drying, it is then heated with 200 kilos. of ordinary sulphuric acid to 100° for four hours and poured into water, when the amido-azo compound separates as a fine brown crystalline precipitate, which is filtered off. In order to convert it into the new dyestuff it is mixed in a lead-lined vessel with 1,000 litres of water and 700 kilos. of ice, and is converted into its sodium salt by carefully adding a solution of soda or soda lye. Phosgene is then passed in under constant agitation until the solution is acid. The colouring matter, which separates out as a brown precipitate, is filter-pressed, and dried with sufficient calcined soda at 100° to produce the sodium salt. This forms a brownish-yellow powder, easily soluble in water, and dyes unmooranted cotton yellow from an alkaline bath.—T. A. L.

The Preparation of Derivatives (Nitro and Amido) of Alizarin-Mono-Sulpho-Acid, and of Dyestuffs therefrom. B. Willeox, London. From "The Farbenfabriken vormals Friedrich Bayer and Co.," Elberfeld, Germany. Eng. Pat. 15,260, October 23, 1888. 6d.

This invention relates to the production of a monosulphonic acid of alizarin-blue by heating amido-alizarin sulphonic acid in presence of nitro-alizarin sulphonic acid, together with glycerol and sulphuric acid. The alizarin-mono-sulphonic acids required for making these nitro-compounds are obtained by decomposing incomplete melts of flavo- or anthra-purpurin with mineral acids and filtering the product whilst hot. The soda salts of the sulphonic acids, together with about 12 per cent. of flavo- or anthra-purpurin, are salted out from the filtrate after cooling. In order to purify the alizarin monosulphonic acids further, either the aqueous solution is extracted with ether or the dry mixture, after the salting out, is extracted with alcohol. The further treatment is then as follows:—50 kilos. of dry alizarin monosulphonic acid are dissolved in 100 litres of water, 200 kilos. of glacial acetic acid are added, and the mixture cooled to 40° , when 25 kilos. of sodium nitrite are added. The reaction is complete when a test gives a brownish-red precipitate on the addition of an excess of soda lye. The whole is then poured into water and precipitated by salting out the yellowish-red nitro-compound. It is purified by dissolving in hot water, and adding an excess of soda lye. On cooling, the neutral salt of the nitro-compound separates as a dark-coloured crystalline precipitate. The substance is reduced by dissolving 10 kilos. of it in 50 litres of water, and an equal weight of fuming hydrochloric acid, raising the solution to the boil, and adding 20 kilos. of stannous chloride. The reduction is complete when a test dissolves in an alkali with a blue colour. The amidosulphonic acid is precipitated from an alkaline solution as a brownish-yellow crystalline precipitate, slightly soluble in water and insoluble in dilute acids. For converting it into alizarin-blue monosulphonic acid, 20 kilos. of the amidosulphonic acid are mixed with 10 kilos. of the nitro-compound above described, 30 kilos. of glycerol, and 150 kilos. of 66 per cent. sulphuric acid, and heated to 130° , until a test dissolves in alkali with a pure green colour. The melt is then poured into water, filtered and purified by conversion into its sodium salt. It may be employed directly for cotton printing, or converted into the bisulphite compound by heating to 50° a mixture of 10 parts of a 20 per cent. paste of the acid with 10 parts of water and 6 parts of sodium bisulphite of 30°B . The solution obtained is diluted with water, and the bisulphite compound precipitated by the addition of salt.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

PATENTS.

Improvements in the Treatment of Rhea, Ramie, and other Grasses, and in Apparatus therefor. H. H. Doty, London. Eng. Pat. 11,704, August 14, 1888. 8d.

This invention relates to a method of "retting" rhea, flax, &c. It consists in exposing the material to an acid fermentation bath, obtained by dissolving brown sugar, molasses, or cane juice in water, for three or four days at a temperature of about 100° F.

The specification is accompanied by descriptive drawings of the necessary apparatus.—E. J. B.

Process and Apparatus for Treatment of Textile Plants. L. de Kien, Courtrai, Belgium. Eng. Pat. 14,100, October 1, 1888. 6d.

THE inventor claims "the method of treating textile plants so as to clear their fibres, by drying the stems and passing them between an upper and lower set of rollers having projecting blades."—E. J. B.

Improvements in Apparatus for Cleansing Wool and like Materials. I. Singer and M. W. Judell, London. Eng. Pat. 14,247, October 3, 1888. 8d.

THE present invention relates to certain improvements in the system of cleansing wool described in Eng. Pat. 2532 of 1888. The improvements consist of (1) an automatic apparatus for discharging either water or bisulphide of carbon; (2) an arrangement for drying the washed wool (see this Journal, 1889, 28); and (3) to an apparatus for drying the sludge which falls to the bottom of the solvent cells. The sludge is fed into one end of a cylinder surrounded with steam, and is carried forward to the other end, where it is discharged by a worm, the axis of which is hollow and heated with steam.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

PATENTS.

Improvements in Apparatus for Dyeing and similarly Treating Textile and Fibrous Materials in all Stages of Preparation. W. E. Heys, Manchester. From C. Vandermeersch, Paris, France. Eng. Pat. 13,175, September 12, 1888. 8d.

THIS apparatus consists of a dyebeck containing a drum or hollow cylinder furnished with two shafts which rotate in stuffing boxes in the sides of the trough. One shaft is solid and connected up with any suitable arrangement for driving. The other shaft is hollow and connected by a pipe with the bottom of the dye vat. On the surface of the hollow drum and opening into it are a series of tubular seats upon which are screwed moveable vessels containing the material to be dyed or otherwise treated. The vessels are perforated at the bottom and are supplied with covers which are also perforated, the covers likewise being provided with a screw-thread, so that these dye-vessels may be turned and screwed on to the hollow cylinder in a reversed position. The dye-vessels participate in the rotary motion of the drum and plunge successively into the bath on one side and emerge by degrees from the other side in a continuous circular direction. By means of a pump the dye-liquor is also drawn from the bottom of the vessel and forced into the hollow drum and through the material in the dye-vessels. The primary circulation thus established is combined with the progressive emergence of the vessels from the bath, and the consequent reverse pressure of the liquid above the level of

the bath causes it to spread in a radial direction and so ensures level dyeing. After the operation is half through each of the dye-vessels is unscrewed and inverted, so that for the rest of the operation the liquor passes through the dyestuff in a direction the reverse of that which it has followed in the earlier part of the treatment.—W. E. K.

Machinery or Apparatus for Scouring and Washing Skins and Wool and Analogous Materials. T. Burns, Edinburgh. Eng. Pat. 2311, February 9, 1889. 8d.

THIS invention relates to machinery for facilitating the scouring and washing of skins, wool, and similar materials. A large oblong trough having water flowing through it has working in it in different positions a number of pairs of wooden rollers, or squeezers, covered with some yielding material. The rollers being capable of adjustment any desired pressure can be applied on the skins. The skins to be operated upon are carried on an endless band between the squeezers, and are kept in position by an arrangement of endless ropes, or the feeding may be effected by a number of small rollers mounted in the spaces between the squeezers. The whole series of squeezers, band or rollers, can be actuated in any suitable manner.—E. S.

Improvements in Producing Parti-Coloured Prints or Impressions, and in Apparatus therefor. W. P. Thompson, Liverpool. From P. J. Haase, Mayence, Germany. Eng. Pat. 4456, March 14, 1889. 6d.

THE object of this invention is to produce in a single impression and with one and the same block a parti-coloured print. To effect this, one portion of the block is cut from a porous substance (as wood, pumice stone, or preferably the root of the nut tree or rattan). The nature of the colours employed for the porous part must differ from the rest of the block; that is, if the latter be supplied with ordinary black printing ink or other oily substance the former must be supplied with water-colours, or *vice versa*, so that they will not run into each other. The blocks are fixed in pans in which the colour suitably diluted is placed, and different colours in the pans may be kept separate by suitable divisions. The blocks are surrounded and held in position by a small rim which takes up the black colour from the ink roller and thus marks a black border round the type or picture; the coloured ink in the pan is sucked up by capillary attraction through the pores of the material of which the block is made, and forms on its surface a layer of water or oil colour which yields the desired impression.—W. E. K.

Improvements in or Relating to Machinery or Apparatus for Scouring and Washing Skins and Wool and Analogous Materials. T. Burns, Edinburgh. Eng. Pat. 11,133, July 10, 1889. 6d.

THE improvements refer to the apparatus described above in Eng. Pat. 2311. Here the rollers are placed at one end of the trough, either directly or attached to it by brackets bolted on. The rollers are dissimilar, one being spurred or grooved along its length, and about 12 inches in diameter, two others being similar but smaller, and the remainder plain. The skins being lifted from the trough and placed on the large roller, the spurs tend to pull them on to the other rollers, from which they fall on to an endless band which conveys them to the washing machinery. In cases where sheepskins which have been treated with lime or other substances on their flesh side are to be washed, another spurred roller working in the opposite direction is placed across the trough in front of the entering rollers, and scrapes the lime off while the skin is passing over it.—E. S.

VII.—ACIDS, ALKALIS, AND SALTS.

Lead needed for Vitriol-Chambers. F. Bode. Zeits. f. angew. Chem. 1889, 357.

In the case of three vitriol works of the author's design, the lead used was distributed as shown by the appended table:—

	A.	B.	C.
Capacity of chambers..... Cub. m.	5,800	4,550	2,265
Lead used..... Tonnes	238·0	160·0	96·2
This was disposed thus:—			
(a) Chambers and tubes..... Per cent.	78·3	82·3	73·2
(b) Towers..... „	14·0	11·2	16·2
(c) Remaining plant..... „	7·7	6·5	10·6

If one take the quantity of lead requisite for making the actual surface of the lead chambers without considering that needed for internal fittings, as unity, one finds the weight needed for the various parts (reckoning the metal to weigh 32·5 kilos. per sq. m.) become:—

	A.	B.	C.
(a) Chambers.....	1·40	1·37	1·33
(b) Towers.....	0·25	0·19	0·29
(c) Remaining plant.....	0·14	0·13	0·18
Total.....	1·79	1·69	1·80

With regard to the item C (b) it must be mentioned that this includes some lead pans heated by the waste furnace heat, and so situated before the Glover tower; on the other hand such pans as were heated by steam or directly by coal are omitted.

Strict comparison is not possible between these three sets of figures as the design was not identical for all; such differences largely depend on the view taken by the manufacturer in erecting them according to whether an apparatus of low first cost is aimed at, or one in which stoppage for repairs may be avoided—objects mutually contradictory. The author is of opinion that with care the ratio of the quantity of lead necessary for the chambers to that calculated from their actual dimensions may be brought as low as 1·25 to 1. By the collection of such data as these and their systematic study, it will become possible by simple means to arrive at a fairly accurate estimate of the quantity of lead needed for chambers of any given design.—J. B.

The Oxides of Manganese obtained in the Wet Way.

A. Gorgen. Bull. Soc. Chim. [3] 1, 605–612.

WHEN caustic potash or soda, free from carbonate, is added to an excess of a solution of a manganese salt, and the resulting manganous hydrate is agitated in contact with air for a fortnight, an amorphous hydrated superoxide is formed having the composition $\text{MnO}_2 \cdot 2 \text{MnO}$, and which appears to be a definite compound of the protoxide of manganese and manganous acid. Ammonia produces the same compound, and if the oxidation be carried out on the water-bath the composition of the product is the same. In an atmosphere of oxygen the oxidation is effected three times more rapidly, and the hydrated superoxide, which is brown and amorphous, contains a little more oxygen than is required by the above formula. If an excess of alkali be employed the hydrate oxidises more rapidly and more completely; in presence of an excess of baryta water, a product containing from 50–93 per cent. of MnO_2 results.

Neutral aqueous solutions of manganous salts when allowed to stand exposed to the air become turbid and deposit a superoxide of a brown colour and containing varying amounts of water of hydration. This decomposition takes place slowly in the dark, more rapidly in diffused light, and very quickly in sunlight. The more dilute the solution is and the weaker the acid with which the manganese is combined, the more rapidly does the oxide separate. The chloride and acetate of manganese deposit an oxide $\text{MnO}_2 \cdot \text{MnO}$, the nitrate an oxide $3 \text{MnO}_2 \cdot 2 \text{MnO}$, both of them containing varying amounts of water. Aqueous solutions of the chloride, bromide, iodide, sulphate or nitrate of manganese are not decomposed by boiling, but a solution of the acetate is, and a brown amorphous hydrate, $\text{MnO}_2 \cdot 2 \text{MnO} + x \text{H}_2\text{O}$ is precipitated.

A solution of iodine in potassium iodide has no action upon the above salts of manganese even after being in contact for six months. Chlorine water added to manganous hydrate suspended in water, oxidises it partially to a hydrate, which when dried at 120° has the composition $\text{MnO}_2 \cdot 2 \text{MnO}$. (The unaltered manganous hydrate was separated by dissolving in ammonium chloride.) Manganous acetate is decomposed by a current of chlorine, and manganites having the approximate compositions $3 (\text{MnO}_2) \cdot \text{MnO}$ and $5 (\text{MnO}_2) \cdot \text{MnO}$ result. Manganous carbonate is slowly acted upon by chlorine water, carbon dioxide being liberated and a manganite, $\text{MnO}_2 \cdot \text{MnO}$, formed; by the further action of chlorine a product having the composition $4 (\text{MnO}_2) \cdot \text{MnO}$, or $5 (\text{MnO}_2) \cdot \text{MnO}$, results. The mother-liquor at this stage is neutral and the whole of the chlorine is combined as manganous chloride, but if the addition of chlorine water be now continued, free hydrochloric acid is formed and the liberated oxygen slowly transforms the manganite into manganese dioxide. Bromine acts similarly to chlorine but more slowly (this Journal, 1889, 541).

—C. A. K.

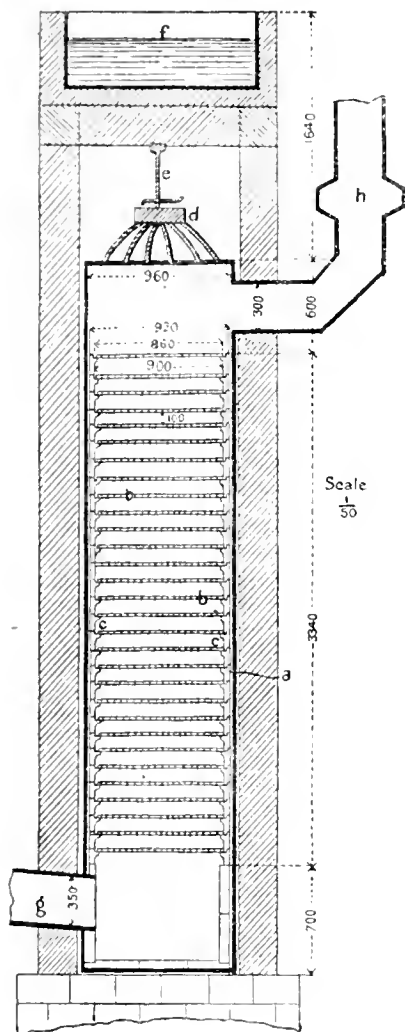
Composition of Roumanian Rock Salt. Istrati. Bull. Soc. Chim. [3] 2, 4–8.

THE deposits of rock salt found in Roumania on the south side of the Carpathian Mountains occur in eocene and miocene strata, generally at a depth of 33 to 83 feet below the surface and in a few districts as an efflorescence on the soil. There are five mines, four of which belong to the State. These last produced 65,395,204 kilos. of salt in 1878, and 84,176,600 kilos. in 1888, of which more than a quarter is exported at 42–45 fr. per kilo. to Bulgaria, Servia and Russia. The deposits, which are of a very uniform nature even to a depth of 1,300 feet, consist of white and grey salt; coloured varieties are very rare. In many cases petroleum is found near the rock salt deposits, and some varieties of the salt of third quality have a distinct smell of petroleum which is removed by pulverising and subsequent warming to 50°–60° C. The salt is very pure. It contains from 99·161 per cent. to 99·924 per cent. of sodium chloride, only in three out of 13 samples analysed is there less than 99 per cent., and in these cases the figures are 98·052, 98·663, and 98·689 per cent. Potassium salts are absent; five of the 13 samples contain sodium sulphate varying from 0·006–0·174 per cent.; the sulphate of calcium varies from 0·101 to 0·903 per cent., the water from 0·024 to 0·304 per cent., and the insoluble residue (argillaceous matter, calcium carbonate, and carbonate of iron) from 0·034 to 0·764 per cent. The salt is rich in gas and contains from 11·36 to 29·84 cc. of gas per kilo., in one case (purest salt from Slanik mine) reaching 117·23 cc. This gas consists of about 25 per cent. of unsaturated hydrocarbons, 20 per cent. of free oxygen. There is no carbon dioxide. It is sufficiently abundant to give rise to small explosions at times.—C. A. K.

Suggestions for Improvements in the Manufacture of Sulphuric Acid. G. Lange. Zeits. f. angew. Chem. 1889, 385–390.

THE recent researches of Schertel and Sorel (this Journal, 1889 283) have sufficiently shown the advantage of a multiplication of solid surfaces within the reaction chamber. Sorel

has shown that the cooling of these surfaces is an additional factor of great importance. The introduction of lead plates into the chamber, as proposed by Thyss, appears to have failed in producing the expected result, and, in addition, the exposure of the metal to the gases without cooling has been found to be attended with rapid disintegration. The author proposes, as a practical solution of the problem, the construction of such plates of a resistant material, and as the cooling agent, the evaporation from them of the water required in the reaction. The arrangement of a column of perforated porcelain plates patented by himself in conjunction with Horstmann, he now shows to fulfil all the necessary conditions of maximum contact of gas and vapour, with the means of securing the optimum of temperature and condensation. The construction of the "Plattenthurm" is shown in the annexed figure.



The chamber is lead-lined, and each plate is separately supported. The entrance and exit of gases at *g* and *h* and the introduction of liquid from the reservoir *f*, through *d*, need no particular description. The efficiency of a tower of this form would probably be ten times that of a coke tower of equal capacity and entirely free from the objection of a prejudicial chemical action on the nitrous gases (Chem. Ind. 1885, 2). The working advantages of the construction are obvious. The effect of the tower in concentrating the reaction area will be to raise the

temperature presumably much above the optimum. To maintain the optimum, and at the same time take advantage of the heat evolved, the plates will be "irrigated" with water or dilute acid in suitable quantity. It is probable that all the water necessary for the reaction could in this plan be introduced as such and without subdivision or vaporisation. The system is likewise theoretically adapted to promote the efficiency and economy of the action of the nitrous gases, as regards the non-formation of nitrous oxide and the production of a nitrogen free chamber acid.

The probability of a considerable reduction of the reaction area has long been foreshadowed in the statistics of the working of the Glover towers. The percentage conversion of sulphur in these towers may be taken at 9-16, and the reaction is effected therefore in $\frac{1}{10}$ of the volume provided in the chambers. With regard to the heat of reaction available for water evaporation, it may easily be calculated that the formation of 98 parts of monohydrate, at the concentration of chamber acid, liberates the heat necessary for the evaporation of 100 parts water at 100 °C. This proportion of water would be some 25 per cent. in excess of the requirements of the process, but taking into account the losses due to radiation, &c., there appears to be the promise of a nearly self-contained equilibrium.

In regard to the practical steps necessary to test this system, it would be expedient in the first instance to introduce a "Plattenthurm" between two chambers, the steam evaporated being used up in the second chamber. The ideal disposition, however, would probably be the following: After the Glover tower a small chamber 16 by 16 by 40 feet; one or more plattenthürms (3 feet diameter with 25-40 plates requiring a height of 13-20 feet); a second chamber and tower; an end chamber for drying the gases, and lastly a Gay Lussac tower, to which function the plattenthurm is well adapted.

In conclusion the author records his opinion that the early stages of the reaction are best carried out in a small lead chamber; the point when the reaction-curve begins to flatten being that at which the plattenthurm will be found to be the effective substitute, and that at which, therefore, in the future it will come to be inserted. By the flattening of the curve representing the reaction, of course, the slackening of that reaction is indicated.—C. E. C.

On the Inter-Diffusion of Acids and Bases. J. Stefan. Monatsh. Chem. 10, 201-219.

AN account of experiments made to ascertain the rate of diffusion between acids and bases in aqueous solution. The apparatus consisted of two similar thick-walled glass tubes, each 12 cm. in length, 7 mm. inside diameter, and 23 mm. outside diameter, and closed at one end with a cemented glass plate, the other end being ground smooth. After being filled with the solutions, the tubes are placed vertically in a stand, the open ends brought together and glided into position so that the surfaces of the columns of liquid are in contact. A millimetre scale is etched on each tube. Hydrochloric acid and ammonia were the typical acid and base chosen for experiment, but the diffusion coefficients of other acids and bases were also determined. Various strengths of solution were used, but considerable dilution was favourable to uniform results, and it was always necessary to have the denser solution in the lower tube, to avoid interference by the action of gravity. The solutions were coloured with litmus and the progress of the sharp boundary between the blue and red served to mark the rate of diffusion, or rather the extension of volume of the stronger solution, for when the acid was in excess the red colour extended upwards, and when ammonia was in excess the blue travelled downwards. When one molecule of hydrochloric acid was opposed to 1.8 molecule of ammonia, the line of demarcation between the red and blue remained in one position, the diffusion of acid and base being equal. When a normal solution of hydrochloric acid (36.5 grms. HCl per litre) was opposed to a one-sixteenth normal solution of ammonia, the red colour marking the acid territory rose in one hour 8.2, in four hours 16.5, in nine hours 24.5 mm.

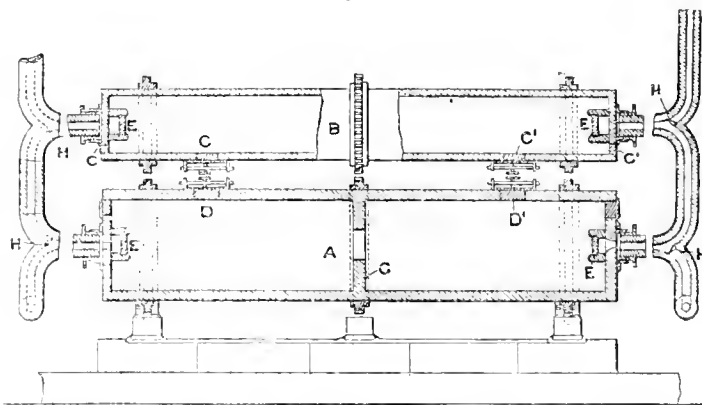
With the same strength of acid but a one-fourth normal solution of ammonia, the growth of the acid solution in the same periods was 5.0, 9.9, and 14.7 mm. When both solutions were of normal strength the increase was only 1.2, 2.3, and 3.5 mm. in the same times. The rate of increase is thus always proportional to the square root of the time reckoned from the commencement of the process, and is less as the relative strengths of the solutions approach a certain ratio which in the present case is 1 to 1.8. The chemical attraction of the acid and base exercise no influence on the rate of diffusion. For simplicity the diffusion is spoken of as taking place only in one direction, the inter-diffusion which is constantly in full operation being left out of account; but the whole of the conditions are considered with the aid of mathematics in a further part of the paper which should be consulted for further particulars. Reference is made to the work of L. Chabry and of J. Coleman in similar directions.—G. H. B.

PATENTS.

Manufacture of Chlorine and Hydrochloric Acid.
D. Gamble, St. Helens. Eng. Pat. 11,581, August 11, 1888. 8d.

THE specification describes a process and an apparatus for the production of chlorine and hydrochloric acid from the mixture of chloride and oxide of magnesium as formed in the Weldon-Pechiney process. This mixture is to be heated in a revolving furnace in the presence of a current of highly heated air, and the resulting gases are led off to be treated in the usual way for the separation of chlorine and hydrochloric acid. According to one method the solid substance is filled into a revolving furnace and subjected to a preliminary drying. The hydrochloric acid is given off chiefly during the drying, and the gases are treated for its recovery on their escape from the furnace. The substance when dry is subjected to the action of air at a higher temperature such as is obtained by a Siemens or Cowper stove, and this operation is continued until the evolution of chlorine has ceased. Another arrangement is illustrated in the accompanying sketches. There are two revolving furnaces, A and

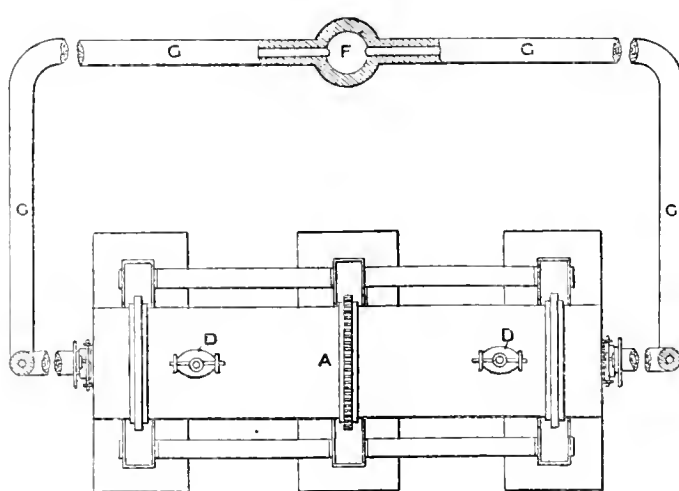
Fig. 1.



B, both of which are supported and driven in the usual manner. The material is first charged into the drying cylinder B, and then it is transferred by gravity into the heating cylinder A. This heating cylinder is divided by an annular transverse partition J, and the two divisions thus formed are charged alternately. The hot air first goes into the division which has been charged the longest and then into the other one; it afterwards passes through the drying

furnace when its temperature has been reduced. In the accompanying figures there is shown a system of pipes, H, G, by means of which the hot air is distributed. By means of the valves H the air may be caused to enter at either end of A and to pass thence to the cylinder B. The baffle plates E are placed opposite the openings of the pipes G, in order to diffuse the air throughout the cylinders. The discharging holes C and C' are arranged to come opposite the holes

Fig. 2.



transferred from B to A. Openings are also provided in the ends of the cylinder B to facilitate the discharge. Another apparatus is also described in the specification. It consists essentially of a revolving furnace 40 ft. long by 6 ft. in diameter, and lined with fire-bricks. The material is fed in at one end and discharged from the other, the longitudinal motion being obtained by means of a helical line of fire-bricks projecting from the internal surface of the furnace. Claims: (1) The improvement in the manufacture of chlorine and of hydrochloric acid respectively, which consists in treating a mixture of chloride of magnesium and oxide of magnesium by heated air or by heated air and steam in a revolving furnace or a series of revolving furnaces substantially as described; (2) In the treatment of a mixture of chloride and oxide of magnesium for the purposes described, the application of one or more revolving furnaces fitted with a helical line of breakers; (3) In the treatment of a mixture of chloride and oxide of magnesium for the purposes described, the application of a series of revolving furnaces with or without vertical, transverse, annular partitions, all these furnaces being connected together in such a manner that the same portion of air passes through all of them in succession; (4) In the manufacture of chlorine or hydrochloric acid from a mixture of chloride and oxide of magnesium and heated air, the causing the solid materials to pass through a revolving furnace in one direction and the air to pass through in the opposite direction; (5) The use of the gases given off by the treatment, in a revolving furnace, of a dried mixture of chloride and oxide of magnesium by highly heated air for the preliminary drying of a fresh mixture of chloride and oxide of magnesium in the same or a separate revolving furnace.—S. G. R.

Improvements in the Production of Basic Lead Carbonate, Chloride, Phosphate, Oxalate, Silicate, Borate, or other Insoluble or Sparingly-soluble Salts of Lead. W. E. B. Benkinsop and F. M. Lyte, London. Eng. Pat. 11,926, August 17, 1888. *Ad.*

THE inventors obtain various insoluble basic salts of lead, such as the carbonate, phosphate, oxalate, &c. by treating some suitable insoluble sort of lead such as the sulphate,

chloride, &c. with the soluble sodium salt of the acid whose lead salt is required. Besides soluble salts for this purpose it is shown that an insoluble salt may be used to obtain the basic carbonate; for example, an insoluble carbonate such as magnesite or dolomite in the presence of water may be employed with equally good results. Warming promotes the reaction.—S. G. R.

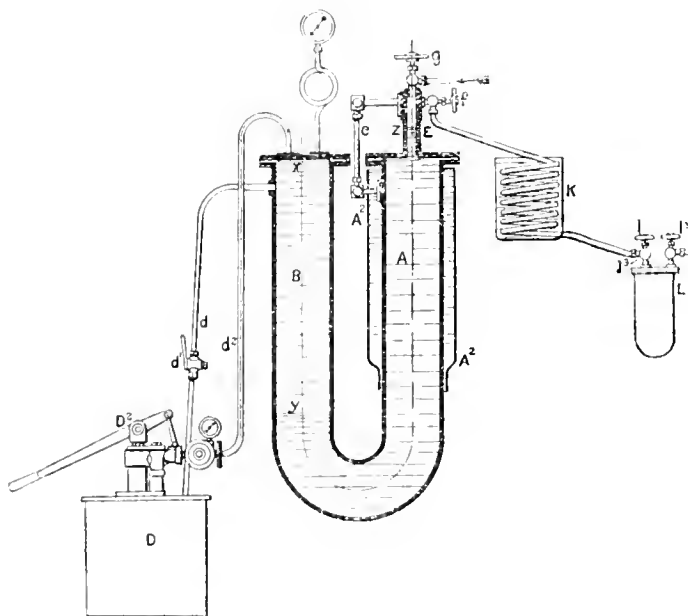
Improvements in the Rectification and Concentration of Acetic Acid and in Apparatus therefor. A. Werber, London. Eng. Pat. 12,336, August 24, 1888. *Sd.*

INSTEAD of allowing the rectified acid to flow back into the general bulk of liquid undergoing rectification, as in the usual type of column stills, the inventor allows only the first runnings to do so, and as soon as these attain a sufficient purity (as determined from a small portion withdrawn by a sample cock) the rectified acid is allowed to flow into a separate compartment of the still, from which it distils and is condensed in a suitable condenser. The two compartments may either be two separate vessels or may be one divided into two by a partition. By the use of this apparatus the necessity for interrupting the process in order to draw off the rectified product is obviated; the crude acid mixed with the necessary reagents is run continuously into the first compartment of the still and the rectified product distils continuously from the second compartment.—A. L. S.

Improvements in and Apparatus for the Production and Retention of Chlorine in a Liquid State for Transport or Storage. R. Willeox, London. From "The Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 13,070, September 10, 1888. *Sd.*

THE apparatus is in two forms, suitable either for a discontinuous or continuous method for the liquefaction of chlorine, the plan in both cases being, however, substantially the same. In the former case (Fig. 1) it is U-shaped and formed of two vessels A and B either joined together DD¹ in the lower furnace, so that the material may be easily

Fig. 1.

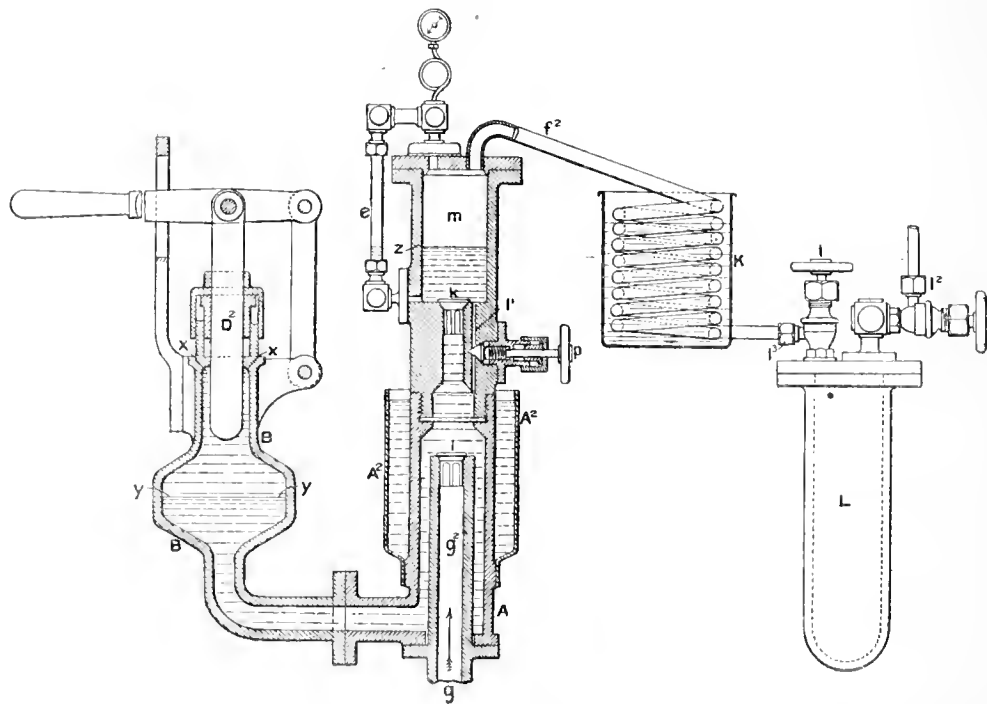


or else made in one piece and furnished with various stop-cocks, tubes, and secondary pieces of apparatus, the uses of which will be seen from the description. The vessels A and B are filled from *y* to *z* with sulphuric acid (used on account of its small solvent action on chlorine), and from *y* to *x* with petroleum to reduce the effect of the acid on the working part of the apparatus to a minimum. When the cock *g* is opened chlorine is admitted into A and the acid thereby depressed, with the result that the petroleum passes by *d* and *d'* into D. But on closing *g* and opening *f* and

working the force-pump D² the petroleum is driven back into B, and the chlorine in A being strongly compressed is liquefied and passes through the cooler K into the receiver L. The process is then repeated, *gf* being now closed and *g* opened. A is kept at about 50° C. to 80° C. by a jacket containing warm water, or in some other way, in order to still further reduce the solubility of the chlorine in sulphuric acid.

If the process is to be carried on continuously (Fig. 2) then the chlorine is introduced by the small tube *g*² opening

Fig. 2.



into A. This is shut by the valve *i*, which closes as the plunger D² descends and opens as it is raised. Above this is another lift valve *k*. The small tube *P* regulated by the valve *p* serves as a communication between the chamber *m* and the space between the valves *i* and *k*. The remaining details and the mode of working are practically the same as those in the first process already described. The apparatus can be made of cast iron, wrought iron, steel, phosphor, bronze, brass, copper, zinc, or lead. The receiver is best made of iron or steel lined with lead, copper, or brass.—S. G. R.

Improvements in the Manufacture of Soda, Potash and Chlorine. W. P. Thompson. From W. Spilker and C. Loewe, Berlin, Germany. Eng. Pat. 13,306, September 14, 1888. *Sd.*

A SOLUTION of sodium or potassium chloride is electrolysed, a porous diaphragm being used, and the chlorine evolved is collected. A solution of the hydrate of the corresponding alkali metal is also produced, and into this is passed carbon dioxide with the formation of the bicarbonate which can by known methods be converted into the carbonate. The levels of the different liquids are maintained by automatic feed-pipes.—S. G. R.

Improvements in Treating Impure Carbonate of Lime produced in making Alkali, and in Recovering Sulphur from Alkali Waste in order to Utilise it for making Cement, and for other Purposes. R. H. Steedman, Dumbarton. Eng. Pat. 14,026, September 29, 1888. *Ad.*

THE impure carbonates of lime obtained from the sources mentioned in the title are mixed together, heated preferably by steam and thoroughly agitated by mechanical stirrers, or better by blowing air through the mixture. The prejudicial sulphur compounds present are acted upon by the free lime and converted into soluble sulphides, which can be removed by washing. When the mud from Chance's process is alone used, milk of lime must be added. When mud from the causticising process is treated by itself air must be blown through it during the boiling operation.

—S. G. R.

Improvements in the Manufacture of Chlorine, Alkalis and Salts from the Chlorides of Sodium and Potassium. T. Parker and A. E. Robinson, Wolverhampton. Eng. Pat. 14,199, October 3, 1888. *Ad.*

A SOLUTION of the chloride is electrolysed in a suitable vessel, there being, however, no porous cell or diaphragm employed. Whilst the electric current is passed a stream of gaseous carbon dioxide, preferably under pressure, is forced in and the hypochlorite at first formed is at once decomposed with the formation of the carbonate of the alkali. The carbon dioxide is generated by calcining carbonate of lime,

and the quicklime thus produced can be utilised for converting the alkaline carbonate into the corresponding hydrate.—S. G. R.

Improvements in the Generation of Chlorine, in Forming a Solution therefrom, and in Apparatus therefor. J. Greenwood, London. Eng. Pat. 14,239, October 3, 1888. *Id.*

WITHIN a large battery jar is placed a series of carbon rods carried on a ring of suitable material, and the whole connected to the negative terminal of an electric generator. A porous cell is placed inside the battery jar and within this again is placed another series of carbon electrodes connected to the positive terminal. Through the outer jar, by means of pipes, a concentrated solution of common salt is passed at any required rate, and through the porous cell a stream of water which, on electrolysis the salt solution, absorbs the chlorine evolved at this terminal, and hence a chlorine solution of such strength as may be required can be readily obtained. A sketch of the required apparatus is given.—S. G. R.

Improvements in the Manufacture of Acetic Acid. M. Cannon, London. Eng. Pat. 11,333, October 5, 1888. *Id.*

THE object of this invention is the preparation of acetic acid, free from tarry matter, from crude pyroligneous acid or its calcium salt. This is achieved by oxidising the tarry matter by nascent oxygen liberated by the action of sulphuric or hydrochloric acid on one of the higher oxidised compounds of manganese.

When the crude calcium salt is the raw material it is first of all distilled with sulphuric acid to obtain the free acid. The impure acid is digested for 12–18 hours with 3 per cent. of one of the following: Manganese dioxide, sodium manganate or other manganate, potassium permanganate or other permanganate. These are added to the cold acid, sufficient sulphuric acid to decompose them is then added, and the temperature raised to 140° F. and kept at that temperature until all effervescence has ceased. The liquid is then distilled, the vapour being condensed in a silver or tin condenser. The distillate, with the exception of the first tenth and the last twentieth, which are re-treated with the next batch of crude acid, is colourless, free from unpleasant taste or smell, and may be used for any of the purposes for which pure acetic acid is required, such as the manufacture of white lead, white acetate of lead, emerald green or other colours, sodium acetate and vinegar.

If an acid of exceptional purity be required the operations may be repeated, using 1 per cent. of the oxidising material. The manganese of the residue in the retort may be re-oxidised by any of the usual methods.—A. L. S.

Improvements in or relating to Manipulating and Washing, Filtering, or otherwise Treating Lime Mud, Black Ash or other Materials in Bulk during the Course of Manufacture, and in Apparatus therefor. G. H. Bolton and T. A. Bullough, Widnes. Eng. Pat. 14,563, October 10, 1888. *Id.*

IN many processes the materials at one time or another have to be conveyed to a filtering press, there filtered and the residue then dug out and conveyed to some other locality in the works. It is proposed to make the filter press itself in the form of a waggon or other equivalent travelling vessel. It can then be readily placed below a converter, causticiser, &c., and the sludge emptied directly into it, and this can then be at once exhausted. In many cases the filtering press can be further fitted with the required apparatus, so that the next reaction or process can be performed within it, thereby obviating any further transference of material altogether.—S. G. R.

Improved Process for the Manufacture of the Hydrates of the Alkalis of the Alkaline Earths, and of their Carbonates, which Process is also applicable to the Dissociation of Alloyed Metals. F. T. Romiquères, Paris, France. Eng. Pat. 11,977, October 18, 1888. *Id.*

TWO boilers are taken, connexion between which can be made at pleasure, and each is about three parts filled with finely divided lead. A solution of concentrated caustic soda containing a little sodium sulphate is run into one of them until the lead is just covered and heat is applied, air being subsequently blown in until a pressure of from 4 to 5 atmospheres is obtained. The solution is then forced into the second boiler, where a similar process is carried on, and this is repeated until all the lead is oxidised and dissolved as plumbite of soda (Na_2PbO_2). On treatment of the solution thus obtained with sodium chloride, chloride of lead is precipitated with the formation of caustic soda in the proportion of two equivalents for each equivalent used in the formation of the plumbite. If carbon dioxide gas be blown in with the simultaneous addition of sodium chloride, then the carbonate of soda is produced. The hydrates of other alkalis can be similarly prepared. Besides lead, other metals such as zinc, arsenic, antimony, tin, can all be treated in this manner, and hence alloys may be separated into their constituents, each being subsequently thrown down from solution in due order and by suitable precipitants.—S. G. R.

Improvements in or connected with the Manufacture of Chlorine. H. W. Deacon and F. Hurter, Widnes. Eng. Pat. 15,063, October 19, 1888. *Id.*

DRY hydrochloric acid gas mixed with the requisite amount of dry air is obtained by adding salt in the required amount to sulphuric acid. Air is blown through the liquid mass by means of a pipe terminating in a rose and dipping below the surface. The air is thus both dried and the agitation caused by its passage through the liquid bisulphate of soda helps in the more complete decomposition of the salt. The gases when thus dried are found to be more suitable for treatment in Deacon's chlorine process than when in a moist condition.—S. G. R.

Improvements in Obtaining Carbonic Acid Gas from Mixtures with other Gases, Obtaining and Utilising the Residual Gases or otherwise, and in the Production of Carbonates of Ammonia. C. F. Claus, London. Eng. Pat. 15,173, October 22, 1888. *Id.*

THE gaseous mixture is, if necessary, first of all cooled and passed through special scrubbers to remove any sooty or tarry matters. The gases then traverse a series of scrubbers from the top of one to the bottom of the next in the usual manner. The last scrubber is fed with fresh ammoniacal liquors which are then pumped to the top of the next scrubber and so on; hence in the first scrubber the fresh gases meet a solution containing a little ammonia and much sesquicarbonate, whilst in the last the ammonia is very largely in excess, the carbonic acid gas having been already almost entirely absorbed. If the residual escaping gases are of value they pass to a gasholder. The sesquicarbonate solution is now pumped to the top of a scrubber termed the condensing tower in connexion with the heating apparatus, and thence into this latter. This consists of a series of shallow closed tanks one above the other, and all enclosed in an air-tight casing or heating chamber. Steam is then injected when seven-eighths of the carbonic acid gas, accompanied by a little ammonia, is driven off and passes through the condensing tower just mentioned to another washing scrubber fed with water, where the last traces of ammonia are removed. These washings pass to the top of the condensing tower, and the pure carbonic acid gas to a gasholder. When the sesquicarbonate of ammonia is required as an essential by-product, it is not run, after reaching the bottom of the condensing tower, into the heating apparatus, but into special receptacles, and used in the ammonia-soda process. In this case a higher temperature in the heating apparatus is also maintained in order to leave less ammonia in the liquors running from it.—S. G. R.

An Improved Process of Manufacturing Acetate or Pyro-lignite of Iron or Iron Liquor. P. McLaren, Falkirk. Eng. Pat. 15,293, October 24, 1888. 6d.

A TUN or cistern of sufficient size is nearly filled with a mixture of sawdust and finely-divided iron, and upon this is run the acid. After standing for a few hours the acid is found to be saturated and is then run off by a pipe placed in the bottom of the vessel. A fresh charge of the acid preferably warmed is then introduced. It is claimed that in this way a much purer product is obtained, that cast-iron borings, or what is called in commerce "iron rust," can be employed, that the acid is saturated in a much shorter time, and that there is no loss of iron inasmuch as there is no preliminary burning of the iron to free it from the tarry matter usually adhering to it, this being retained by the sawdust. The sawdust when too impure can be dried and burned in the furnaces of the manufactory.—S. G. R.

Improvements in Apparatus for Incinerating Spent or Used Alkaline Lyes or other Waste Products or Precipitates containing Carbonaceous Matter. T. McDougal and J. Jarline, Penicenick. Eng. Pat. 15,675, October 31, 1888. 8d.

THE apparatus herein referred to consists essentially of a furnace made up of three main parts, these being placed the one above the other. At the top is a large pan in which the lye is partially concentrated by waste heat from below. Under this are two brickwork vessels, deeper in the centre than at the sides, running the whole length of the furnace. These rest on the crown of the arch of what is practically a reverberatory furnace which is furnished with a fire at each end, and with its hearth divided into two portions by a ridge raised above the bottom and running the whole length of the bed. The working of the furnace is as follows:—After the lye has undergone a partial concentration in the upper pan it is run by suitable channels on to the shelving sides of the tanks below, over whose heated surfaces it passes to the lower central portions, the tanks being thus gradually filled. Here it is further concentrated, and then by apertures passing through the crown of the arch it reaches the hearths below, where the final incineration takes place. By a suitable arrangement of flues the heated gases from the furnaces can be caused to travel in any required direction.—S. G. R.

The Treatment of Waste Liquors from Galvanising Works or other Liquids containing Chloride of Iron or Chloride of Iron and Hydrochloric Acid, and for extracting therefrom Oxide of Iron and Hydrochloric Acid. T. Turner, Birmingham. Eng. Pat. 16,166, November 8, 1888. 4d.

THE liquors having undergone, if necessary, a preliminary concentration, are run into suitable vessels kept at a temperature considerably above the boiling point of the liquid, but below a red heat. Hydrochloric acid is driven off with formation of basic chlorides of iron. Air and steam are then introduced, with the complete conversion of the chloride into the oxide and the liberation of the residual hydrochloric acid. The hydrochloric acid gas is passed through condensing towers or other convenient apparatus.—S. G. R.

Improvements in Vessels used for Boiling and Evaporating Acids or Strong Alkalis. W. Townsend, Ravensthorpe. Eng. Pat. 16,523, November 14, 1888. 4d.

THE inventor places within the metal retorts either a fireclay or earthenware glazed vessel set in cement, the apparatus being thus more durable and not acted upon by the liquors to be concentrated.—S. G. R.

Improvements in the Manufacture of Common Salt and in the Construction of Appliances for effecting the same. A. Collingridge, London. From V. Cornet and A. Jones, Paris, France. Eng. Pat. 3338, February 25, 1889. 8d.

THE brine travels from an overhead reservoir through a filtering press made in sections bolted to one another. It then passes to an evaporating chamber, divided into an upper and smaller and a lower and larger division by a horizontal partition, where it is heated and concentrated by a fire placed beneath. The steam which is formed is taken by a suitable arrangement of pipes through a series of either iron or stout porcelain retorts, which are charged with finely-divided iron scrap or turnings, and placed in the furnace already mentioned, and which thus subserves two purposes. The inflammable gas thus produced can either be stored until required for use or it is burnt in the upper division of the evaporating chamber in ordinary atmospheric burners, the heat being concentrated on the dividing diaphragm in the evaporating chamber, and thus aiding in the more rapid evaporation of the brine.—S. G. R.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Manufacture of Bottles by Machinery. H. M. Ashley. (A Paper read before the Mechanical Science Section of the Brit. Assoc., Newcastle Meeting, 1889.)

THE new system of manufacture is based on the fact that glass, generally a very slow conductor of heat, becomes, under certain conditions, a very rapid conductor. By varying the temperature glass can within five minutes be rendered fluid, plastic, elastic, or brittle. It was during the transition of the glass from the solid to the molten state that the plastic condition is reached. In the process of the author no joints or welds are required, and the operations necessary may be briefly described as casting, punching, and blowing. A dummy bottle is first cast in an inverted position in what are known as "parison and ring" moulds; then, whilst semi-fluid, a hole is punched inwards in the neck, the piece removed remaining inside and serving to form part of the bottom. The bottle is finally completed by being blown out with compressed air in the bottle-mould. The air pressure was about 10 lb. per square inch. The apparatus is arranged on a rotating frame, by means of which the bottle in its various stages of development is passed on from one operator to another. It was stated that the glass treated by this process is very strong, and that a better finished bottle could be turned out by it than by the old process.

The Technology of Glass. Dingl. Polyt. J. 273, 129—131.

O. SCHOTT describes experiments which he has made with a view to improving the quality of glass used for optical and scientific purposes. He tried the effects of the addition to the glass of a large number of materials such as boric and phosphoric acids, cadmium, zinc, erbium, cerium, didymium, thallium, and other metals. Fletcher's ovens were used in the experiments. In attempting to reduce chromatic aberration it was found that boric acid caused a contraction in the blue portion of the spectrum and an expansion in the red, whilst fluorine, sodium, and potassium acted in the opposite way, the other substances tried producing no differences. Boric acid can consequently be advantageously added to flint glass, which shows excessive aberration in the blue. The percentage of potassium which can be introduced into crown glass being rather limited, fluorine, which is easily added to phosphate glass, should also be added. Phosphoric acid, combined with certain metallic oxides, gives glasses of low dispersion and high refraction. Such glasses, combined with boric acid flint glass, form excellent objective glasses for telescopes. Alkalis must be added in small amount only to

boric and phosphoric acid glasses, or otherwise the polish of the glass is quickly injured by atmospheric influences. Hygroscopic glass is rendered serviceable by the addition of fairly large proportions of alumina, zinc oxide, &c. With phosphate glass, magnesia, alumina, and potash produce the least dispersion. Baryta and phosphoric acid yield crown glass with little dispersion and an index of refraction of 1.55 to 1.59.—E. B.

PATENTS.

Improvements in the Utilisation of Waste and other Glass. H. A. Pavely, Richmond. Eng. Pat. 12,450, August 29, 1888. *Ad.*

WASTE and other glass is melted and poured into suitable moulds for the manufacture of bricks, tiles, drain pipes, and the like.—E. G. C.

New or Improved Machinery for the Manufacture of Seggars or Saggars, Crucibles, Melting Pots, Pipes, and other Hollow and Tubular Articles from Clay or other Plastic Material. J. Hamblet, West Bromwich. Eng. Pat. 14,644, October 11, 1888. *1s. 1d.*

FOR details of this invention the specification and drawings must be consulted.—E. G. C.

Improvements in or relating to Painting or Printing upon Earthenware. W. H. Turner, Tunstall. Eng. Pat. 18,577, December 19, 1888. *Ad.*

THE inventor produces the design upon the plate or roll by etching with acid in the well-known manner, but instead of completing the process at one or two operations, he prefers to make several operations of it, by this means "obtaining differences and fineness of shade hitherto unobserved."

—E. G. C.

Improvements in the Manufacture of Porous Earthenware. H. J. Allison, London. From C. C. Gilman, Eldora, Iowa, U.S.A. Eng. Pat. 9645, June 11, 1889. *Ad.*

FIBRES of asbestos wool are introduced into the plastic composition and thoroughly incorporated with it.—E. G. C.

An Improved Compound suitable for the Manufacture of various Articles by Moulding. H. H. Lake, London. From C. T. Lee, Boston, U.S.A. Eng. Pat. 9927, June 17, 1889. *Ad.*

SIXTY-FIVE parts by weight of mica in pieces varying in size up to "one-eighth or one-quarter of an inch" are incorporated with 35 parts of shellac by the aid of heat, worked into sheets and afterwards re-softened for moulding, or moulded direct into any desired shape. The laminated character of the mica enhances the strength of the product.

—B. B.

Improvements in the Manufacture of Translucent Enamel, and in the Application of the same in Relief for the Decoration of Glass, Metal, or any Ceramic Ware. W. Lutwyche, London. Eng. Pat. 10,322, June 25, 1889. *Ad.*

THE following materials are used in the production of this translucent enamel:—minium, boric acid, oxide of zinc, stannic acid, sand, soda, feldspar, fluor spar, carbonate of potassium, carbonate of calcium, borax, and sodium nitrate. The colouring matters are manganese dioxide, purple of Cassius, ferric oxide, lead chromate, cobalt oxide, cuprous oxide and cupric oxide.—E. G. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Notes on Portland Cement. Zeits. f. angew. Chem. 1889, 366—371 and 384.

Schumann has shown (Zeits. f. angew. Chem. 1881, 523) that all cements and building stones expand when saturated with water, and contract on drying. Recent experiments of his fix the mean expansion for prisms of one part of Portland cement, and three of normal sand 10 cm. in length, at 0.0088 mm. for one week, and 0.002 mm. for one to four weeks, the test pieces being kept under water. The contraction in the dry state is of greater importance; similar prisms kept under water for one week and then exposed for three weeks to the air, gave an average contraction of 0.0417 mm.

R. Dyckerhoff has investigated the influence of magnesia on Portland cement. He finds that up to 3 per cent. no evil effect can be traced to it, but larger proportions cause the cement to be of an exceedingly treacherous character, as its tendency to retrograde in strength and to expand is only manifest after the lapse of many weeks, and thus escapes detection by the standard tests.

The test used for detecting a tendency to expand is called the "firing" test ("Darrprobe"), and is executed as follows:—The cement is gauged neat with enough water to make it of normal consistency, and two pats 10 × 1 cm. made of it on glass or metal plates, and placed in a damp box in order to protect it from sunshine or draughts, and thus avoid the formation of cracks due to shrinkage. At the end of 24 hours the pats are transferred to an air-bath, the temperature of which is gradually raised to 120° C., and kept there for two or three hours after the last visible evolution of steam has ceased. Any crumbling, or the formation of cracks starting at the edge of the pat, and disposed somewhat radially, condemns the cement for use in work exposed to the air. Care must be taken to distinguish the cracks above-mentioned from cracks caused by shrinkage due to too rapid drying; these latter start from the centre, and occur concentrically or assume the form of a capillary network.

Cements which are not burnt to the sintering point, e.g., Roman cement, are less liable to injury from the presence of much magnesia. (Cements made from magnesia and magnesium chloride, harden in the air, but soften when exposed to moisture; marble-like table-tops made by F. A. Schmidt of Dresden failed from the same cause, and their manufacture had to be given up.)

Schott long endeavoured to make a cement of purely basic materials by burning together magnesite and waste marble, founding his hopes on the fact that intimately mixed calcium and magnesium carbonates yield on ignition a slightly sintered mass which, when finely powdered, sets under water, but without success.

R. Dyckerhoff finds that Portland cement mortars, after free exposure to the disintegrating influence of the atmosphere for 10 years, show a distinctly increased strength in compression.

In the case of the cement from "Stephans Dom" in Vienna (which appears to have failed), analysis showed that it had been used without the addition of sand, and revealed no cause for its destruction; various observers advance different hypotheses, such as assigning the failure to the action of water penetrating into the crevices due to the shrinkage of the cement, which shrinkage would have been avoided by the use of sand, also to the inferior character of the stone itself, while Schott dwells on the fact that the cement was of English make.

Schiffner enumerates three heads under which the influences governing the hardening of Portland cement may be grouped. (i.) The nature and character of the normal sand. (ii.) The influence of foreign matters, such as acid liquids, vegetable oils, liquors containing tannin, sour beer, and such like, that may come in contact with it, owing to the use to which structures built with it may be put. (iii.) The careless treatment of it while building, e.g., delay in using it after mixing, the use of too much or too little

water, and so forth. He has instituted a series of experiments, showing the result of different treatments of cement after gauging. (i.) Cement put, immediately after gauging, in a closed box for 24 hours, then kept 27 days under water, and finally exposed to the extremely dry air of the laboratory, showed no signs of expansion, was of satisfactory hardness, and had no tendency to retrograde in strength; it contained 10—11 per cent. of combined water and 1·15 of carbonic anhydride. (ii.) Cement treated in the same way, save that it was kept only three days under water, was somewhat inferior in hardness to that mentioned under (i.), but showed no proneness to expansion or distortion: it contained 6—7 per cent. of combined water and 15·25 per cent. of carbonic anhydride. (iii.) Cement exposed at once to dry air was all more or less friable; its precise condition was governed by several causes, such as the time of year, thickness of the test-pat, fineness, rate of setting; it contained less than 4 per cent. of combined water, and 7—8 per cent. of carbonic anhydride.

The reason of this is simple: parts not exposed to water or very damp air for a sufficient time, fail to obtain enough water for their complete hydration: this was strikingly shown by transferring some of the pats—so friable that they could be moved only with difficulty—to water for four weeks, at the end of which time they had become fairly hard and permanent in air.

Böhme proposes that the normal consistency of a cement be determined by means of a standard needle having a circular end 1 cm. in diameter and loaded with 300 grms. If this come to rest 6 mm. from the surface of a glass plate on which is the cement to be tested, confined by a ring 8 × 1 cm., the consistency of that cement is normal.

Tomčič has ascertained the influence of air and other gases on the strength of Portland cement. Dry carbonic anhydride, and, in a less degree, dry air, increase the strength in tension and compression appreciably, while moist air, dry sulphuretted hydrogen, and the addition of 0·25 to 1·00 per cent. of calcium sulphide considerably lower it.—B. B.

PATENTS.

Manufacturing Artificial Stone. E. de Pass, London.

From R. H. Stone, Brighton, Victoria. Eng. Pat. 4927, Nov. 10, 1881. (Second Edition.) 6d.

This inventor uses the following materials and proportions:—Sand, 70—80 per cent.; amorphous silica or silicates, 10 per cent.; slaked lime, 10 per cent.; water, 10 per cent., by measure respectively.—E. G. C.

Improvements in the Manufacture of Artificial Stone and Concrete Blocks. J. W. Ransome, Stoke Newington.

Eng. Pat. 14,286, October 4, 1888. 4d.

The usual method is to mix the materials (say Portland cement and sand), with water, and to place the mixture in a mould. According to the present invention the dry materials are placed in a mould and exposed to pressure, and while in this state water is introduced, preferably from beneath.—E. J. B.

Improvements in the Manufacture of Cement. C. J.

Widmark, Örebro, Sweden. Eng. Pat. 964, January 18, 1889. 4d.

The inventor claims the manufacture of cement by submitting lime, previously burned to the ordinary degree, or such other ingredients as may be used, "to a further burning under a high degree of heat, and then pulverising it or them."—E. G. C.

An Improved Vitreous Material for Paving and other Purposes. J. Rust, London. Eng. Pat. 13,211, July 13,

1889. 4d.

The ingredients are:—Sand, soda ash, native barium carbonate, China clay, phosphate of lime, and sodium nitrate.

—E. G. C.

X.—METALLURGY.

The Influence of Chemistry upon the Iron and Steel Industry in Recent Years. Sir Lowthian Bell, Bart. (Presidential Address to the Chemical Section of the British Association, Newcastle-on-Tyne, 1889.)

It has occasionally been the practice of former occupants of this chair to devote a considerable portion of the presidential address to the more recent discoveries in chemical science. This branch of learning advances now with such rapid strides and covers so wide a field that no one who has not made it the business of his life can hope to discharge this duty with even a moderate share of success.

My immediate predecessor, indeed, discouraged any further attempts in this direction on the ground of the impossibility of doing it justice within the limits of a short discourse, and his remarks were consequently directed to the best methods of teaching the science with which Section B is more directly concerned. I propose this morning to add my testimony to the importance of Dr. Tilden's recommendation by comparing the rate of progress of one of our great national industries as it has been advanced with and without the aid which chemistry is capable of affording. For this purpose I have selected the metallurgy of iron, not only from my greater familiarity with its details, but because, in my judgment, it affords a suitable example for the object I have in view.

It is needless to insist on the disadvantage attending the application of a science to practical work, without a fair knowledge of the principles which regulate its action. At the same time it would be unfair to those who were engaged in the manufacture of iron during the first half of the present century, to deny the value of the services which they rendered to their art, without having given much thought to the laws of nature upon which their processes depended. The work so performed sufficed, nevertheless, to place the world in possession of the metal in such abundance and at so low a cost that no engineering works were delayed on account of the high price or absence of the required quality in the produce of our ironworks during the period in question. On the other hand it is not to be denied that since the ironmasters have allied themselves with the chemist they have made more progress in thirty years than their predecessors did in three centuries.

No one unacquainted with the archaeology of the iron trade could suppose that the colossal furnaces now pouring forth their streams of molten metal, followed by the rapid action of the Bessemer converter, were the modern representatives of the iron-making appliances of former days. Out of these last, in a low hearth not larger than a domestic fireplace, often dependent on the wind for their blast, a few pounds of ore were, at a considerable cost for labour, fuel, and waste of metal, converted into malleable iron. By means of a modern furnace, in an hour and a half a 10 ton converter can be filled with liquid cast iron, which in 20 minutes may be run into ingots cheaper, stronger, and more malleable than the best wrought iron of our ancestors, or indeed of our own manufacture.

How out of the small fire of the ancient ironworks, the German Stück-Ofen was evolved is a matter of conjecture. In both, owing to the conditions under which the fuel was burnt, carbon dioxide was largely the product of its combustion. The oxidising property of this gas was in each the cause of the waste of metal just spoken of. Probably, and for other reasons than avoiding this loss of iron, attempts were made to increase the dimensions of the Stück-Ofen. If this addition were one of limited extent, the smelter would find, to his cost, that a substance was obtained which no longer possessed the malleable property of that obtained from the lesser furnace. This change would be due to the absorption of carbon, but not in sufficient quantity to constitute that valuable form of the metal known as cast iron. With a material, useless for the smith and incapable from its difficult fusibility of being run into moulds, we can understand the delay which took place in the introduction of the blast furnace which, about the middle of the 16th century, gave to cast iron a recognised and valuable position in the arts.

In those days there was no very exact science to appeal to, for 250 years after the "high furnace" of the Germans and French had been set to work, Fourcroy, in his "General System of Chemical Knowledge and its Application to the Phenomena of Science and Art," arrived at the conclusion that cast metal was erroneously supposed to be a mixture of slag and iron, or a compound of arsenic or manganese and iron. This was written in 1804 in a work of 5,000 pages, when he lent to the opinion that Monge and Berthollet were more correct in considering the product of the blast furnace as consisting of iron, oxygen, and carbon.

When the malleable iron-maker had placed in his hands a material containing, as the pig did, more than 90 per cent. of metal, he found it greatly to his advantage to avoid having to deal with all the earthy matter contained in the ores, for it was the presence of silica and alumina which helped to add to the waste incurred in the old hearths. The object sought for in treating ore in the old Catalan fires, as they were called, was one of a reducing or deoxidising character, whereas the reverse of this was required when ore was replaced by pig iron. In the first case, oxygen had to be removed from the oxide of iron, in the latter oxygen had to be united with the metalloids found in the pig. These were distinctions unknown in the days we are considering, and therefore did not trouble the minds of the ironmasters. In both cases there was a large quantity of oxide of iron present, and when pig iron was handed over to the Catalan furnaceman, it was the oxide of iron so generated which performed the desired duty, and thus this simple mode of procuring malleable iron remained undisturbed for upwards of 200 years.

The discovery which led to the discontinuance of the low blast furnace as a means of procuring iron in its malleable form was that of puddling made by Cort in 1784. In point of fact Cort's process was merely doing in a reverberatory furnace that which was previously effected by means of compressed air. In an economic point of view, however, the difference is great, and its consequences were of immense importance, for to the puddling furnace we were first indebted for an ample supply of cheap iron by which, in a variety of well-known ways, the interests of the human race have been so largely promoted. As an indication of the indifference of those formerly engaged in industrial pursuits to the scientific aspect of their calling, may be mentioned the fact that puddling had been largely followed for upwards of half a century before it occurred to any one to examine the chemistry of the process.

Down to the beginning of the 17th century the only fuel used in the blast furnace, and, indeed, in the manufacture of iron generally, was charcoal. In 1620 Dudley made several attempts to substitute mineral coal in his smelting works for vegetable fuel, which, by the exhaustion of timber, had become very expensive. He failed in this, and in consequence the British iron trade gradually fell, until the entire output was not equal to the production of one modern blast furnace. This happened in 1740, when Darby, by treating pit coal in the same fashion as the charcoal burners had done with wood, i.e., by charring it, restored vitality to an expiring industry. It is true that the restoration must have been of a languid character, for in half a century afterwards it is said the weekly produce of a furnace did not exceed 15 or 16 tons.

Various changes were introduced into the manufacture of iron in the first quarter of the present century, but these were rather of a mechanical than of a chemical nature. They chiefly owed their origin to the lessons taught by the chemist Black to James Watt, who profited by them in the application of steam as a motive power. This brings us to the year 1828, a year which will always be distinguished in the annals of the iron trade, by the discovery of Neilson of the value of heated air in smelting the ores of this metal. I never heard it maintained that this inventor had any pretensions to be considered a man of science. Had it been otherwise, the knowledge of the virtues of the hot blast might have been indefinitely postponed, and this opinion is founded on the fact that for many a long year no satisfactory explanation was given why heat, obtained by burning coal, in the hot air apparatus, was capable of saving three or four times its weight in the fuel consumed in the furnace itself.

I propose, with your permission, to consider this subject with more attention than I shall devote to other portions of this address, and I am led to do this, not only because it is one of some scientific interest, but because its study seems to afford a solution to some questions in respect to which great differences of opinion prevailed among those whose daily work led them to pay much attention to their details. These questions have all a reference to the quantity of fuel consumed in smelting the ore, as this may be affected by the temperature of the blast and the dimensions of the furnaces employed for this purpose.

As is well understood, the heat excited in an iron furnace may be classified under three heads:—

First, that derived from the combustion of the coke at the point where the blast enters the furnace, the ultimate product being carbonic oxide.

Second, the conversion of a portion of this carbonic oxide into carbon dioxide.

Third, the heat carried into the furnace by the blast.

For the better illustration of the relations which the heat derived from these sources bear to one another, a table (No. I.) has been prepared in which the quantities of each are given in centigrade calories, and reckoned upon 20 units of iron to correspond with English weights. The information upon which the calculations are based is derived from actual observation gathered from furnaces of different sizes and fed with air at different temperatures.

A second table contains statements showing the manner in which the heat so generated is appropriated in the various divisions of the duty the furnaces had to perform, and for facility of comparison, alongside the quantities of heat so required, their equivalents in the coke used have been added.

In the table No. II. the appropriation of the heat is separated into *Constants* and *Variables*. The first consists of items where the quantity of heat required in making a particular quality of iron is only liable to alterations of trifling amount. On the other hand, the variables exhibit in A and B differences so considerable that work which in the furnace blown with cold air absorbed 73,388 calories per 20 cwt. of pig iron was done with 58,645 calories by merely raising the blast to 485°.

TABLE I.

—	A.	—	—	—
Height of furnace in feet.....	48	48	80	80
Calories per unit of coke burnt to CO.....	2,078	2,028	2,018	2,045
Calories from portion of this CO burnt to CO ₂	560	1,059	1,636	1,463
Total calories from coke	2,638	3,087	3,654	3,508
Calories in blast	—	508	534	732
Total heat per unit of coke.....	2,638	3,595	4,188	4,240
Temperature of blast C	0°	485°	485°	695°
Cwt. blast per ton of metal.....	228	128	163	94
Cwt. escaping gases per ton of metal.....	285	170	138	126
Cwt. slag per ton of metal	31	31	29	28

The cause of this great variation in the amount of heat required for a given weight of pig iron, produced under different circumstances as to temperature of blast and size of furnace, depends on changes in the actual amount of work to be performed. How this variation arises will be best seen in the description of the four examples set forth in the two tables.

TABLE II.—SHOWING THE APPROPRIATION OF HEAT AND ITS EQUIVALENT PER TON OF IRON IN CWT. OF COKE.

Appropriation of Heat per 20 of Pig Iron.	A—Blast 6° C.		B—Blast 485° C.		C—Blast 485° C.		D—Blast 695° C.	
	Calories.	Coke.	Calories.	Coke.	Calories.	Coke.	Calories.	Coke.
Constants:—		Cwt.		Cwt.		Cwt.		Cwt.
Reduction of Fe_2O_3 in ore	33,168	12'550	33,168	9'200	33,168	7'905	33,168	7,898
Reduction of metalloids in pig	4,174	1'382	4,174	1'161	4,174	'996	4,174	'984
Dissociation of CO ($2\text{CO} = \text{C} + \text{CO}_2$)	1,440	'546	1,440	'400	1,440	'344	1,440	'340
Fusion of pig iron.....	6,600	2'501	6,600	1'836	6,600	1'576	6,600	1,557
Constant calories per 20 of pig	45,322	..	45,322	..	45,322	..	45,322	..
Coke consumed per 20 of pig .....	..	17'179	..	12'606	..	10'821	..	10'689
Variables:—								
Evaporation of water in coke	630	'239	411	'114	312	'074	298	'070
Decomposition of water in blast.....	5,420	2'055	3,348	'931	2,720	'649	2,408	'568
Expulsion of CO_2 in limestone	6,660	2'526	5,920	1'647	5,654	1'207	4,070	'961
Reduction of CO_2 in limestone to CO	6,912	2'620	6,144	1'709	5,248	1'254	4,099	'962
Fusion of slag	18,590	7'045	17,325	4'819	16,720	3'903	15,565	3'673
Carried off in escaping gases	29,482	11'178	18,485	5'144	11,943	2'636	8,906	2'101
Heat in tuyere water at hot-blast furnaces, loss from walls, &c.....	5,694	2,158	7,011	1'950	7,057	1'686	9,389	2'216
Variables for 20 of pig.....	73,388	..	58,645	..	48,154	..	44,735	..
Variables for coke for 20 of pig.....	..	27'821	..	16'314	..	11'499	..	10'551
Sum of constants and variables:—								
Calories for 20 of pig iron.....	118,710	..	103,967	..	93,476	..	90,057	..
Cwt. of coke for 20 of pig iron .....	..	45'	..	28'92	..	22'32	..	21'24

Beginning with A, which is a furnace 48 ft. in height, blown with cold air and consuming 45 cwt. of coke and 18 cwt. of limestone per ton of metal, the volume of gas produced may be taken at 14,460 cubic yards at ordinary temperatures and pressures. At the temperature at which it escapes we may assume the volumes per ton of iron to be about 36,000 cubic yards, passing out of the furnace at the rate of 675 cubic feet per minute.

In comparing the consumption of coal formerly burnt in the hot-air stoves with the saving of coke in the furnace, account must be taken of the different conditions of the combustion. In Table I., owing to the small quantity of carbon dioxide formed, the heat evolved is only 2,638 calories per unit of coke, whereas each unit of the coal consumed in heating the air afforded three times this quantity of heat. Doubtless there was a great loss in the operation of heating the air, for it would not appear that much above one-fourth of the theoretical quantity of heat capable of being generated by the coal reached the furnace through the tuyeres.

We have now to consider the nature of the change which is effected in a furnace where, for every 2,638 calories generated by the combustion of the coke, 508 calories are carried in by the blast. It will be readily understood that, with the velocity at which the gases are passing out of the cold-blast furnace, they have but little time to impart their heat to the incoming solids, or to have the carbonic oxide they contain converted into carbon dioxide. The withdrawal of so much coke, and its place taken by heat contained in the blast, means that the 14,460 cubic yards of escaping gases are reduced to about 12,120 cubic yards. The effect of this is not only to alter the speed at which the gases are passing through the materials, but to alter the relation in point of quantity which the ironstone present in the furnace bears to the coke, so that in point of fact a larger space is occupied by the ore than was before, and a lesser one by the fuel. We have thus the carbonic oxide passing more slowly over the oxide of iron at the same time

that there is a greater quantity of the oxide exposed to the influence of the reducing gas. To illustrate how this operates, a table has been prepared showing how each 1,000 cubic feet of furnace space is occupied in the four cases we are considering:—

	A.	B.	C.	D.
	48 ft. Cold Blast.	48 ft. Hot Blast.	80 ft. Hot Blast.	80 ft. Hot Blast.
Coke.....	Cubic Feet. 736	Cubic Feet. 686	Cubic Feet. 590	Cubic Feet. 590
Limestone	63	75	86	77
Ironstone	201	239	324	333
Total.....	1,000	1,000	1,000	1,000

The immediate effect of the introduction of the hot blast is to alter the spaces filled by the three minerals from those given in Column A. to coke 686, limestone 75, and ore 239 cubic feet. This is followed by a twofold advantage. Volume for volume, ore and limestone possess double the heat-intercepting power of coke, and there is 19 per cent. more ore ready to oxidise the carbonic oxide passing over it at a reduced speed of 16 per cent. than there was when using cold air. The increased efficiency of the coke, due to a more perfect cooling of the gases and higher oxidation of the carbonic oxide, permits its further suppression until the relative spaces filled by the materials are those shown under Column B. These advantages would not of themselves suffice to save 16 cwt. of coke or thereabouts out of 45 cwt., but the reduction in the coke consumed is followed by a diminution in the quantity of air used and in the weight

of gases and slag produced. A reference to the appropriation of heat classified under the head of "Variables" will show in consequence diminution from 73,338 to 54,643 calories.

It may be asked whether this prolonged exposure of the ore to the reducing gases could not be secured by driving the furnace at a slower speed. There is, however, a point which may be regarded as one of equilibrium, at which the quantity of cold materials charged at the top just suffices to reduce the temperature of the escaping gases, as far as is possible consistent with the dimensions of the furnace. If the volume of blast entering at the tuyères is lowered one-half it would mean that the materials would be exposed for twice the time to the hot gases that they were previous to the alteration in the rate of driving. The elevation in the temperature of the coke would enable its carbon to act on the carbon dioxide, so that there would ensue as great a loss under the second head of heat evolution in Table I. as there is gained by a more perfect interception of the heat contained in the gases.

There is, however, another way of securing this prolonged exposure of the ore to the action of the reducing gas without incurring the inconvenience just referred to, viz., by increasing the dimensions of the furnace blown with cold air. When this was done by raising the height from 48 to 71 feet it was found that the duty performed by the coke, apart from the heat contained in the blast, was just about the same as that in the hot-blast furnace.

With regard to the position of equilibrium above referred to, it is worthy of remark that, while this was reached when a furnace of 48 feet ran 100 tons per week when driven with cold air, it was not arrived at in one of similar dimensions using heated air until the make was increased to about 220 tons.

When we proceed to examine the composition and weight of the gases given off by a 48-foot furnace blown with air at 485°C ., it will be found that about 20 per cent. of the carbon as dioxide has disappeared, due no doubt to the still excessive temperature of the upper zone and too rapid a current of the reducing agent. An obvious way to remedy this evil would be by an addition to the capacity of the furnaces. This was done by raising them to a height of 80 feet, with a cubical space three or four times greater than those of 48 feet. In such a furnace almost the full theoretical quantity of carbon as dioxide has been obtained, but, while the larger furnace held three or four times more ore, &c., than the smaller, the production was only about double that of the lesser. On referring to Table II., it will be seen that a further economy of 6.6 cwt. of coke has been effected in furnace C. as compared with B., due solely to an enlargement of space, for the temperature of the blast was exactly the same in both. This improvement, it will also be perceived, is due to an extension of those causes which acted so beneficially when hot air was applied to B.

If 6.6 cwt. of carbon or thereabouts be the full quantity per ton of iron which can be found in the gases as dioxide, and if, in a furnace working under the conditions of C., it requires 22.32 of coke to furnish this carbon, and that in the carbonic oxide, it is clear we cannot withdraw any coke without disturbing the position of equilibrium supposed to have been established in the case of the furnace in question. Suppose that into such a furnace, the blast, instead of 485° , is admitted at 695° as happened under Column D. The additional heat, 732 calories, instead of 534 as in C., will make itself felt throughout the entire height of the furnace, including, of course, the upper zone. Immediately this happens, some of the carbon dioxide generated by the reduction of the ore attacks the coke and escapes as carbonic oxide. If Table I. is examined, it will be seen that almost the whole of the additional heat carried into the furnace D., as compared with C., has been absorbed by the disappearance of carbon dioxide, so that the net power of the coke unit in both cases is practically the same. Nevertheless, it will be remarked that there is still a small saving of coke due to a reduced amount of blast, escaping gases, &c.

From what has preceded, it has been concluded that a furnace of 80 ft. affords sufficient opportunity for the gases being as fully saturated with oxygen as the nature of the

process of deoxidising the ore will permit. The sensible heat in the escaping gases, however, still represents a considerable loss, reduced, as it has been, from 29,482 to 11,013 calories.

According to estimate it was believed that the reduction of oxide of iron ought to be attended by an increase of temperature—in other words the conversion of carbonic oxide into carbonic dioxide produced more heat than that absorbed by splitting up oxide of iron into its constituent parts. The estimated difference not being a large one, an experiment was made by substituting in the furnace inert substances having about the same specific heat as the ore. The results confirmed the correctness of the calculation—the temperature of the escaping gases fell, and rose to their normal point when the use of ore was recommenced. A more expensive experiment was subsequently made in the same direction by building, at Ferryhill, a pair of furnaces having a height of 103 feet, without any substantial benefit being derived from the large additional expenditure incurred.

It was Scheerer, I think, who first divided the blast furnace into zones. The first division, beginning at the top and extending 12 feet downwards, was designated the preheating zone; the following 18 feet downwards was distinguished as the reducing zone; the next 8 feet the carburising zone, followed by 4 feet which constituted the zone of fusion. The lowest of all, having a depth of about 6 feet, was named the zone of combustion. The author of this mapping out, as it were, of the interior of the furnace does not wish to be understood as confining its various functions within the respective spaces assigned to them; on the contrary, he admits the existence of considerable variations of position. My own observations, however, have led me to conclusions varying considerably from those adopted by Scheerer.

The fundamental cause of these differences seems to depend on the temperature considered as being required for a commencement of the reduction of the ore. By Scheerer, the reducing zone is considered to require a temperature of $1,000^{\circ}$ to $1,200^{\circ}\text{C}$. This change undoubtedly is not the same with all kinds of ores, but my experiments were conducted when using almost every variety of the mineral. According to the trials made, a mixture of one volume of carbon dioxide and two volumes of carbonic oxide at a temperature of 410° removed 10 per cent. only of the oxygen in Cleveland ore, and 37.8 per cent. from an artificially prepared oxide. The composition of the gases at the different depths, however, indicates in an unmistakable manner the nature of the action which is going on at any particular point. A table has been prepared from actual analyses of the gases, which gives the quantity of oxygen present for every 1,000 parts of metal produced; and to this is added the weight of carbon they contained. The results vary, but the general inference to be drawn from the observations made on furnaces of 80 feet is that, by the time the minerals have passed through a space of 8 feet of the depth they have to travel, all the oxygen susceptible of removal from the ore in the upper region is found in the gases, the remainder being retained until it reaches the zone of fusion. The same is the order of action, in a somewhat modified form, which was found to prevail in the case of furnaces 48 feet in height.

On casting the eye along the lines of figures, a somewhat remarkable circumstance is apparent, viz., that the quantity of oxygen per 1,000 of pig iron gradually decreases as the gases ascend, until they approach the upper region, when it commences to increase. This had been the subject of observation for many years without any complete explanation being given of its cause. Dr. Percy, among others, bestowed some attention to the circumstance without arriving at any opinion satisfactory to himself. It is a little extraordinary that, so far as I have seen, no notice has ever been taken of the fact that the carbon in the gases followed the same law. While engaged in investigating the action of furnace gases on the ore, a peculiarity was observed previously unknown to me, viz., that large quantities of carbon were deposited by the dissociation of the reducing gas, the action being $2\text{CO} = \text{CO}_2 + \text{C}$. Experimentally, I

ascertained that spongy iron, as well as oxide of iron, was capable of producing the change, and that 30 per cent. of carbon dioxide, mixed with the carbonic oxide, arrested the reaction, the temperature at the time being 420°. Dr. C. A. Wright, who subsequently became chief chemist of our laboratory, was asked to continue the examination. The conclusion arrived at was the impossibility of effecting the complete reduction of Fe_2O_3 or of any oxide by CO . On the contrary, when metallic iron known to contain no

oxygen was exposed to a current of this gas, carbon was deposited and oxygen absorbed. It would seem, therefore, that this absorption of oxygen by the iron and precipitation of carbon suffice to explain the disappearance of these two elements from the gases, and that they remain in this condition until the fusion of the iron, in contact with intensely heated carbon, liberates the oxygen as well as that portion of the carbon which is not absorbed by the metal in order to produce pig iron.

TABLE III.—SHOWING THE QUANTITY OF OXYGEN AND CARBON IN GASES PER 1,000 PARTS OF PIG IRON PRODUCED. THE EIGHT FEET IMMEDIATELY BELOW CHARGING PLATES IS OCCUPIED BY CHARGING APPARATUS.

Distance below Top of Minerals.	0 Feet.		8½ Feet.		18 Feet.		31 Feet.		44½ Feet.		57 Feet.		62½ Feet.		68 Feet.	
	O.	C.	O.	C.	O.	C.	O.	C.	O.	C.	O.	C.	O.	C.	O.	C.
No. 1. Oxygen ...	1,843	..	1,250	..	1,235	..	1,234	..	1,230	..	1,207	..	1,137	..	1,348	..
Carbon....	..	1,101	..	864	..	816	..	871	..	904	..	849	..	890	..	967
No. 2. Oxygen ...	1,843	..	..	..	1,410	..	1,482	..	1,190	..	1,207	..	1,255	..	1,366	..
Carbon....	..	1,104	..	..	..	914	..	1,046	..	894	..	887	..	..	..	927
No. 3. Oxygen ...	1,670	..	1,309	..	1,206	..	1,312	..	1,256	..	1,253	..	1,253	..	1,378	..
Carbon....	..	1,048	..	926	..	907	..	918	..	946	..	931	..	939	..	1,013
No. 4. Oxygen ...	1,670	..	1,271	..	1,224	..	1,300	..	..	..	1,261	..	1,285	..	1,387	..
Carbon....	..	1,048	..	897	..	898	..	917	..	..	..	926	..	977	..	1,024

NOTE.—Nos. 3 and 4 were using partially calcined limestone, hence the deficiency of O and C until the lower depths are reached.

TABLE IV.—SHOWING WHAT MAY BE REGARDED AS A TYPICAL INSTANCE OF THE ABSENCE OF CARBON DIOXIDE IN THE GASES TAKEN FROM A FURNACE OF 80 FEET. MEASUREMENTS TAKEN FROM THE HIGHEST LEVEL OF THE MINERALS, *i.e.*, EIGHT FEET BELOW CHARGING PLATES.

Depth below Charge.	Escape Pipe.	3½ Feet.	9½ Feet.	16 Feet.	22½ Feet.	28½ Feet.	35 Feet.	41½ Feet.	66 Feet.
Carbonic acid	16°07	11°71	10°03	8°17	6°12	..	..	°72	3°01
„ oxide	27°34	29°71	31°39	31°40	32°79	35°27	36°00	36°02	39°47
Hydrogen	°11	°10	°07	°14	°28	°10	°11	°08	°14
Nitrogen	58°48	58°48	58°51	60°29	60°81	61°63	63°89	63°18	57°38
Total	100°	100°	100°	100°	100°	100°	100°	100°	100°

So far, then, as the analyses given in Table III. enable us to judge, instead of the upper two-thirds of a furnace being required for the purposes of reduction, no material change is effected after passing through 18 feet in a modern furnace of 80 feet in height. After this the composition of the gases, and, therefore, of the minerals, remains pretty steady until the vicinity of the tuyères is reached, with the consequences already referred to.

Of the excess of oxygen at the zone of combustion it is highly probable that a portion is due to the reduction of P_2O_5 , SiO_2 , SO_3 , and CaO . In the case of Cleveland iron I have estimated this at 54 parts per 1,000 of pig iron produced, but the average total oxygen, beyond that furnished by the blast in the first two instances given, was 130 parts. At this rate there must have been 76 parts of oxygen liberated from the oxide of iron, which is equal to 19 per cent. of that originally combined with the iron in the ore.

It may be appropriate here to refer to what may be taken as a typical expression of the working of a blast furnace in respect to the presence of carbon dioxide. An analysis of the gases is therefore inserted in Table IV., drawn from an 80-feet furnace at various levels, with the simple remark that it is improbable that carbon dioxide can exist for any length of time when exposed to incandescent coke at the temperature which prevails at the depths mentioned in the last two columns.

Something like 40 years ago the escaping gases from the blast furnaces, rich as they were in carbonic oxide, were permitted to burn wastefully on the surface of the minerals charged at the throat. This meant a loss of about 54 per cent. of the heating power of the coke. For reasons already given it was of course impossible to utilise much of this heat in the actual smelting of the ore, because of the necessity of preserving a large excess of carbonic oxide in the gases. This, however, constituted no reason why, apart from the furnace work itself, this vast quantity of gaseous fuel should not have been utilised, as it no doubt would earlier have been, had the ironmakers known, as they now do, its full value. To-day all the blast and other engines are driven and the air is heated at our blast furnaces by fuel formerly wasted, and this without any labour for stoking being required. In Great Britain alone the annual saving from this cause is fully equal to four million tons of coal.

In connexion with the other volatile products which accompany the iron smelters' work I will only mention ammonia. Some qualities of coal admit of being used in the raw state. In this case, as in distilling coal for illuminating purposes, ammonia is generated and may be collected. Instead, however, of the ammoniacal vapour being all contained in the hydrocarbons as in gas-making, it is diluted in addition with most of the fixed carbon as oxides and all the nitrogen of the atmospheric air used in its combustion.

Nevertheless Messrs. Bairds, of the Gartsherrie works, and others, are manufacturing large quantities of ammonia sulphate from the ammonia so obtained. A similar object is achieved by attaching the necessary condensers to the apparatus for coking coal. The process of distillation is then carried on in hermetically closed ovens heated by the combustion of the gases evolved. These, before reaching the fire-place where they are burnt, are deprived of their ammoniacal vapours by passing through condensers provided for the purpose. Previous, however, to this being done, the waste heat from the coking process had been applied for generating steam, so that at certain collieries in the county of Durham all the mechanical power is obtained without any coal being specially burnt for this purpose.

Before speaking of the next and last great improvements in connexion with my subject, I should like to say a few words, and a few words only, respecting steel, a well-known and most valuable compound of iron and carbon. Let me first observe that it seems improbable that this substance was not earlier known to the ancients, as was at one time supposed. The facility with which the metal combines with carbon renders it very unlikely that acieration would not occasionally take place when iron itself was the object of the manufacturer. Certain it is that Agricola, who wrote in 1556, describes in Latin a mode, apparently as well known as that of making iron itself, of making *Acie*. The engraving in his "De re metallica" shows bars of malleable iron placed upright in a charcoal fire resembling that of a Catalan hearth. These, after an exposure of several hours to the incandescent charcoal and hot carbonic oxide, were found changed to steel and employed as such.

After the invention of the blast furnace, pig iron was placed in a similar hearth to the Catalan, and while in a melted state a blast of air was directed upon the molten metal, until just as much carbon remained with the iron as constituted steel. This mode of procedure continued to be practised long within my own recollection, and may, for what I know, still be followed in some districts. The subject of steel-making occupied the attention of Hassenfratz, of Réaumur, and others, but practically the only process followed until 1865 was the well-known one of cementation.

Since the days of Fourcroy it had been ascertained that in addition to the iron carbon was an essential ingredient in cast metal, but invariably accompanied by more or less silicon, and whenever the minerals contained sulphur or phosphorus these metalloids were also present. The nature of the actions employed for ridding the product of the blast furnace of these substances so as to render it malleable had also been carefully examined and explained by the light of scientific investigation. The manufacturer had, it is true, learnt by experience and observation how to produce an article of excellence without much knowledge of the science of his art. Among other things he ascertained that to obtain a ton of wrought iron he required the heat of an equal weight of coal in the puddling furnace; but he did not know, nor did even men of science, I think, ever dream, that the oxidation of the metalloids in the pig iron, and that of a small portion of the metal itself, would afford heat enough to enable the workman to dispense with the use of all coal in the process of conversion. When, therefore, the iron trade was informed of this in a paper read before the British Association in 1856, entitled "A mode of making iron without the use of fuel," its author, Henry Bessemer, was set down by the iron trade as a deluded enthusiast. At that period I doubt whether 10 pounds of wrought iron had ever been seen in a state of fusion at one time. Bessemer, in his description, however, spoke of melting tons of it with no more heat than that afforded by the rapid oxidation of about 5 or 6 per cent. of the weight of the pig iron used. Not only, therefore, was the subject one of economic but also of high scientific interest. Nevertheless, a mere statement of the title of the paper was all the notice bestowed by our predecessors in their "Transactions" on a discovery which has revolutionised the art of making iron. It is quite true that for some time it appeared as if the scientific aspect of the question were to constitute its only recommendation, for the malleable iron made in a Bessemer converter proved unmanageable when hot, and destitute of strength when cold. Finally it was ascertained that phosphorus was the source

of the evil, and further, that while carbon and silicon could be almost entirely removed from the molten metal, this third metalloid remained unaffected by the treatment. The extent to which the hurtful influence of phosphorus makes itself felt in the wrought iron obtained by the Bessemer process is somewhat remarkable, because while two- to three-tenths per cent. is often present in puddled bars of fair quality, probably no consumer would accept Bessemer steel when it contains half of this amount. The first success was obtained in Sweden, where, by using pig iron containing a mere trace of the objectionable substance, a product was obtained which was satisfactory. For many years the beneficial effect produced by manganese on steel had been well known, and it occurred to R. F. Mushet, son of David Mushet, one of, if not the earliest scientific metallurgist in the United Kingdom, to try its influence in the converter on iron made from the hematite iron of the West of England, which contained from 0.5 to 1 per cent. of phosphorus. This addition, apparently by its removing occluded or combined oxygen in the molten iron, afforded the necessary relief, and the operation being one of extreme simplicity, enables steel or wrought iron to be produced at a greatly reduced cost. To such an extent has this been carried, that ore is brought by sea over a distance of 1,000 miles to Middlesbrough, and from it steel rails are made more cheaply than a greatly inferior article of iron can be produced from the abundant and economically wrought bed of ironstone found within a couple of miles of that town. As an example of the facility of conversion may be adduced the fact that the molten metal is brought direct from the blast furnace, turned into steel or ingot iron as the case may be, and the heat evolved by the operation is sufficient to enable the product in many cases, without further use of fuel, to be taken direct to the mill and rolled into a finished bar.

We have just seen that 1 per cent., or thereabouts, of phosphorus renders steel or ingot iron valueless; in like manner very insignificant variations in the quantities of carbon or silicon materially affect their quality. Now the blow, as it is termed, in a Bessemer converter may be accomplished in from 12 to 15 minutes. It is clear that therefore the opportunity of ascertaining the precise quality of the steel is one of very short duration. It is, I think, not disputed that a product can be obtained by this process possessed of very high, if indeed not of the highest, excellence, but it is also pretended that the quality is not sufficiently uniform for certain purposes. The ordinary reverberatory furnace is incapable of affording the necessary temperature for melting steel or wrought iron, but by employing the fuel in a gaseous state, and by heating the air and gas before they are brought together, as is done in the valuable furnace suggested by the Messrs. Siemens, the heat is so intensified that wrought iron in it is rapidly fused. Steel is now largely made in such furnaces, either by mixing wrought and cast iron, as proposed by M. Pierre Martin, or by means of cast iron alone, when the carbon is removed by the addition of iron ore and some limestone, in which case, by the agency of the ore, the metalloids are oxidised and removed from the bath of iron. Some hours being required for this sufficient opportunity is afforded for ascertaining the progress of the operation.

The cause of the iron in the Siemens furnace as well as in the Bessemer converter retaining its associated phosphorus began in time to attract the attention of chemists. In each case the expulsion of the metalloids is effected by oxidation. The carbon is gasified, and the silicon on being acidified is absorbed and forms a slag containing usually 45 to 50 per cent. of silicic acid. In the presence of such an excess of this substance, any phosphoric acid, if formed, could not be absorbed by the slag. It was the late M. Gruner, of Paris, who, in 1867, first pointed out this fact, and he it was who first recommended the use of lime in order to render the slag basic instead of acid. Further, in order to avoid the presence of silica, he recommended at the same time that the converter should be lined with lime instead of with fireclay.

The same subject engaged my own attention, when guided by the fact, that as oxide of iron in puddling was capable of acidifying and removing a large quantity of the phosphorus as iron phosphate, it might be possible

to make this removal more complete by some modification of the temperature of the furnace. This was found to be practicable without reducing the carbon below the point necessary for the easy fusion of the metal. The result of these experiments was communicated to the Iron and Steel Institute in March 1877, when it was shown that pig iron containing 1.75 per cent. of P could in a few minutes have this reduced to .2 per cent. This process is now being used in the United States for freeing cast iron from most of its associated phosphorus.

The rapid destruction of the ordinary Bessemer converter led Mr. G. I. Snelus to consider the practicability of using a lime lining, and on experimenting with this on a working scale he confirmed the opinions previously enunciated by Grüner by observing that the presence of lime had removed a considerable quantity of the phosphorus. These discoveries constitute the foundation of the very important basic process of Messrs. Thomas and Gilchrist, which consists in adding lime to the molten steel in a converter constructed on the principle described by Mr. Snelus. Considerable difficulty had, however, been experienced by this metallurgist in the attachment of the lime lining to the walls of the converter. This important question was solved by Mr. Edw. Riley by exposing dolomite to a very high temperature in order to prevent further shrinking, and then grinding it and mixing the powder with coal tar. This formed a species of cement which is applied to the sides and bottom of the converter in the form of bricks or as cement. Doubtless, simple as the idea is, it has greatly contributed to the success of the basic process.

The acidification and subsequent transference to the slag of the phosphorus by the basic treatment has led to its application to agriculture. For this purpose the slag is ground to a fine powder and sprinkled over the land without any further preparation. By this operation an indispensable element of animal life is derived from the remains of living creatures which, ages ago, found a grave in the ferruginous mud destined to become the great Cleveland bed of iron-stone.

Before closing this portion of my official duty, I cannot refrain from tendering to chemists an assurance of the great advantage the manufacturers of iron feel they have derived from the lessons taught them by chemical science. I am the more anxious to do this because we, among others, have been reminded that we are losing the supremacy among industrial nations which we once enjoyed, for want of that knowledge of chemistry which is more assiduously cultivated abroad than it is in our own country. I am not prepared to deny that the opportunities for acquiring a scientific education are less generally spread here than is the case in France, Germany, or Belgium, but for this the nation, and not the iron trade in particular, is responsible. It must also be admitted that as manufacturers we no longer stand so far above other lands as we formerly did. In this result any differences of education are in no way concerned, for if I were to classify the nationalities of the various inventions enumerated in the course of my remarks the fears of those who are alarmed at the appearance of a Belgian girder or a German steam-engine on our shores would, I think, be allayed. Perhaps I may be allowed to offer a very few words on the technical side of this important question of education. Much I shall not be able to say, because I have not yet been able to learn the precise position which the subject occupies in the minds of its most earnest advocates. If it means, as is sometimes alleged, a system by which, along with scientific instruction, manual dexterity in the use of tools or a practical knowledge of various manufacturing processes has to be acquired, I confess I am not sanguine as to the results. Certain I am that if foreign workmen are more skilful in their trades, which, as a rule, I doubt, and which in the iron trade I deny, this superiority is not due to scientific training in the manner proposed, for in this they possess, so far as I have seen, no advantage over our own workmen. My objection to the whole system is the impossibility of anything approaching a general application being practicable. I have not a word to say against the rudiments of science being taught wherever this is possible. The knowledge so obtained may often give the future work-

man a more intelligent interest in his employment than he at present possesses, but I think they who expect much good to attend such a thin veneer of chemistry or physics do not take sufficient account of the extent of the knowledge already possessed by more highly educated men who are now directing the great workshops of the world. It is by extending and enlarging this that substantial aid has to be afforded to industry and science, and not by teaching a mere smattering in our primary or any other schools. In the case of young people who from necessity must leave the schoolroom at an early age, my own leaning is towards the present system, with the addition of drawing and some natural science. By these, certain important lessons are taught, which, if not followed under the discipline of the schoolmaster, run some risk of being entirely neglected. After this, probably, the playground will be found more useful and much more popular with the schoolboy than trying to learn a trade by means of tools which, before he has to use them in earnest, may be thrown into the scrap heap.

As a national question the attention of the Government, Imperial or municipal, ought to be directed to the importance of establishing in all great manufacturing centres, institutions resembling the Physical College of this city. These should consist of appropriate and even handsome buildings, properly furnished with all the instruments and appliances required for teaching the sciences in their practical bearings on industrial pursuits. In Newcastle, as well as in other places, this has been done on a fairly ample scale, and the advantages the College of Science in this city is capable of affording are offered on such terms that no one can plead expense as a barrier to mental improvement.

Bearing in mind the importance of the subject, and remembering, as my colleagues and myself do, the difficulties we have had to encounter, and those we have still before us, I am strongly of opinion that the erection and maintenance of colleges of science should not be left to the accidental liberality of the few, but should be taken in hand by the nation at large.

On Alloys of Iron and Silicon. R. A. Hadfield. A paper read at the Paris meeting of the Iron and Steel Institute, 1889.

THE alloying of elements, other than carbon, with iron is a comparatively new field, and possesses special interest, not only to those concerned and engaged in the treatment of metals, but also to those who study the physical properties of substances. As the properties and nature of alloys of carbon and iron are fairly well understood, it is hardly necessary to consider them here, and in order to narrow down the considerations dealt with in this paper to a practicable limit, attention will be confined solely to alloys or mixtures of which metallic iron and silicon form the principal constituents.

An investigation of the properties of manganese steel, *i.e.*, an alloy of iron and manganese, was placed before this Institute by the author some 12 months ago, and its physical properties have been fairly well determined, as compared with alloys of iron with other elements. This was the more practicable owing to the fact that the manufacture of "cast iron" alloys of manganese, that is, ferro-manganese, had been for some time past in a very advanced state. In other words, by the cheap production of the alloys known as rich ferro-manganese, a material containing 80 per cent. of manganese and 5 per cent. to 7 per cent. of carbon, the residue being iron, has enabled experiments to be readily carried out by further alloying such rich manganese products with pure iron.

Mr. Turner's paper, read at the British Association Meeting, Bath, last year, described experiments with steel containing from 10 per cent. to 50 per cent. of silicon, and the details were fully given in the "Proceedings" of the Institute. The writer was asked by Mr. Turner and the British Association committee to investigate the effect of higher percentages of silicon, and he thought that the result of his inquiries might also be of interest to the Institute.

The subject of alloys of iron and silicon has for some years occupied the writer's attention, but it was not until lately that rich cast-iron alloys of silicon, *i.e.*, ferro-silicon,

have been obtainable, and even now they cannot compare in richness of silicon with that of the manganese in ferro-manganese. The highest ferro-silicon yet made contains not more than about 18 per cent. to 20 per cent. of silicon. Fortunately, however, owing to the peculiar fact, noticed more fully further on, as to its lowness in carbon, this is much better fitted for experimental work, as compared with, say, 20 per cent. ferro-manganese. Such a percentage of silicon, though comparatively speaking not so high, is sufficient to enable a suitable experimental material to be made, *i.e.*, a resultant material not containing too much carbon to interfere with an examination of the effect of the metalloid silicon upon the metal iron. Thus while in the case of rich spiegel or ferro-manganese the carbon present amounts to some 5 or 6 per cent., the 20 per cent. ferro-silicon, on the contrary, contains comparatively little carbon—always under $1\frac{1}{2}$ per cent. and often under $\frac{3}{4}$ per cent.—so that by means of this cast-iron alloy, when further diluted or mixed with pure iron, the malleable material or steel produced practically contains but little carbon. The curious fact that ferro-silicon alloys, as they rise in silicon, diminish in carbon, was first noticed in some laboratory experiments 18 years ago by Mr. Edward Riley. This will be again referred to further on. Whilst the scope of the experiments described in the present paper is in no way to deal with material other than malleable compounds of iron and silicon with small quantities of iron and manganese, it may be useful to give some general reference to previous experiments.

The only commercial employment of silicon with other metals is that of silicon bronzes. Silicon is stated to act upon the copper in a similar manner to phosphorus. The qualities of such alloys are great strength and tenacity, high electrical conductivity, and resistance to corrosion. Wire made of this material is stated to have a conductivity of 80 per cent., and a tensile strength of about 36 tons per square inch.

Mr. Warren, in a recent number of the "Chemical News," states that silicon, when in the nascent state, converts platinum into a brittle silicide, or by heating graphitoid silicon in contact with platinum to a full red heat, combination at once takes place, resulting in a brittle regulus containing as high as 10 per cent. silicon, which is fusible at a red heat, and breaks with a crystalline fracture.

Silver and gold are reported as not presenting any great affinity towards silicon, but on heating a mixture of potassium silico-fluoride with either silver or gold in an amorphous condition to a high temperature, a well-fused regulus of silicide of the metal may be obtained. In the latter instance, an alloy containing 5 per cent. of silicon is almost as brittle as antimony. Silver, when alloyed with 10 per cent. of silicon, is stated to have a slightly red tint.

Rich cast-iron alloys of silicon are now usually described as ferro-silicon and silicon-spiegel respectively, the latter containing manganese in addition to silicon. Silicious alloys of cast iron were usually known as glazed pigs, owing to their peculiar glazed appearance when fractured. It is curious that this very material—burnt pig, as it was often called, and only then made accidentally—was formerly thrown on one side as useless, whereas now it is made purposely on a commercial scale and in large quantities—another of the many proofs of the advantage of bringing scientific knowledge to bear upon industrial metallurgy. Such ferro-silicon, by itself, is perfectly useless in the refinery or puddling furnace, or for iron castings. The early samples of silicious iron seldom contained more than from 1 per cent. to 6 per cent. of silicon; but Mr. Riley, of London, in 1872, was the first to point out that rich ferro-silicon was likely to play an important part in metallurgical industry. By means of laboratory experiments he made in the crucible samples containing as high as 22 per cent. of silicon. He also discovered that as silicon increased carbon decreased, until with 20 per cent. of the former the latter is not present in quantities of more than $\frac{3}{4}$ per cent. to 1 per cent., and the greater part of this small amount existed as graphite. Spiegeleisen and ferro-manganese are the richest carbon alloys that can be produced, and they contain about 6 per cent. of carbon; ordinary cast iron rarely exceeds about 4 per cent., and never contains more than about $4\frac{1}{2}$ per cent. So strong, however, is the action of silicon in preventing carbonisation, even in the presence of a large excess of carbonaceous fuel, that in silicon-spiegel—an alloy of iron, manganese, silicon, and carbon, and notwithstanding the presence of a large amount of manganese—it (that is, the silicon) has still the upper hand, and prevents, as in the case of ferro-silicon, carbonisation taking place. A few typical analyses of ferro-silicon, silicon-spiegel, ferro-manganese, and spiegeleisen may be of interest here (see Table I.), but for a fuller description, and of the methods

TABLE I.

	ANALYSES PER CENT.				REMARKS.
	Carbon.		Silicon.	Manganese.	
	Graphite.	Combined.			
Analyses of <i>spiegel</i> and <i>ferro-manganese</i> , showing the gradual increase of carbon as the manganese increases	4.27	11.0	8.11	Sulphur and phosphorus practically absent, remainder being iron.
	..	4.78	5.2	41.74	
	..	5.63	4.2	19.82	
	..	6.53	3.7	80.04	
	..	7.20	1.4	80.04	
Analyses of <i>special manganese</i> , showing that if the silicon becomes high the carbon diminishes very considerably .....	..	3.56	4.90	23.90
	..	2.56	4.20	50.00	
Analyses of <i>silicon-spiegel</i> or <i>silicide of manganese</i>	3.3	1.85	10.74	19.64	
	6.7	.98	12.60	19.74	
	9.0	.30	15.94	24.36	
Analyses of <i>ferro-silicon</i>	2.35	.05	8.77	2.42	
	1.85	.01	11.20	2.78	
	1.20	.23	14.00	1.95	
	.55	.11	17.80	1.07	

These analyses are from the paper of Mr. Holgate, Assoc. R. S. M., Darwen, on "The Manufacture of Ferro-Manganese and Ferro-Silicon in the Blast Furnace."

of manufacture employed in their production, reference is given to Mr. Holgate's admirable paper on "The Composition of Ferro-Manganese and Ferro-Silicon made in the Blast Furnace." The writer is indebted to this paper for the analyses in question. Four of the samples quoted represent spiegele and ferro-manganese, and it is interesting to note that, as the manganese rises, there is a gradual increase of carbon up to as high as 7 per cent. A noteworthy fact is, that if silicon, even in 50 per cent. ferro-manganese, is allowed to reach 4 per cent., the carbon is at once much reduced, in some cases to the low amount of about 2½ per cent. This action is still more intensified in the alloys known as silicon-spiegele or silicide of manganese, of which two analyses are given. From the latter it will be seen that, provided the silicon exceeds 10 per cent., the carbon is reduced to an exceedingly low point, and that although manganese may be present even in comparatively high percentages, this is quite immaterial. This decrease of carbon takes place both in the combined and in the graphitic form, but principally in the former. A very valuable property of these spiegele alloys is the fact that they contain practically no sulphur, the much-dreaded enemy of the steel-maker.

It will, therefore, be seen that in the blast furnace, somewhat strange to say, silicon cannot be reduced unless carbon is also present, and yet, when reduction of silicon occurs with the production of highly silicious iron, carbon is practically absent in the resultant material. The late Dr. Percy, more than 20 years ago, referred to this in his "Metallurgy," and said that, according to his experience, no reduction can take place when silica and iron, without carbon, are heated together, even at the highest furnace temperature. Possibly this might now be accomplished in the powerful electric smelting furnaces, and it would be interesting to know whether alloys as rich in silicon as the present valuable alloys of ferro-manganese are rich in manganese could be produced. If so, without doubt, considerable employment could be found for them in metallurgical industry.

Alloys or compounds of iron, carbon, and silicon, non-malleable in their nature and coming under the term "cast iron," have been thoroughly investigated in this country by Mr. T. Turner of Birmingham, and the results have been placed before this Institute, so that it is unnecessary to do more than touch upon this matter here. Great credit is due to this investigator for the lengthy and valuable researches he has made in the direction indicated, as also to Mr. Keep, of Detroit, U.S.A., who has lately presented interesting papers on the same subject to the American Institute of Mining Engineers. Mr. Keep sums up so well the general results of all investigations up to date, that it may be well to briefly mention them, especially as some of the remarks apply, to some extent, to the malleable compounds or alloys of iron and silicon now being described. Both Mr. Keep and Mr. Turner find that white carbonaceous cast iron, which would invariably give porous and brittle castings, are made free from honeycombs and possess much greater strength by the addition of comparatively small amounts of silicon. The latter result is one which was considered contrary to previous experience. If further additions are made, say up to 2 per cent., the iron becomes grey, and at this point the maximum strength is obtained. If more silicon is added, although the iron becomes still more grey, it also becomes weaker. By a still further addition a closer grain results, but the iron is even more brittle than in its white condition. Too much silicon also produces, as in the silicon steel now being described, lack of fluidity and greater shrinkage. Mr. Keep thinks that silicon in cast iron is evidently to some extent combined with the iron and carbon, but whether it exists also in a form corresponding with graphitic carbon mechanically mixed with the remaining mass, is a question still in dispute and unanswered. As now well known, the principal effect of silicon is to change the carbon from the combined to the graphitic state. One point particularly mentioned by Mr. Keep, and an important one, is that silicon irons have always had the reputation of imparting fluidity to other brands, and naturally this was at first supposed to be owing to the silicon added. It has now been found that this is not directly so, and that it is from the fact that the silicon present causes an increase in the quantity of graphite, and

consequently a more fluid cast iron. Silicon is not, therefore, directly the cause, except by its indirect action on the carbon.

In conclusion, on this point, as Mr. Snelus said more than 17 years ago, it is generally supposed that the absorption of much silicon tends to set free the carbon in the graphitic state. No statement more concisely expresses the influence of silicon on what is termed cast iron than that given some eight years ago by Mr. C. F. King, of Newport, U.S.A., in an able paper read before the American Institute of Mining Engineers on "The Chemical Action of the Bessemer Process." He said it is due to the presence of silicon in pig iron that carbon is set free on cooling, and it is in proportion to the diminution of the silicon that the carbon remains chemically combined. Mr. King gives a diagram showing the rate of elimination of the metalloids in the process named, and it is a somewhat remarkable coincidence that the percentage point (1·8 per cent. Si) where the diminishing silicon curve cuts the combined carbon and graphitic curves, is exactly that which gave the maximum tensile strength in the material made by Mr. T. Turner, and later by Mr. Keep, in their numerous tests as to the effect of silicon upon cast iron. The diagram referred to and given (Diagram I.) shows that by a diminution in the silicon highly graphitic pig iron becomes rapidly mottled, and eventually white, although practically none, or but little, total carbon is oxidised; and this, as far as can be seen, is solely by the fall of the silicon from 2·50 to 1·70 per cent. Whilst, therefore, Messrs. Turner and Keep show that white iron can be converted into mottled, and eventually grey, by means of additions of silicon, this diagram shows the converse, namely, that with silicon abstracted cast iron becomes mottled and eventually white.

Outside, one might say ever within, the laboratory, the properties of the metalloid silicon or silicium are but little known. No fuller details can be found than in that part of Dr. Percy's "Metallurgy" relating to silicon, where all the methods for its production on a laboratory scale are given.

It is ordinarily described as a non-metal, very hard, dark brown in colour, a non-conductor of electricity, lustrous, not readily oxidised, and soluble in all ordinary acids, with the exception of hydrofluoric. It is said to resemble carbon in its general properties; others add that it exists like carbon in a graphitic, amorphous, and combined or adamantine form, but this has still to be determined.

Mr. Henry J. Williams, St. Louis, Missouri, U.S.A., this year presented a paper to the American Institute of Mining Engineers on "The Determination of Silicon in Ferro-Silicons, its Occurrence in Aluminium as Graphitoid Silicon, and a Study of its Reactions with Alkaline Carbonates." As the latest investigation of this kind, it may be well to refer to the experiments. Mr. Williams' method of determining the metalloid was by means of fusion with sodium carbonate, the idea being to dissolve it as soluble sodium silicate, and leave the iron in a very spongy and finally divided condition, so as to be readily attacked by acids. He noticed some curious facts during fusion. As soon as the sodium carbonate was thoroughly melted and the heat reached its maximum, the reaction became very violent, bubbles of gas (carbonic acid) rising to the surface and bursting into flame. This had been noticed before by another observer making experiments of similar nature with graphitic pig iron. Mr. Williams was, however, somewhat puzzled, as the ferro-silicon with which he was experimenting was high in silicon and comparatively very low in carbon, yet it gave the same result. To ascertain why silicon acts exactly like carbon during the reduction, he endeavoured to obtain an iron entirely free from foreign elements—particularly carbon—while containing high silicon, but he was unsuccessful. He found the desired condition realised in the aluminium of commerce, most of which, in spite of its name, he states contains not less than 3 per cent. or 4 per cent. of silicon, but, of course, no carbon. He found that a large part of the silicon in such aluminium seemed invariably present as an allotropic modification of that metalloid, crystallising in fine glistening black plates resembling some forms of graphite, and he considered that this was evidently the graphitoid form of silicon which Deville has mentioned in connexion with aluminium, but

which has not yet been isolated or found to exist in iron. Dr. Percy mentioned at length the same fact, and describes the material as resembling graphite from iron-smelting furnaces, and as being hard enough to scratch glass, with a specific gravity of 2.49. As regards, however, the form silicon may take in cast iron or steel, Mr. Keepe considers that, whether it exists in a state corresponding to graphitic carbon, and mechanically mixed with the remaining mass, is still a question in dispute. Mr. Holgate, of Darwen, also, in the paper before referred to, after making many analyses, says he has never found any evidence as to the existence of graphitic silicon in such alloys, though he has noticed some slight difference in the behaviour of silicon when dissolved in acids. Mr. Turner, in his paper some two years ago, after carefully investigating this point, both by means of experiments of his own and of those of Sir Frederick Abel, Mr. Snellus, and others, says that it may be considered that in a vast majority of cases, at least, silicon has only one form. Finally, therefore, the practical metallurgist has at present apparently no means of readily determining this point, although he may have reason to think that silicon does vary its form in cast iron or steel.

In metallurgical literature but little reliable information is to be found as to the effect of silicon upon iron. Mr. Howe, in his excellent work on "The Metallurgy of Steel," gives an excellent *resumé* of what has appeared. Some 14 years ago, in America, good results were promised by a process which was to use "Codoris, or silicon ore," as it was termed. This was to dephosphorise or neutralise the phosphorus in the metal under treatment. Only a few years back the writer had reason to investigate this matter in America, but found that this so-called puddled silicon iron or silicon steel contained no silicon.

Referring now to the consideration of silicon alloyed with the metal iron, the common belief has been that steel which has to be used in its forged state should contain practically none, or as small an amount as possible. Any quantity exceeding .10 per cent., or up to .20 per cent. at most, has been considered to be highly injurious. "Give a dog a bad name" is well illustrated in the present case, as will be seen from the results and tests given. At any rate, it may be safely said that silicon has been blamed in a somewhat hasty manner. This blame may be well deserved in alloys of carbon, silicon, and iron, as such alloys, as regards ductility, have no doubt proved unreliable and of little value, but the blame has been put at the door of silicon, whereas it is now proved that silicon alloyed with iron, provided carbon is absent or only present in small amounts, gives good tests as to toughness and malleability. It will be seen that $1\frac{1}{2}$ or even 2 per cent. may be present, and yet the material may possess 25 to 30 per cent. elongation; whereas the same percentage of carbon alloyed with iron would give a product barely malleable and one possessing but little elongation under tensile stress. Whilst, therefore, the common belief that alloys of carbon, silicon, and iron are brittle or even dangerous is quite correct, the cause is not due to silicon only, but to the combination of silicon with carbon and iron, a case parallel to some extent to that pointed out by the well-known Terre-Noire Company's experiments, where it was proved that phosphorus may be present in iron provided the carbon is low and the manganese high, a fact (that is, as regards phosphorus) still more prominent in wrought irons. As also pointed out by Mr. Howe, "Silica is often mistaken for silicon; who knows how far it is responsible for this metalloid's bad name?" This was actually noticed by Mr. Turner in test bars of steel containing comparatively low percentages of silicon, that is, under .5 per cent., much of the silicon present being in the oxidised condition.

Also, according to M. Gautier, there is a difference between steel made with silicon only and that with silicon and manganese, i.e., between a product made by adding ferro-silicon (carbon, silicon, and iron alloy), and that with silicon-spiegel (carbon, silicon, manganese, and iron alloy), and he mentions the following interesting experiment by his then colleague, M. Pourcel.

In a porcelain tube were placed two receptacles, one holding steel made by adding ferro-silicon only, and the

other steel by an alloy of silicon-spiegel. A current of chlorine was passed until all the iron was removed in the state of chloride. It was then seen that in the first receptacle there remained a network of silicate of iron, preserving the original formation of the piece, whilst steel by silicon and manganese alloy left no residuum. Also that such steel with no manganese was red-short, lacked fluidity, and possessed other defects. The writer has, however, not noticed such difference in the material now described, which in its molten state pours well, the ingots forging easily, and up to 2 per cent. silicon the ductility in the testing machine being very good.

However, as suggested by Mr. Howe, possibly silicon may enter into different combinations in steel, some promoting, some impairing ductility and malleability. In favour of this is the fact that so many well-known scientists and metallurgists have utterly condemned in forged steel the employment of silicon, even if present in small amounts. Such strong opinions would not be expressed without good grounds, and a reasonable explanation for the apparent discrepancy noticed by different observers seems to some extent to be in the direction named. At any rate, the samples described in this paper, and containing up to 2 per cent., present a remarkable ductility and toughness both in the bending and tensile specimens.

The writer wishes it be understood that he does not claim that silicon should take the place of carbon. Smaller quantities of carbon produce the requisite hardness and different tempers required in the industrial application of steel, and, in fact, silicon alone does not produce a steel that will harden by water-quenching, thus in this respect resembling manganese steel. Still it is a somewhat remarkable fact that a steel (specimen C, Table II.) containing 1.60 per cent. of silicon, a metalloid ordinarily so much distrusted, stretched 35.10 per cent. (on 2 in.) with 54.52 per cent. reduction in area, and a test bar from the same material tested by Professor Kennedy, gave 24.30 per cent. (on 10 in.) with 58.30 per cent. reduction in area. Also had not the specimen D., tested by Professor Kennedy, broken in the threads (the diameter of the bar over the threads being only .93 in. against .898 in. of the tested part of the bar, too small a difference in the holding part), no doubt his test would have confirmed the writer's, that a material with even 2.13 per cent. of silicon can elongate 36.50 per cent. on 2 in. (equivalent to about 27 per cent. on 10 in.) with 59.96 per cent. reduction in area. So that whilst it may not be advisable to use silicon as a hardener in making steel, it is important to have proved that the brittleness noticed in ordinary so-called silicon steel is due rather to the combined presence of the two hardeners, silicon and carbon. It may be here mentioned that the ductility noticed cannot be attributed to manganese, which was only present in small quantities, about .20 per cent. to .30 per cent.

The material employed in these experiments was made by melting in crucibles good wrought iron scrap, low in sulphur and phosphorus, to which was added in varying and increasing quantities rich ferro-silicon containing 20 per cent. of silicon. The ingots, $2\frac{1}{2}$ in. square, were reduced by forging in the ordinary method to $1\frac{1}{2}$ in. square billets, then rolled down to bars $1\frac{1}{2}$ in. diameter.

The effect of silicon upon iron is as follows:—1. In its forged condition. 2. In its cast condition.

1. Forged condition. The forge reports that the material A. (Table II.) (.24 per cent. Si) did not forge well, cracking somewhat whilst being hammered, but all the other samples, B. to H. (.79 per cent. to 5.53 per cent. Si), when forged at a fair yellow heat, required no special care, thus clearly showing that silicon, even up to as high as about 6 per cent., does not destroy the malleability of the metal iron. Upon, however, exceeding this percentage the material is red-short, crumbles at a low heat, and notwithstanding the low percentage of carbon present (.25 per cent.) becomes really a species of cast iron. It should also be here mentioned, that if the carbon had been higher, the point at which malleability ceases would have been with a much lower percentage of silicon. Nor is such red-shortness removed by the addition of manganese.

TABLE II.

Series and Mark referred to in the Paper.	Test Bar Mark.	Analysis per Cent.				Drillings taken from	How Ingot Forged.	Whether Tested in Unannealed or Annealed Condition.	Mechanical Test by	Original Diameter.	Original Area.	Limit of Elasticity in Tons per Square Inch.	Amount of Stretch in Inches at Elastic Limit.	Breaking Load in Tons per Square Inch on Original Area.
		Carbon.	Silicon.	Sulphur.	Phosphorus.	Manganese.								
* A	..	·14	·24	·08	·05	·14	Ingot	Fairly well	..	Inches.	Inches.	..	..	..
A	1	..	·18	..	..	..	Test bar	..	Hadfield	·7979	·5	22·00	·0065	33·00
A	9	..	·20	..	..	..	Test bar	..	Hadfield	·7979	·5	15·17	·0095	25·00
† A	..	..	..	..	..	..	..	..	Kennedy	·898	·633	15·17	..	23·44
B	..	·18	·79	..	..	·21	Ingot	Very well	..	..	..	..	..	..
B	2	..	·79	..	..	..	Test bar	..	Hadfield	·7979	·5	25·00	·013	31·00
B	10	..	·73	..	..	..	Test bar	..	Hadfield	·7979	·5	19·00	·0045	29·50
B	..	..	·87	..	..	..	..	..	Hadfield	·7979	·5	19·00	..	28·50
B	..	..	..	..	..	..	..	..	Kennedy	·898	·633	18·16	..	27·49
C	..	·19	1·60	..	..	·28	Ingot	Very well	..	..	..	..	..	..
C	3	..	1·09	..	..	..	Test bar	..	Hadfield	·7979	·5	28·0	·008	37·5
C	11	..	1·52	..	..	..	Test bar	..	Hadfield	·7979	·5	25·0	·0045	33·00
C	..	..	..	..	..	..	..	..	Kennedy	·898	·633	23·09	..	32·5
D	..	·20	2·18	·06	·04	·25	Ingot	Very well	..	..	..	..	..	..
D	4	..	2·11	..	..	..	Test bar	..	Hadfield	·7979	·5	31·00	·004	39·5
D	12	..	2·13	..	..	..	Test bar	..	Hadfield	·7979	·5	25·50	·005	31·0
D	..	..	..	..	..	..	..	..	Kennedy	·898	·633	29·22	..	27·98
E	..	·20	2·67	..	..	·25	Ingot	Very well	..	..	..	..	..	..
E	6	..	2·69	..	..	..	Test bar	..	Hadfield	·7979	·5	32·0	·0055	42·5
E	13	..	2·67	..	..	..	Test bar	..	Hadfield	·7979	·5	24·0	·0052	32·0
E	..	..	..	..	..	..	..	..	Kennedy	·898	·633	23·5	..	28·52
F	..	·21	3·46	..	..	·29	Ingot	Very well	..	..	..	..	..	..
F	6	..	3·39	..	..	..	Test bar	..	Hadfield	·7979	·5	35·0	·01	47·5
F	14	..	3·36	..	..	..	Test bar	..	Hadfield	·7979	·5	30·0	·009	39·0
F	..	..	..	..	..	..	..	..	Kennedy	·803	·506	29·45	..	34·17
G	..	·25	4·49	..	..	·36	Ingot	Very well	..	..	..	..	..	..
G	7	..	4·18	..	..	..	Test bar	..	Hadfield	·7979	·5	45·0	·003	49·0
G	15	..	4·23	..	..	..	Test bar	..	Hadfield	·7979	·5	None visible	..	38·0
† G	..	..	..	..	..	..	..	..	..	..	..	..	..	..
H	..	·26	5·53	·06	·04	·29	Ingot	Very well	..	..	..	..	..	..
H	8	..	4·9	..	..	..	Test bar	..	Hadfield	·7979	·5	None visible	..	48·0
H	16	..	4·80	..	..	..	Test bar	..	Hadfield	·7979	·5	25·0	·0075	25·0
§ H	..	..	..	..	..	..	..	..	Kennedy	·803	·506	None visible	..	38·98
I	..	·04	7·23	..	..	·29	Ingot	..	No test bar made, would not forge.	No test bar made, would not forge.				
J	..	·08	8·85	·07	·05	·08	Ingot	..	No test bar made, would not forge.	No test bar made, would not forge.				

* Samples A to D bent double cold, and afterwards flattened close without breaking.
 † Specimen "G" was not quite straight, and snapped across the middle with a blow from a hammer while being "set" by the workman. It was evidently very brittle.
 ‡ Test bar broke simultaneously in two places, so that a piece 5 in. long from middle flew right out. This piece itself was nearly separated in two parts by a crack.

* This test bar had a black oxidised surface at fracture quite unweilded.

TABLE II.—continued.

Series and Mark referred to in the Paper.	Ratio of Limit to Break.	Extension in a Length of —inches.	Total Extension.	Reduction of Area.	Appearance of Fracture of Test Bar.	Appearance of Fracture of Annealed Forged Bar from which Test Bar was prepared.	Modulus of Elasticity by Professor Kennedy, in lbs. per square inch.	Bending Test of Annealed Bars, $\frac{1}{4}$ " wide by $\frac{1}{2}$ " thick.		Relative Hardness determined by Professor Turner in Flat Bars, $\frac{1}{4}$ " \times $\frac{1}{2}$ ".
								Tests by Hadfield.	Tests by Turner.	
A	Per Cent.	Per Cent.	..	..	..	..	..	..
A	30.05	54.54	Silky .....	..	..	..	..	..
A	37.55	60.74	Silky	Mild and rather brittle.	..	..	Bent cold through 180°, radius $\frac{1}{2}$ " perfect.	20
A	.647	10	16.9	42.7	Silky, but with a large reedy flaw ..	..	30,160,000	..	..	..
B	27.50	54.54	..	..	..	..	..	..
B	34.62	54.54	..	Mild, close, granular ..	..	..	Bent cold through 180°, radius $\frac{1}{2}$ " perfect.	20
B	35.45	54.54	..	..	..	..	..	..
B	.631	10	25.5	42.56	Silky .....	..	29,970,000	..	..	..
B	25.5	66.4	Silky at edges, very finely granular at centre.	..	..	..	..	..
C	31.10	50.58	Centre silky, outside finely crystalline	..	..	..	..	..
C	35.10	54.52	Silky	Mild, close, granular ..	..	..	Bent cold through 180°, radius $\frac{1}{2}$ " perfect.	24
C	.710	10	24.3	58.3	Silky at edges, very finely granular at centre.	..	29,600,000	..	..	..
D	18.48	25.02	..	..	..	..	..	..
D	36.50	50.96	Silky	Granular, but crystals much larger.	..	..	Bent cold through 180°, radius $\frac{1}{2}$ " perfect.	24
D	.723	10	5.6	..	Broken screw thread (.987 diameter), fracture somewhat coarsely crystalline.	..	26,500,000	..	..	..
E	27.6	25.36	Coarse and slightly granular .....	..	..	..	..	..
E	6.05	6.64	Coarse and granular	Coarse, open .....	..	..	Bent double, but broke in radius with last blow.	26
E	.824	10	2.5	..	Broken screw thread (.987 diameter), fracture somewhat coarsely crystalline.	..	28,410,000	..	..	..
F	11.10	14.22	Coarse and slightly granular .....	..	..	..	..	..
F	8.85	9.28	Coarse and granular	Coarse, open .....	..	..	Bent through 180°, but broke off sharp at bend.	30
F	.862	10	3.2	5.65	Entirely and somewhat coarsely crystalline.	..	..	..	..	..
G004	..	Coarse and slightly granular .....	..	..	..	..	..
G64	.70	Coarse and granular	Coarse, open .....	..	..	Broke at 45°	33
G	Broke at 15° .....	..
H	Coarse and slightly granular .....	..	..	..	..	..
H30	..	Broke in thread, coarse and granular ..	..	..	..	..	..
H37	..	Entirely and somewhat coarsely crystalline.	Very coarse .....	..	..	Snapped in three pieces at first blow of hammer.	36
H	..	10	.7	1.98	..	..	28,650,000	..	..	..
I
J

NOTES.—1. The tests by Professor Kennedy were made with a lever machine, those by the author with a hydraulic machine made by Sir Joseph Whitworth.

2. Unfortunately the tests made by Professor Kennedy were made on bars with holding parts only .03 in. larger than that under stress. The bars were thus much more liable to break in the thread; in two specimens this occurred, and the result of these two tests can hardly be considered complete.

3. In the Whitworth machine "permanent set" is usually readily observed by the "give" of the finger on dial; but to be quite sure on this point, the test pieces were taken out and very carefully gauged in a Whitworth measuring machine at successive and increasing stresses, until the permanent set was discovered by an actual increase in the length of the test bar.

4. The relative hardness of other substances determined by Professor Turner's sclerometer:—Lead, 1; copper, 8; softest iron, 15; mild steel, 21; good cast iron, 21 to 24; hard cast iron (scrap), 36; window glass, 60; very hard white iron, 72; manganese steel, under test; silicon steel, 20 to 36.

5. These tests will be found plotted on Diagram III.

It may also be here mentioned, that no return of strength takes place by a further addition of silicon, as is so specially characteristic of manganese steel. Any further addition merely increases its resemblance to silicious cast iron. Nor do gradually increasing percentages, as is the case with manganese steel, destroy the magnetic properties of the alloy, a 7 per cent. material seems quite as susceptible as ordinary iron or steel drillings.

As regards the results of the mechanical tests on this steel in its forged state, these are so fully detailed in Table II. (Tensile and Bending Tests), Table III. (Compression Tests), and Diagram III. that it is only necessary to add a few remarks here.

Apparently silicon, up to $1\frac{1}{2}$ or $1\frac{3}{4}$ per cent., added to iron, although increasing the limit of elasticity and raising the tensile strength, does not impair ductility; but after this the further increase of tensile strength noticed is only obtained with a serious loss of ductility. Apparently there is no sharp line of demarcation, but after exceeding about $1\frac{1}{2}$ to 2 per cent. further slight increases cause great changes in the characteristics of the material. In this respect therefore, its action rather resembles that of carbon, in contradistinction to the action of manganese, of which larger amounts are required to effect similar changes.

The fractures from the tensile test bars, up to "D," specimen (2.18 per cent. Si) are silky, after this completely and coarsely crystalline. As in the specimens in the cast state, neither annealing nor water-quenching seem to have any effect on the structure.

The annealed flat bending pieces, half inch wide by one-fourth inch thick, gave good results, specimens A., B., C., and D. (.24 per cent. to 2.18 per cent. Si) bending double cold without fracture, more like soft steel, and after being bent double the pieces were flattened close together cold without showing signs of fracture. Specimen E. (2.67 per cent. Si) also bent double cold, but broke in the radius with the last blow. F. (3.46 per cent. Si) was much stiffer, bent only to a right angle. G. and H. (4.49 per cent. and 5.53 per cent.) would not bend at all, and were exceedingly brittle. These bending tests were confirmed by Mr. Turner's experiments with bars of the same size. Up to D. specimen the samples bent to an angle of 180° , with one-eighth inch radius.

Pieces from the bars used for bending tests were also tested for weldability, but entirely without success. The writer's experience has always been that silicon is quite fatal to welding, notwithstanding that the contrary might be expected

from the fact that silica is of such material assistance in welding wrought iron.

As regards water-quenching or hardening, samples A., B., C., and D. (.24 per cent. to 2.18 per cent. Si) were unaffected, *i.e.* unhardened, by even the highest heat. Even if plunged at welding heat into water made specially cold, no hardening beyond a surface stiffening took place, nor did their toughness seem impaired by this treatment. Specimen E. (2.67 per cent. Si) was heated to an ordinary yellow heat, and plunged into cold water at about 70°F . This piece was much stiffened, but only broke on being bent double. Another piece of the same material, heated to a welding heat and plunged into water at about 52° , also proved very stiff, and only broke when bent double. F. (3.46 per cent. Si) this sample was only stiffened by being water-quenched at a welding heat. It was just as brittle as before, and had not hardened, being easily touched by a file. In this respect, therefore, *i.e.* as to being toughened by water-quenching, this material differs from manganese steel. The heating did not cause much alteration in fracture, the crystallisation being still open and coarse. H. (5.53 per cent.) was quenched both at ordinary heat and at a welding heat, and although the surface was skin-hardened, upon being fractured it was easily filed. These tests, therefore, clearly prove that silicon does not confer the same property as carbon does upon iron, *i.e.* of becoming hardened when dipped hot into a cooling medium. It should also be here stated that the whole of the samples were subjected to high heats, even to a welding temperature, without falling to pieces. In fact, as regards this point, they behaved more like mild steel, apparently proving that silicon itself does not cause iron to become red-short.

That silicon steel has a certain kind or degree of softness or lack of body compared with carbon steel is especially brought out in the compression tests (Table III.), where sample E., although apparently very hard and brittle (high in the scale of Turner's hardness tests, *viz.*, 33), crushed up 38 per cent. of its length under a compression load of 100 tons per square inch. A correspondingly hard temper of carbon or tungsten steel would not shorten more than 20 per cent., or if hardened, would remain unaltered. A very mild steel, containing not more than .20 per cent. of carbon, would not shorten much more than this sample containing over $2\frac{1}{2}$ per cent. of silicon. At any rate, therefore, silicon is not so powerful a hardener of iron as is carbon. Mr. T. Turner has tested this material in his sclerometer, or hardness testing machine, the results of which are given under his name in Table II.

TABLE III.
COMPRESSION TESTS.

Series.	Test Bar Mark.	Analysis per Cent.			Load applied in Tons per Square Inch.	Reduction in Length produced by Load.	Diameter Increased to.
		Carbon.	Silicon.	Manganese.			
B	205	.18	.79	.21	.. .. .	Before being Tested. 1.0	.7977
					10	.9058	.799
					20	.9915	.800
					30	.9472	.822
					40	.853	.8895
					50	.814	.894
					60	.7305	.95
					70	.658	1.002
					80	.5975	1.056
					90	.547	1.115
					100	.503	1.153

No. 205 gave a sharp indication at 32 tons.

TO ILLUSTRATE MR. HADFIELD'S PAPER ON "ALLOYS OF IRON AND SILICON."

Diagram 1.

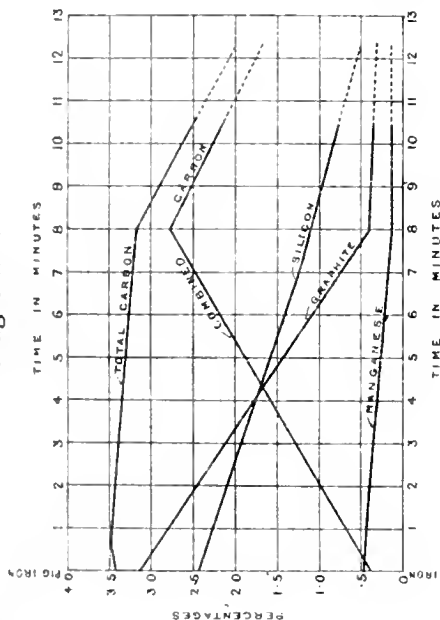


Diagram by Mr. King showing the influence of Silicon during decarburization upon the graphitic and combined carbon in cast-iron.

Diagram 2.

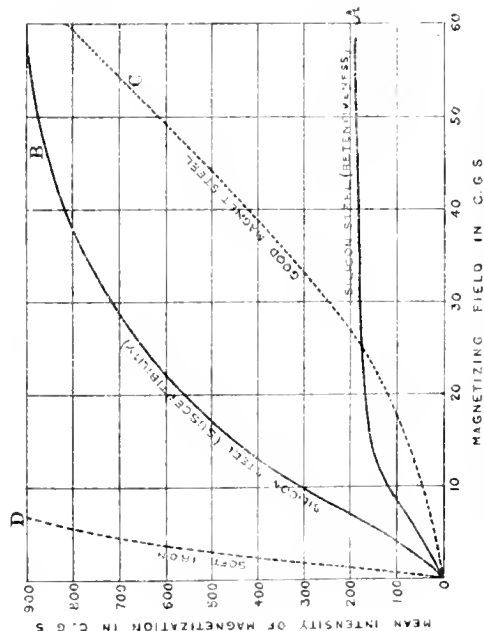
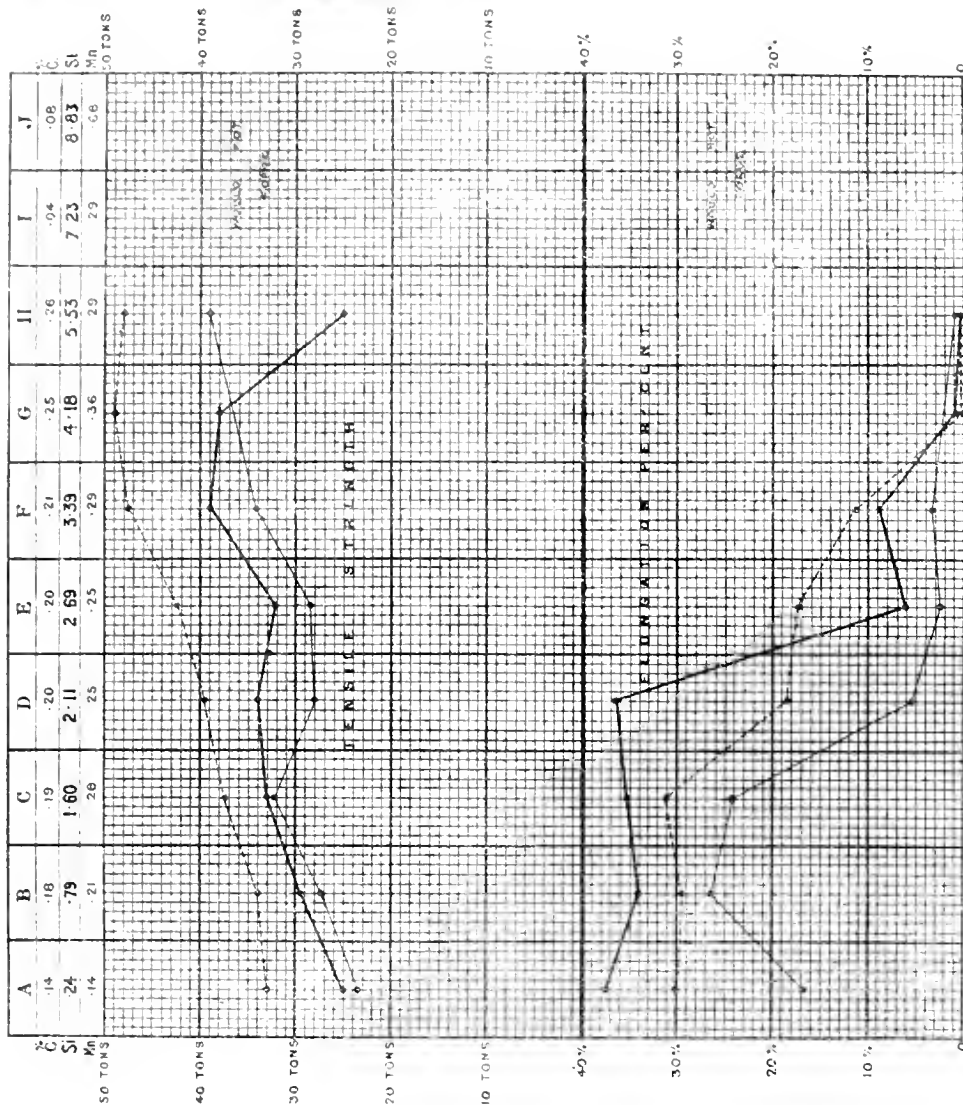


Diagram by Mr. Bottomley showing magnetic retentiveness and susceptibility of Silicon Steel (4.3% Si.) compared with ordinary iron and steel



Tensile and elongation tests of Silicon Steel, plotted from Table 1.

— = Annealed test-bars (Hadfield) on 2" lengths.
 - - - = Unannealed " " 2" "
 — = Annealed " (Kennedy) " 10" "

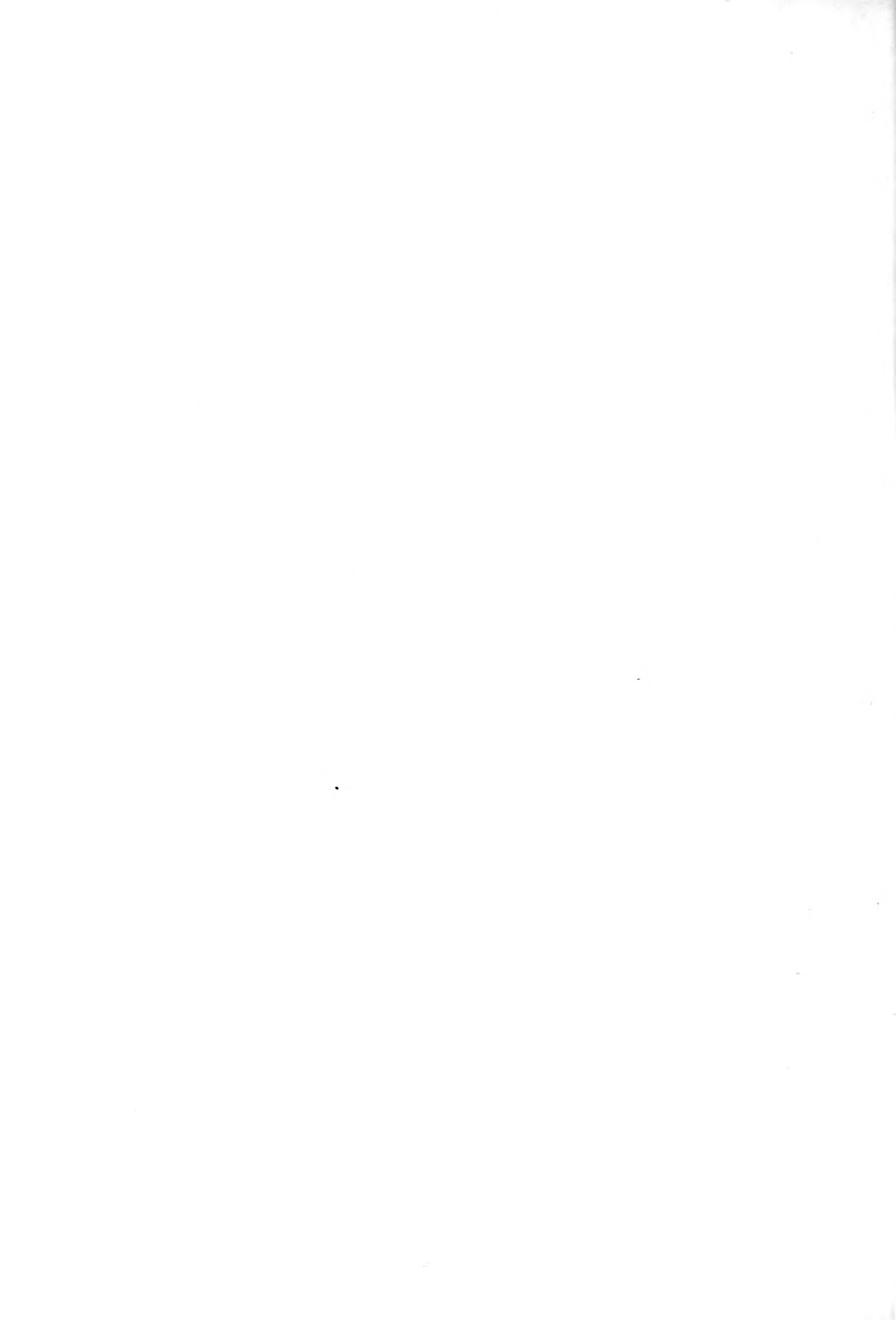


TABLE III.—COMPRESSION TESTS—continued.

Series.	Test Bar Mark.	Analysis per Cent.			Load applied in Tons per Square Inch.	Reduction in Length produced by Load.	Diameter Increased to.
		Carbon.	Silicon.	Manganese.			
E	206	20	2.67	25	.. .. .	Before being Tested. 1.009	.7979
No. 205 gave no indication of set by pointer.					10	1.009	.7979
					20	1.008	.8000
					30	.9915	.808
					50	.901	.850
					100	.622	1.0345
F	207	21	3.46	29	.. .. .	Before being Tested. 1.009	.7985
No. 207. No indication of set by pointer.					10	1.009	.7985
					20	1.009	.795
					30	1.0045	.8000
					100	.6455	1.0115
G	208	25	4.49	36	.. .. .	Before being Tested. 1.008	.7985
No. 208. No indication of set by pointer. Gave several loud reports as pressure was increased up to 50 tons, and then ceased.					10	1.008	.7985
					20	1.008	.7985
					30	1.0045	.8000
					40	.9895	.803
					100	.683	1.003

TABLE IV.—NON-MALLEABLE FERRO-ALLOYS.

Name of Alloy.	Special Constituents.	Composition per Cent. (in some cases approximate).									Magnetic Susceptibility.	
		C.	Si.	S.	P.	Mn.	Cr.	W.	Al.	Fe.	In Bulk.	In Drillings or Powdered State.
Spiegeleisen.....	Manganese	Per Cent. 4½	Per Cent. ..	Per Cent. ..	Per Cent. ..	Per Cent. 14	Per Cent. ..	Per Cent. ..	Per Cent. ..	Per Cent. 81½	Attracted.	Very slightly influenced.
Spiegeleisen	Manganese	5½	..	..	..	36	..	..	..	58½	Not attracted.....
Ferro-manganese .	Manganese	7	..	..	..	82	..	..	..	11	Not attracted.....
Ferro-silicon.....	Silicon....	1	16	..	..	1	..	..	..	82	Strongly attracted.
Ferro-silicon.....	Silicon....	¾	20	2	77½	Strongly attracted.	Very slightly influenced.
Silicon-spiegel	Manganese and silicon	2	8	..	..	20	..	..	..	70	Easily attracted.
Silicon-spiegel	Manganese and silicon	1½	16	..	..	20	..	..	..	62½	Strongly attracted.
Ferro-chrome.....	Chromium	4	1	..	..	1	8	..	..	86	Strongly attracted.
Ferro-chrome.....	Chromium	5	2	1	28	64	Strongly attracted.	Very slightly influenced.
Ferro-chrome.....	Chromium	5	1	..	..	1	63	..	..	30	Not attracted.....
Ferro-chrome.....	Chromium	5	2	..	..	1	79	..	..	13	Not attracted.
Ferro-aluminium .	Aluminium	1	1½	..	..	..	..	..	10	87½	Strongly attracted.
Ferro-aluminium .	Aluminium	3	1½	12	83½	Very strongly attracted.	Strongly attracted.
Ferro-aluminium .	Aluminium	3	1½	..	..	..	..	..	13	77½	Very strongly attracted.
Ferro-aluminium .	Aluminium	1	1½	..	..	..	..	..	20	77½	Slightly attracted
Ferro-tungsten ...	Tungsten .	4	1	..	..	1	..	40	..	54	Very strongly attracted.
Ferro-phosphorus.	Phosphorus	1	½	..	10	4	84½	Strongly attracted.	Strongly attracted.
Ferro-sulphur	Sulphur ..	½	¼	5	..	..	..	..	..	93½	Strongly attracted

In order to test this steel in the shape of wire, samples E. (2·67 per cent. Si) and G. (4·49 per cent. Si) were reduced to rods, and Messrs. Shipman and Co., of Sheffield, kindly undertook to draw them into wire. The G. material, though readily rolled into rods, would not, however, draw, nor did annealing soften or give it the requisite ductility. In the rod state the tensile strength was 59 tons per square inch, with 12 torsions in eight inches. Crucible carbon steel would stand about the same test, and Swedish Bessemer, with high carbon, is slightly higher in torsion, but lower in tensile strength.

The material E. was readily drawn to No. 20 B.W.G., standing 180 lb. tensile strength (64 tons per square inch), with 157 torsions in eight inches. Annealing lowered the tensile strength to 120 lb. (about 48 tons per square inch), and slightly increased the torsions to 169 in eight inches. The wire-makers endeavoured to harden both G. rods and E. wire, first in oil and then in water, but without success.

Professor Barrett, of Dublin, has kindly undertaken to determine the electrical properties of the steel wire just mentioned, but the results are not yet completed. About 12 months ago the writer, thinking that silicon might confer upon iron qualities suitable for the manufacture of magnets, sent to Mr. Bottomley, in Sir W. Thomson's laboratory, Glasgow, a forged sample containing 4·43 per cent. of silicon, and 18 per cent. of carbon.

The results of Bottomley's experiments, as will be seen from Diagram No. III., were unfavourable. He found that the material had less susceptibility and more retentiveness than good soft iron, and that it had enormously less retentiveness than hard steel suitable for magnet-making. The diagram shows two curves "A" and "B," "A" showing the retentiveness of the bar and "B" the susceptibility. The dotted curve "C" represents what the bar should be if it were suitable for magnet-making, and the dotted curve "D" what it would be were it good soft iron.

Considerable attention having been given to the curious non-magnetic properties of manganese steel, the writer was led to make the approximate tests detailed in Table IV., to see if iron, alloyed with other elements than manganese, would also lose its magnetic susceptibility. From the list given it will be seen that practically manganese is the only exception, for as regards ferro-chrome, it is only when very high percentages of chromium, and but comparatively small amounts of iron are present, that the material is not susceptible.

MALLEABLE FERRO-ALLOYS.

Malleable compounds of iron with other elements so far experimented upon (including carbon, silicon, sulphur, phosphorus, chromium, tungsten, aluminium, and nickel) are strongly susceptible to magnetisation.

Alloys of manganese and iron, however, form an exception to this. As is now well known in manganese steel, as soon as the manganese exceeds 8 or 9 per cent., the material is only attracted when in a finely divided state such as drillings or powder, and with further increase of manganese even this slight susceptibility disappears. The same fact is noticed as regards the non-malleable compounds of iron and manganese. Alloys of iron, nickel, and manganese are also not susceptible.

2. *Cast state.*—As might be expected, the whole of the samples are very free from honeycombs, but this soundness in the cast is only acquired at the expense of toughness or ductility. As regards this freedom from honeycombs, it may be of interest to state here that although silicon does produce soundness in steel, yet Mr. Holgate noticed that in making ferro-silicon of 13 to 15 per cent., there is in casting an unusually large outburst of gas, and the pigs are exceedingly full of honeycombs. A sample is exhibited among the specimens accompanying this paper. In watching a cast of material of this percentage from the blast furnace, he noticed that when the exterior of the pigs became almost solid, and whilst the interior was still liquid, the metal began to boil up, and frequently for 15 or 20 minutes some cwt. of metal in each bed boiled over, this going on until the pigs were quite set and solid.

It would be interesting to know what is the cause of this outburst, and the composition of the escaping gases. It has been stated in metallurgical literature that in some hot overblown Bessemer charges silicon may be present in considerable percentages, and yet the steel rise or boil over when poured into ingot moulds.

Silicon steel pipes or settles to a much greater extent than ordinary steel, and this in itself is a considerable disadvantage. Its fluidity when being poured is less than that of ordinary steel. The crystallisation or form of fracture of the lower percentages is somewhat like ordinary mild cast steel, but on exceeding about 2½ per cent. silicon a striking change occurs; the crystals become very large, glazed in appearance, and cleave somewhat after the nature of spiegeleisen. As this large

TABLE V.—CORROSION EXPERIMENTS.

—	—	Percentage of Silicon.	Strength of Acid. (H ₂ SO ₄).	Length of Immersion.	Loss.	Colour after Treatment.	Remarks.
			Per Cent.	Days.	Per Cent.		
Silicon steel (C.).....	Bar	1·60	50	21	6·32	Very bright.	After being taken out of the acid and dried, the silicon steel and wrought iron appeared as if burnished, and retained their brilliancy for some time.
" " (E.).....	"	2·67	"	"	3·32	Very bright.	
" " (G.).....	"	4·49	"	"	4·20	Very bright. Soon dulled over, although carefully covered up.	
Ordinary mild steel...	"	..	"	"	7·48	Dull bright.	
Wrought iron.....	"	..	"	"	4·47	Most brilliant.	
Silicon steel (E.).....	Wire 20 B.W.G.	2·67	"	"	31·80	Very bright.	
Ordinary mild steel...	"	..	"	"	17·29	Dull.	
Ordinary wrought iron	"	..	"	"	17·09	Very bright, like wrought bar.	
Manganese steel	"	Mn (12%)	"	"	51·18	..	

MOISTURE TEST.

—	—	Percentage of Silicon.	Weight before Placing in Moist Atmosphere.	Weight after keeping 24 Days in Moist Atmosphere.	Increase in Weight.
			Grms.	Grms.	Grms.
Silicon steel (C.).....	Bar	1·60	20·634	20·644	0·1

and marked crystallisation increases the material becomes exceedingly brittle, and if still further additions are made, the appearance of the material approaches silicon pig iron, and is non-malleable.

High percentages of silicon in the cast or unforged material causes a considerable increase in shrinkage or contraction. This point is already a difficult one with the steel-founder, who for many years has been on the horns of the dilemma, that whilst silicon increases soundness, it increases the tendency of castings to draw. In cast iron this fact of silicon also increasing contraction has been noticed by Mr. Keep.

Also, as in the forged so in the cast material, when the silicon exceeds about 2 per cent., and the peculiar crystallisation noticed in the samples exhibited commence, neither annealing nor water-quenching seems to have any effect in changing the structure.

It is well known that considerable difficulty is experienced in dissolving drillings of ferro-silicon; so tedious is the process, that recourse is usually made to the sodium carbonate process. This is not requisite with silicon steel, which requires only the ordinary hydrochloric acid method. The silica residue is very clean and free from iron.

A considerable number of estimations have proved that the silicon is very uniform and homogeneous in this steel. Analyses taken from different parts of the same ingot and bar give results very similar to each other. No traces of graphite are noticed, the carbon always being present in the combined form. If the material analysed is in the form of drillings, they keep their shape, the iron being dissolved out.

Experiments have been made with this steel in comparison with other material as regards its corrosion. Table V. gives the time of immersion in the sulphuric acid and the loss.

In conclusion, the author wishes it to be understood he does not claim that there is any field for the employment of such an alloy or high silicon steel as that here described. This paper is presented only for the purpose of scientific interest, and in order to place on record the actual effect of the metalloïd silicon on iron. Silicon cannot take the place of carbon; the latter has always the advantage of being more easily applied, and of producing a material more suited to the various requirements of users of steel.

It is also clearly proved by these experiments that silicon, unlike carbon, does not confer upon iron the property of becoming hardened when water-quenched.

The following table gives the specific gravities of the silicon steel, as well as that of ferro-silicon:—

TABLE VI.

		Per-centage of Silicon.	Specific Gravity.	Remarks.
Silicon steel (E.)..	Ingot	2.67	7.38	
" " " "	Wire 20 B.W.G.	2.67	7.88	
" " (G.)..	Ingot	4.49	7.54	
Ferro-silicon	" "	5.00	7.00	
"	" "	8.00	6.943	
"	" "	16.00	5.303	Doubtful.
Ordinary grey cast iron.....	" "	" "	7.10	

TABLE VII.—SAMPLES OF THE ALLOYS OF IRON AND SILICON EXHIBITED TO ILLUSTRATE THIS PAPER.

Section I.—Samples of silicon steel in the cast state containing from .24 per cent. to 8.83 per cent. of silicon.

Section II.—Samples of silicon steel in the forged state containing from .24 per cent. to 5.53 per cent. of silicon.

Section III.—Test bars as mentioned in Table II.

Section IV.—Bending pieces given in Table II.

Section V.—Compression pieces given in Table III.

Section VI.—Samples of ferro-alloys to illustrate magnetic properties.

Section VII.—Silicon steel wire 2.67 per cent. Si, 20 B.W.G.

Samples of ferro-silicon containing 16 per cent. silicon yet honeycombed.

Silica from silicon steel.

Also other samples.

Roasting Iron Ore. The Ironmonger.

STERLING G. Valentine has made a valuable series of experiments in the desulphurisation of pyritiferous iron ores, from which he draws the following conclusions:—Heat alone, without access of air, can remove, at best, only one-half of the sulphur present. Atmospheric oxygen is absolutely necessary for a proper desulphurisation. Even at a low heat ore is properly desulphurised if air can gain access freely to the FeS_2 in it. Sulphate of iron can be decomposed by heat equally well with or without air. In order that the residuum of sulphur in roasted ores may consist, so far as possible, of sulphates, the roasting must be effected with free access of air. Fusion or sintering of ore is likely to prevent any further desulphurisation. Sintering does not allow much of the remaining sulphur to be in the form of sulphate. Fusion, hence, should never occur in roasting, except after continued heating in air at a lower temperature. Ores cannot be properly desulphurised in the upper part of the blast-furnace. An efficient roaster must allow easy control of heat, abundant air access to the hot ore, and rapid removal of the products of combustion.

Notes on the Iron and Steel Manufacture in France in 1887. Prof. S. Jordan. Iron and Steel Institute, Paris Meeting, 1889.

COAL AND COKE.

Production of Coal and Coke in France in 1887, compared with 1877.

Coal-fields.	1877.	1887.
	Tonnes.	Tonnes.
Northern coal-field	6,720,000	11,317,000
Loire coal-field.....	3,340,000	2,989,000
Gard coal-field.....	1,660,000	1,831,000
Burgundy and Nivernais coal-field ..	1,380,000	1,497,000
Central coal-field	1,020,000	994,000
Aveyron and Tarn coal-field.....	975,000	1,076,000
Auvergne coal-field	240,000	291,000
Iterault coal-field	238,000	208,000
South Vosges coal-field.....	186,000	186,000
Creuse and Corrèze coal-field.....	178,000	153,000
Western coal-field	237,000	136,000
Western Alps coal-field	132,000	132,000
Total for coal and anthracite	16,305,000	20,810,000
Provence and Alps brown coal-fields.	470,000	457,000
Sundry brown coal-fields.....	30,000	21,000
Total for brown coal	500,000	478,000
Sum total.....	16,805,000	21,288,000

N.B.—The French *tonne* is 1,000 kilos

It will be seen that the coal output of France has increased in 10 years by about 25 per cent., and that this increase has nearly altogether taken place in the Northern coal-field.

The coal consumption of France having been 31,191,000 tons for 1887 (instead of 24,144,490 tons for 1877), the foreign imports must have been 10,565,000 tons (including 4,046,000 tons of British coals), instead of 7,882,000 tons (including 2,867,000 tons of British coals), for 1887.

Coke.—As to this fuel the author can only repeat what he said in 1878. Coal is just now produced in France almost only in the improved coke ovens, called Belgian coke ovens, of the Smet, Coppée, or other analogous systems, in which the introduction of the coal to be carbonised is effected through hoppers placed in the arched ceiling of long rectangular and horizontal chambers or vaults, opened at both ends, and the extraction of the coke is effected by means of mechanical steam pushing rams. The vertical Appolt ovens are not now much in use; they are only to be seen at Blanzay, Creusot, and Bezenet. The obsolete beehive ovens are used only at one or two collieries, and can be seen in the exhibition of the Loire collieries; but their products are not intended for blast furnaces, and are only used for foundry purposes. The visitor can find in the exhibits at the Douchy, Escarpelle, and Dourges collieries some examples of improved plants for the manufacture of coke, and in some other collieries will be found specimens of the coke produced.

Coke is manufactured sometimes with only screened small coals, at other times with washed small coals, according to the purity of the fuel to be obtained. The so-called "washed coke" used for blast furnaces contains generally from 6 to 10 per cent. of ash; the unwashed ones contain 10 to 12 per cent., and often more. The small coals carbonised are seldom of only one origin; the coke-makers rather try to obtain economical mixtures by associating the dearer coking coals with the largest possible proportion of the cheaper non-coking coals, so as to come as near as possible to the limit of the property of coking. These mixtures are made with great care by means of various apparatus, such, for instance, as the Carr disintegrator. The coke-makers have, in that way, been able to notably lessen the cost of production of coke, owing especially to the use of the Coppée and other improved ovens, which produce good coke with coals that would not cake in the beehive ovens. Messrs. Seybel and Bernard exhibit in the "Palais des Machines" some drawings of improved coke ovens specially intended for the coking of meagre coals.

Messrs. Schneider and Co. have tried at Le Creusot a new form of vertical coke oven, known as the Bauer system; but the author would require some further data as to the results obtained in order to be able to speak of these ovens.

The application of coke ovens to the production of tar and ammoniacal salts has found a place in some collieries, as at those of Bessèges, Mais, Terrenoire, St. Etienne (Carvès ovens), and the Campagnac colliery (Seybel ovens); but commercial circumstances have not favoured the extension of the manufacture of by-products. The author believes that for some years past no other ovens have been built in France for that purpose; besides, the quality of the coals used here for the production of coke does not suit this special industry of by-products so well as the English or German coals.

SECTION II.—THE PIG IRON MANUFACTURE.

According to the official statistics, the comparison of the pig iron production in France for the years 1877 and 1887 is as follows:—

	1877.	1887.
Pig iron production:—	Tonnes.	Tonnes.
Coke pigs.....	1,372,000	1,547,000
Charcoal pigs.....	80,000	12,000
Coke and charcoal pigs.....	54,000	9,000
Sum total.....	1,506,000	1,568,000

SECTION II.—THE PIG IRON MANUFACTURE—*cont.*

	1877.	1887.
Number of furnaces in blast:—	Tonnes.	Tonnes.
Coke blast furnaces.....	133	84
Charcoal blast furnaces.....	69	12
Coke and charcoal mixed blast furnaces...	30	5
Sum total.....	232	101
Consumption of raw material:—		
Coke.....	1,900,000	1,800,000
Wood charcoal.....	120,000	15,000
Iron ores.....	3,323,000	3,453,000
Indigenous ores.....	2,346,000	2,298,000
Algerian ores.....	330,000	48,000
Foreign ores.....	647,000	1,107,000

These figures indicate that important changes have taken place during the ten years that have elapsed since the 1878 Exhibition.

The production of charcoal pig iron has continuously decreased, and now shows only an unimportant tonnage.

The smelting of iron ores with a mixture of coke and charcoal was a local and temporary peculiarity, and this practice is disappearing more and more, either because the blast furnace owners, who, being unable to use coke only owing to the smallness of their plant, mixed coke with charcoal in order to lessen the cost of production, have finally put their furnaces out of blast, or because they have decided to build larger furnaces, and to use coke alone.

The production of pig iron by means of coke is therefore now the only important branch of the French pig iron trade. The author reported to the Institute in 1878 as to the geographical distribution of the blast furnaces in France. The following statement will show the changes since that time:—

BLAST FURNACES IN BLAST.

Districts.	1877.	1887.
North and Pas-de-Calais district.....	16	12
Mourthe and Moselle district.....	32	31
Champagne district.....	59	14
Franche-Comté district.....	9	2
Central district.....	21	7
North-Western district.....	13	1
Perigord and Aveyron district.....	19	4
Pyrenees and Landes district.....	18	11
Loire and Rhone district.....	29	10
Alpine district.....	6	3
South-Eastern district.....	10	6
	32	101

The total number of blast furnaces has decreased more than one-half, but the pig iron production has nevertheless increased. From about 6,500 tons the mean annual make per furnace has increased to 15,500 tons, and, if the details were looked for, it would be found that the progress in this respect has occurred in the two first districts, and, above all, in the Mearthe and Moselle district, which, with less than a third part of the total number of the French furnaces, has produced more than one-half of the total annual make of pig iron.

SECTION III.—MANUFACTURE OF WROUGHT IRON AND STEEL IN OPEN FIRES AND IN PUDDLING FURNACES.

The introduction of the new and economical processes for manufacture of cast steel has effected great changes in the iron industry of France as well as of other countries. The following statement, taken from the official statistics, gives an idea of these changes since 1878:—

	1877.	1887.
Number of puddling furnaces (iron)	995	637
" " (steel)	51	35
Number of open fires (iron)	243	53
" " (steel).....	6	5
	Tons.	Tons.
Production of puddled iron	821,006	617,997
" of charcoal refined iron	63,487	16,864
" of puddled and charcoal-refined steel.....	20,273	12,532

These figures are sufficiently expressive, and the author does not think it necessary to discuss them specially.

SECTION IV.—MANUFACTURE OF STEEL IN CONVERTERS.

According to the official statistics, there were 24 Bessemer converters at work in France during the year 1877, but no data are given as to their output. The data for 1887 are as follows:—

Converters in activity	28
Output in 1887, viz. :—	Tons.
Rails	189,200
Bars	107,300
Plates and sheets	28,400
Total	324,900

The author cannot indicate separately the output of acid Bessemer steel and of basic steel; but the statistics allow us to estimate at about 143,000 tons, the quantity of basic steel contained in the 324,900 tons above stated. The producing power of basic steel in the French steelworks is, however, much greater than would be supposed from the above figures, as well as of acid Bessemer steel. Indeed, although the official statistics indicate that some 28 converters were at work in 1887, this only represents about two-thirds of the actually existing converters, which will number from 42 to 44. Some Bessemer steel works have been entirely idle in 1887, such as those of Terrenoire, Givors, Saint Nazaire, Pagny on the Meuse; while some others worked with only a part of their plant.

SECTION V.—MANUFACTURE OF STEEL IN OPEN-HEARTH FURNACES.

There were, in 1877, 51 open-hearth furnaces in France. Their number appears to have decreased in 1887, owing to the closing of the Sireuil Works, in which Messrs. Martin were the pioneers of this new manufacture, and to the reduced working of the Terrenoire and Besseges works. The official statistics furnish the following data for 1887:—

Number of open-hearth furnaces in work	69
Output in 1887, viz. :—	Tonnes.
Rails	13,709
Bars	90,498
Plates and sheets	39,557
Total	143,764

But the number of furnaces in working order in 1889 is notably greater, and may be estimated at about 75 furnaces of various systems and sizes.

Since the time of the introduction by Messrs. Martin of the new process in their Sireuil Works, the size of the open-hearth furnace has always been increasing. Instead of the 3 to 4-ton furnaces first used, 10-ton furnaces, 20-ton furnaces, and even, as in some steel works of the Loire district, 35-ton furnaces can now be found.

In reference to the manner of constructing the furnace, the majority are of the fixed type, the so-called Siemens-Martin furnace, designed at first by the Messrs. Martin themselves, and having regenerators situated underneath the hearth, and the reversing valves on one of the small sides. In two or three steelworks only can the Pernot furnaces be found, with a revolving circular basin or hollow hearth, or the Batho furnace, with a round hearth, supported by an iron plate, free underneath, and with round regenerators with plate-iron casing placed laterally and above ground. But the use of these varieties of the open-hearth furnace does not seem to extend very much in the French steelworks, which look as if they preferred the ordinary type. All these furnaces are heated by means of generator gases. Water-gas and petroleum have not yet been tried in France for that purpose, so far as the author knows. The number of casts in 24 hours varies according to the different works and types of furnaces, between two and four.

The most general mode of working is the scrap process. The ore process is not employed in France as far as the author knows, and the combined use of scrap and ore, as in the Laundore process, is only in current practice at the Allevard Works, as far as the author can say.

The nature of the lining varies in the different works, and according to the description of materials used. Sometimes the lining is acid, that is, it is made with sand, ganister, or silicious puddle; sometimes it is basic—that is, made with magnesia bricks or puddle (according to the system patented in 1869 by Mr. Emile Muller), or with dolomitic bricks and blocks; at other times the lining is neutral—that is, made with chrome ore (according to the Valtou-Remaury process). When the lining is made with chrome ore, Messrs. Valtou and Remaury state that no material is taken from the lining either by the molten metal or by the slag, so that no corrosion takes place, and it becomes possible to act on the metal either by scraps or by ores, or by various agents in such a manner as to effect a complete dephosphorisation, and to produce various descriptions of steel. Messrs. Valtou and Remaury exhibit drawings of furnaces neutrally lined, specimens of their chrome ore and linings, and products of some steelworks working their process. French steelworks, such as Fourchambault and Aulais, for instance, choose the neutral lining rather than the basic one, which, they say, is sooner worn out, and above all when some iron ore is used in the process.

The properly-called dephosphorising mode of working, that is, the conversion of truly phosphoretic pigs (such as those of Meinthe and Moselle) in cast steel by the open-hearth process, is not yet much used in France. This description of pig iron is sooner dephosphorised in the basic Bessemer converter. Mr. Fould-Dupont, however, shows in his beautiful exhibit (Central Gallery) cast steel of every form obtained in open-hearth furnaces from his Pompey pig iron.

On the other hand, in many steelworks, the basic or neutral lining is used for making open-hearth steel with ordinary pig and scrap, not free enough from phosphorus to yield good steel on an acid lining, and too low in phosphorus to be worked in the basic converter. Some of them are even working pure pig and scrap upon basic and neutral hearths, and produce soft and extra soft steels of very high quality; these steels being, besides, either simply carbon steels, or steels into whose composition enter silicon, manganese, and chrome, inasmuch as the open-hearth furnace is a very convenient and adaptable one, which allows the easy introduction and stirring of any reagent in the metallic bath.

Upon the whole, the modes of working in the open-hearth furnace are very diversified in France, not only owing to the acid, basic, or neutral lining, but also owing to the composition of the materials, pig iron, scrap, ores, and alloys employed.

SECTION VI.—MANUFACTURE OF BLISTER STEEL AND OF CRUCIBLE CAST STEEL.

The use of cementation or converting furnaces is somewhat stationary in France. There were, in 1877, 34 converting furnaces with an output of 1,717 tons of blister steel; in 1889 the number of working furnaces was 24 and the output was 1,491 tons.

The furnaces are not employed only for the carbonising of superior wrought-iron bars, intended for the making of shear steel or tool cast steel; they are also used for adding carbon to certain puddled steels and even to certain cast steels for special purposes.

In reference to crucible steel, the official statistics give, for 1877, 101 furnaces with an output of 7,252 tons; and for 1887 only 39 furnaces (containing 501 crucibles) have produced 7,532 tons. The old furnaces, heated by coke fires, and containing two or four crucibles each, are now to be found in a few inconsiderable works; the large steelworks employ actually nearly everywhere large gas Siemens furnaces, containing 20, and even 40 crucibles.

The crucible melting is not actually only employed for producing tool cast steel by the fusion of blister steel, or for making homogeneous iron by the fusion of pig iron with malleable iron. This mode of melting metals has now taken a prominent place in the manufacture of the new steels, in which several substances besides carbon are alloyed with iron, as can be seen in the Exhibition by inspecting the Unieux, Assailly, and Firminy exhibits.

At Messrs. T. Holtzer & Co.'s, M. Brustlein began, many years ago, and has continued since, practical researches and experiments with a view to ascertain the influence of some metalloids (such as silicon), and of some metals (such as manganese, chromium, tungsten, and copper), on the mechanical properties and the qualities of cast steels. These trials brought him to the manufacture in crucibles of some iron alloys, like ferro-chromium and others. In 1878 the Unieux Steelworks exhibited ferro-chromium and chrome steels, which were much admired. In 1889 these works exhibit chromium carburets, silico-chromium, ferro-chromiums of various percentages, silico-ferro-chromium, manganese-ferro-chromium—all these alloys being obtained in crucibles; and also a comparative series of different grades and kinds of steels, carbon steel, manganese steel, silico-manganese steel, copper steel, wolfram steel, chrome steel, and chrome-wolfram steel.

SECTION VII.—MISCELLANEA.

The researches and the chemical studies relating to iron metallurgy have been numerous during some years past; they have not been unfruitful for the iron industry. The basic or Thomas-Gilchrist process is one of their fruits, the importance of which cannot be contested. Messrs. Thomas and Gilchrist have been induced to make trial of their basic linings, as they told the author in 1878, by the scientific writings of the late Professor Gruener. The Rollet process, the Valtou-Remaury neutral lining, and others, can also justly be considered as results procured by the chemical laboratory.

Since the considerable increase of the new cast steels (Bessemer and Siemens-Martin) manufacture, these metals have been particularly studied by chemists, often associating themselves for that purpose with mechanical engineers, as can be seen by the writings of Mr. Deshayes on the relations between the mechanical properties of steel and its chemical composition.

But what appears to the author to characterise above all the scientific researches made in France on the metallurgy of iron during this period is the intervention of physical science in these researches. Metallurgists already knew the calorimetric studies of Messrs. Troost and Hautefeuille on the carburised, siliconised, and manganese pig irons. They possess now, among others, Mr. Forquignon's researches on malleable cast iron and steel, those of Mr. Pionchon on the calorific capacities and the physical changes of iron at high temperatures, the studies of Messrs. Osmond and Werth, engineers at the Crenost Works, on the intimate structure of steel; those of Mr. Osmond on the transmutations of iron and carbon in the malleable irons, steels, and

white pigs; and in all these works there have been used at the same time chemical analysis, calorimetry, microscopy, and even electrical measures. Visitors to the Exhibition can see in the Metallurgical Gallery an apparatus used in the Montluçon-Saint-Jaques Steelworks for studies of that kind—the Evard apparatus, for ascertaining and measuring metal dilatations at high temperatures. Besides, moreover, can be found the Mesuré and Nouel pyrometric telescope as employed for practically ascertaining the temperature of incandescent bodies, based on polarisation phenomena.

These various scientific studies have had an influence which is considerable over the French metallurgical works, although the author cannot possibly do more than allude to it. One of their results, and perhaps not the least important, is the considerable increase in the making and employment of steel castings in France, a fact which has forcibly impressed visitors to the Exhibition of 1889.

PATENTS.

Improvements in Extracting Gold and Silver from Ores or other Compounds. J. S. MacArthur, Pollokshields, and R. W. Forrest and W. Forrest, Glasgow. Eng. Pat. 10,223, July 14, 1888. 6d.

CHIEFLY improvements of Eng. Pat. 14,174 of 1887 (this Journal, 1888, 678). The ores are first treated with an alkali or alkaline earth, then washed with cyanide solution, and precipitated with freshly-prepared and finely-divided zinc. The improvements in the zinc process are claimed also for other than cyanide solutions.—T. L. B.

An Improved Method of Extracting Gold from the Various Auriferous Ores. C. T. J. Vautin, London. Eng. Pat. 11,399, August 7, 1888. 6d.

THE expense and delay of roasting gold ores is obviated by treating first of all with chlorine, bromine, or iodine, and then amalgamating. Claim is made for the combination of the two processes—chlorination and amalgamation.—T. L. B.

Improvements in Means or Apparatus to be Employed in Coating Metal Sheets with Tin, Terne, and other Metals or Alloys. J. G. Thomas, Llangennech, and G. H. White, Pontardulais. Eng. Pat. 11,854, August 16, 1888. 8d.

THE several processes from fluxing to finishing are here performed in one continuous operation. The plate passes first through a bottomless box contained in the upper part of the tinning pot; this box contains the flux supported on the surface of the molten metal. It is conducted thence by guides through the molten metal to a pair of rolls, whence it passes through a narrow neck to the grease pot at the entrance of which it is received by another pair of rolls. Between this second pair of rolls and the next pair or finishing rolls, which are arranged above the level of the molten metal, an enclosed guide is provided to conduct the plate. This guide passes above the level of the molten metal and enters a short distance into the grease, which is supported on the surface of the molten metal. Scrapers are also provided to remove any dross from the surface of the molten metal. As the guide encloses the surface of the molten metal through which the plate passes, there is only a small surface on which dross can form and it is thus readily removed. A second pair of finishing rolls is provided, whence the plate is conducted away as desired. The two pots are heated by separate fires, and by reason of the narrow neck both pots may be kept at different temperatures. Six claims are made.—T. L. B.

A New or Improved Process of obtaining Aluminium. B. J. B. Mills, London. From J. D. Bennett, Brooklyn, U.S.A. Eng. Pat. 12,343, August 27, 1888. 4d.

THE process consists of two main operations, the first is to roast a mixture of clay or other aluminous earth, alum, and salt; and the second is to heat in a retort the roasted material so obtained with whiting, asbestos, and lamp-black.

The aluminium is thus produced in buttons and globules, and is separated from the remainder by sifting. The function of the asbestos is to "prevent all slag from forming, and produce an ash whose porous character permits of the filtration and percolation of the globules of aluminium as they are formed."—A. W.

Improvements in the Manufacture of Sodium and Potassium. H. W. Wallis, London. Eng. Pat. 12,626, September 1, 1888. 4d.

"HYDRATED alkali" is powdered and mixed with 10 or 15 per cent. of carbonaceous material, also pulverised, and fed at intervals into a heated retort. It is claimed that this method is preferable to that (already known) of feeding the retort periodically with a mixture of fused alkali and carbonaceous material, both because of the extraneous heat needed to keep the mixture fluid, and of the alleged fact that a mixture so kept for some time becomes less easy to reduce.—H. B.

Improvements in and Connected with the Recovery of Tin, Spelter, Solder, and like Metals or Alloys from Scrap or Refuse Tinplate and other like Coated Metal Wares. R. C. Thompson, St. Helens Junction. Eng. Pat. 12,937, September 7, 1888. 8d.

AFTER cleaning, the material is heated to a temperature equal to or greater than that of the melting point of the metal to be recovered in the presence of gas or liquid, which prevents the oxidation of the metal. The melted metal may then be removed by agitation or other suitable means. The patentee proposes for the purpose a centrifugal machine, drawings of which are given in the specification. Seven claims are made.—T. L. B.

Improvements in the Manufacture of Sodium and Potassium. W. White, Cheshunt. Eng. Pat. 13,125, September 11, 1888. 4d.

IN order to avoid the well-known difficulty of obtaining a sufficiently intimate mixture of the sodium salt (carbonate or hydrate for example) and the reducing agent (some form of carbon) hitherto existing on account of the fusibility of the one and the buoyancy of the other, the patentee substitutes uncrushed charcoal for the powder usually employed, allows it to absorb within its pores the greatest quantity of sodium carbonate or hydrate in a molten condition it can take up, and then heats it in a retort and condenses the resulting sodium vapour in the ordinary way. It is claimed that a comparatively low temperature suffices for the reduction, and that the process is also applicable to potassium and to alloys of the two common alkali metals.—B. B.

The Manufacture of Plates and other Articles from an Alloy or Alloys of Copper and Nickel by Rolling at a Red Heat. Sir H. H. Vivian, Swansea. Eng. Pat. 13,358, September 15, 1888. 4d.

ALLOYS are made containing from one-tenth to 10 per cent. of nickel, the remainder consisting of pure copper. The two metals are melted together, cast into ingots, annealed and rolled at a red heat just as copper is rolled.—E. E. B.

Improvements in the Extraction of Copper from Copper Ores. H. Doetsch, Huelva, Spain. Eng. Pat. 13,359, September 15, 1888. 4d.

PERSULFATES of iron are obtained by dissolving natural iron oxides in sulphuric or hydrochloric acid. The patentee mixes with the ground oxides the equivalent quantities of the mineral acids, preferably strong sulphuric acid heated to 100° to 150° F. The persulphate is dissolved in water to about a one per cent. solution and then poured over copper ore. The copper is thus got into solution, from which it is precipitated by means of metallic iron.—T. L. B.

Improvements in Alloys. H. Eckhardt, Dortmund, Germany. Eng. Pat. 13,742, September 24, 1888. 4d.

CHROME iron ore and Bessemer slag of specified composition are smelted together with coal, or the chrome iron ore and slag are made into briquettes with tar and smelted in a blast furnace. The alloy thus produced contains 50 per cent. of chromium, 20 of manganese, and 20 of iron. If an alloy without manganese be required, powdered glass should be substituted for the slag.—E. E. B.

Improvements in and relating to the Manufacture of Steel and Iron. H. J. Smith, Newmans. Eng. Pat. 13,843, September 25, 1888. 6d.

To prevent red-shortness soda lime (or potash lime) is added to the iron in place of spiegeleisen or any other compound of manganese, preferably at the same stage in the manufacture at which it is customary to add the manganese.—E. E. B.

Improvements in the Manufacture of Alloys of Steel and Nickel. H. Schneider, Le Creusot, France. Eng. Pat. 14,150, October 2, 1888. 6d.

NICKEL is melted with iron or steel, care being taken to prevent oxidation of the nickel at this stage by covering it with anthracite during the fusion. More iron is subsequently added, and the operation conducted as in the manufacture of ordinary steel. Oxidation is prevented by means of a layer of slag or cinder and precautions must be taken to avoid red-shortness in the metal before the introduction of the ferro-manganese. The steel thus produced is specially suitable for the manufacture of ordnance, armour-plates, gun-barrels, &c. for military use.—E. E. B.

Improvements in and relating to the Extraction of Gold from Refractory and other Ores, and in Apparatus employed therein. J. Greenwood, London. Eng. Pat. 14,240, October 3, 1888. 8d.

THE powdered (and, if necessary, roasted) ore is charged into a chlorinator, and a solution of chlorine is then pumped in until a pressure of 80 to 100 lb. per square inch is obtained. All air is preferably expelled. After the apparatus has been revolved for some time the mixture is filtered through asbestos cloth in a shallow wooden apparatus, cone-shaped underneath, and the ore washed by means of a current of water introduced from beneath. The solution of gold chloride is then run into an electrolytic cell, the gold is therein deposited, and the chlorine liberated passed into water, the solution thus formed being used again as already indicated. Five claims are made. Drawings of the apparatus are given in the specification.—T. L. B.

Improvements in Apparatus employed in Coating Metal Plates or Sheets with Tin, Terne, or Lead. E. Brazier, Bilston, and J. Thompson, Wolverhampton. Eng. Pat. 14,807, October 15, 1888. 8d.

THIS is an apparatus by means of which the separate wash pot and grease pot are dispensed with, and the whole process reduced to one operation. It consists of a shallow dish in which the metal is melted, suspended in a larger pot filled with grease, to which is affixed the usual rolls, guides, &c. The sheets are pushed first through the grease, then the coating metal, and finally through the grease again, and are delivered by the rolls. Drawings are given. The advantages are: a minimum quantity of coating metal can be used, as its temperature is maintained by the body of grease in which it is suspended; the metal cannot be overheated; and any loss thereby is prevented.—A. W.

Improvements in and relating to the Manufacture of Steel and Iron. H. J. Smith, Newmains. Eng. Pat. 16,061, November 6, 1888. 4d.

THE object is to dispense with the use of spiegeleisen or ferro-manganese in the well-known oxidation processes, by subjecting the blown metal to the action of a mixture of sodium or potassium hydrate or carbonate and magnesia, or other alkaline earth, &c. The mixture may also contain metallic oxides, iron, or other metallic substances. The above materials remove the oxide of iron from the blown metal and are also said to diminish the percentage of carbon.

—A. W.

Improvements in and relating to the Extraction of Zinc from its Ores. H. A. Hunnicke, St. Louis, U.S.A. Eng. Pat. 18,024, December 10, 1888. 8d.

THE oxide ore and flux are heated to the reducing temperature before mixing with the fuel, which latter is also similarly pre-heated. The whole is then mixed in the reduction chamber, which is kept at a high temperature, and wherein the zinc vapours are produced. The superheated vapours and gases are then cooled as rapidly as possible in the condenser, the object being to minimise the period of existence of that stage during cooling in which the zinc reacts on the carbonic acid with the re-formation of oxide. This may also be accomplished by getting rid of the carbonic acid by passing the vapours, &c. through heated charcoal, with the result that the products consist only of carbon monoxide and zinc vapour. Drawings of a desirable plant are given.—A. W.

A New or Improved Metallic Alloy. F. Ellis, Harborne. Eng. Pat. 3109, February 21, 1889. 4d.

THE alloy consists of copper, 87 parts by weight; zinc, $6\frac{1}{2}$ parts; tin, 4 parts; arsenic, 2 parts; and phosphorus, $\frac{1}{2}$ part. The copper is first melted, and the zinc, tin, arsenic, and finally phosphorus added. The metal obtained is free from porosity, very ductile and elastic, slightly liable to tarnish, and retains a good polish. It is recommended for use in jewellery, ornaments, electro-work, metallic pens, bells, gongs, and shaft bearings.—A. W.

Improvements in or relating to the Coating of Metals. A. J. Boulton, London. From W. G. Clark, Hergott Springs, South Australia. Eng. Pat. 3149, February 21, 1889. 4d.

THE iron or steel is heated to a welding heat, coated with a flux and dipped into molten copper, whereby it becomes covered with a skin of the latter metal. The flux used is a local native earth, and is composed of silicious sand, oxides of iron and aluminium, and carbonate of lime, but the proportions are not given. Two sheets of copper, or a sheet of copper and one of iron, can be welded together by the aid of this flux.—A. W.

An Improved Metallic Alloy for Syphon Heads and other Objects, and for Tinning Purposes in General. D. J. Reisz, M. Berkovits, and J. Biehler, Budapest, Hungary. Eng. Pat. 3916, March 6, 1889. 4d.

THREE to five parts of nickel are heated to redness, when 10 parts of molten tin are added. Complete amalgamation takes place in about half an hour, and this alloy is then thoroughly stirred up with 990 parts of molten tin. The alloy thus obtained is compact, strong, and has the colour of nickel.—E. E. B.

Improvements in the Method of Purifying Quicksilver. P. Schroedter and A. Schroedter, Berlin, Germany. Eng. Pat. 5980, April 8, 1889. 6d.

THE mercury to be purified is filtered through cane or any dry non-resinous wood or stem of fibrous structure. A typical apparatus consists merely of a glass funnel joined at the end of its stem by a rubber ring to a piece of cane

about 12 cm. long and 1 cm. in diameter, on the top of which a plug of cotton-wool freed from oily matter is placed.—B. B.

Improvements in and Means or Apparatus for the Extraction of Metals from Metallic Ores or Matters containing Metals. N. Lébedeff, St. Petersburg, Russia. Eng. Pat. 7353, May 2, 1889. 8d.

THE natural ores, or combinations resulting from metallurgical operations (such as slags), and containing the oxidised metals, are melted in suitable appliances, such as crucibles or reverberatory furnaces, and a reducing gas is forced through the mass when in a state of fusion. To impart sufficient fluidity for the convenient injection of the reducing gas, it may be necessary to add a flux, the nature of which must be determined according to the ore under treatment. When the metal is reduced by the action of the gases, the slag and metal may be run out and treated as desired. The apparatus proposed consists essentially of two reverberatory furnaces placed one on each side of a vertical shaft. The ore is placed in the shaft, and is thus roasted before reaching the furnaces. The reducing gases are introduced by suitable tubes or inlets through the roof of the furnace.—T. L. B.

Improvements relating to the Welding, Soldering, or Brazing of Metals, and to Apparatus therefor. H. H. Lake, London. From E. Thomson, Massachusetts, U.S.A. Eng. Pat. 8038, May 14, 1889. 11d.

THIS specification does not admit of a suitable abstract. It is full of detail of the different methods and plans of the patentee for the various applications of electric soldering, brazing, &c. There are 50 drawings given.—A. W.

An Improved Flux for Coating Iron or Steel with Copper, and for Welding Copper. H. H. Chandler, Lanra, South Australia. Eng. Pat. 9187, June 3, 1889. 4d.

THE flux is composed of carbonate and sulphate of lime in a state of fine subdivision, either separate or mixed together.—E. E. B.

Improvements in the Treatment of Auriferous and Argentiferous Materials, and in Apparatus therefor. A. W. Lockwood, Auckland, New Zealand, and H. Chappel, Sydney, New South Wales. Eng. Pat. 9476, June 7, 1889. 6d.

THE ores, broken to small gauge, are roasted in retorts exactly resembling gas retorts. A perforated pipe runs along the bottom of each retort, whereby steam, superheated steam, or carburetted hydrogen may be passed. In the process sulphur, arsenic, and base metals are carried off and conveyed to condensing chambers. The roasted ore is afterwards ground and amalgamated as usual.—T. L. B.

Improvements in Joining Pieces or Articles of Metal Foil or Thin Metal together, or to other Pieces or Articles of Metal. J. Y. Johnson, London. From L. H. Rogers, New York, U.S.A. Eng. Pat. 11,734, July 23, 1889. 8d.

THE idea is to press the two sheets or foils together up to the line along which it is desired to join them and leaving the remainder free from pressure. The excess is then cut off, and the two freshly exposed edges fused together by the aid of a soldering iron. Two pieces of tin foil can in this way be joined together without a flux, but when tin foil is joined to some other metal a flux such as sal-ammoniac is preferred. The two acts of removing the excess and fusing the surfaces may be conducted in one operation and by the same tool. Drawings are given.—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Bichromate Batteries for Domestic Lighting. Dingl. Polyt. J. 272, 561—564.

SOME of the recent devices for increasing the applicability of double and single fluid bichromate batteries for domestic lighting, are described. Such are *Mareschal's* plan for raising and lowering the zines in a single fluid battery which can be operated electrically from a distance, and the mercury cup used by *Radiquet* for two-fluid batteries, in which the zinc of each cell stands, and is thus kept thoroughly amalgamated; to the latter also is due a syphon which can be started without sucking and its attendant risk; the limb of the syphon, which is in the liquid it is desired to draw off, is surrounded by a wider glass tube closed at the bottom save for a hole smaller than the bore of the syphon itself; to the upper end of this outer tube is attached a flexible tube, on blowing through which the liquid in the annular space between the two tubes is depressed, and most of it choosing the easier path, is driven up into the syphon instead of through the small hole at the bottom of the wider tube.

Another arrangement for keeping the zinc amalgamated, described in *Le Génie Civil*, 1889, 107, and capable of utilising zinc scrap, consists in enclosing the zinc in a copper basket which is connected by two perforated copper rods with a porcelain capsule containing mercury which already contains a little zinc in solution, and which distributes itself over both copper and zinc, forming a protective coating, permanent with any ordinary output of current from the cell.

E. Landmann has arrived at the following conclusions with regard to single fluid bichromate cells:

- (1.) Such cells, especially if provided with some arrangement for regulating the area of the immersed portion of the positive plate, are capable of yielding a powerful current for a considerable time.
- (2.) It is essential to renew the spent fluid close to the plates; with a large volume of the exciting liquid, e.g., 6 litres, in a deep cell in which the active surface of the zinc is about 1 sq. dm., no alteration of the area of the immersed surface is necessary for about two hours.
- (3.) From their high E.M.F. and small internal resistance these batteries are well adapted for lighting glow lamps in parallel.
- (4.) In the case of retort-carbon the resistance and specific volume increase with the hardness and fineness of texture. The softer and more porous kinds, and those with a high specific gravity, give a higher E.M.F. and are less readily polarised. The use of artificial carbon plates is not advisable.
- (5.) Zinc as pure as possible, free from iron and carbon (compare Chem. News, 60, 95), should be used to avoid local action.
- (6.) Sodium bichromate is in every way preferable to the potassium salt, and chromic acid to either, as no crystals of chrome alum form, but its price is against it.—B. B.

PATENTS.

Improvements in and connected with the Manufacture of Iron. A. G. Greenway, West Derby. Eng. Pat. 6326, April 28, 1888. 8d.

An electric current is passed through cast iron in a molten state through which air is also forced, the object being to produce iron of greater strength than has hitherto been possible. Drawings accompany the specification.—E. E. B.

Improvements in the Means of Preparing Metallic Surfaces for the Reception of Non-adhesive Electro-Deposits in the Form of Tubes, Cylinders, Pans, and like Metal Wares. F. E. and A. S. Elmore, Cockermouth. Eng. Pat. 12,264, August 25, 1888. 6d.

The metal surfaces—properly cleaned and prepared—are coated with lead or a lead alloy by dipping in a bath of molten lead or alloy. Where necessary, as with cast iron, a coating of tin or a tin alloy is first applied and followed

by one or more coatings of the first-mentioned metal or alloy. Such a coating protects the original metal surface from the action of the bath and fills up all pinholes, &c.; the deposit of other metals upon it by electrolysis is, moreover, non-adhesive. When the metal surface or mould is composed of several parts, the coating is made to fill all interstices at the junctions.—E. T.

Improvements in Galvanic Batteries. A. Schanschlied, London. Eng. Pat. 12,290, August 25, 1888. 8d.

THE improvements are in methods of emptying and filling battery cells. In one method, each battery cell is provided with a second cell or annex, with which it communicates by a small hole near the bottom. Each annex communicates in a similar way with that on either side of it. These holes are large enough to keep the cells supplied with new liquor, but are too small to allow much electricity to flow. The annexes are supplied from a tank in which the level is kept constant by a ball-cock. The spent liquor, which is of low density, leaves the cell by an overflow pipe, and each cell has an opening at the bottom for emptying it.

In another method the cells are placed at successive lower levels, and the liquor flows from the top of one to the bottom of the next. In a third method, each cell is connected to its neighbour by a flexible tube, inserted near the bottom of each. If the bend of the tube be held above the level of the liquid in the cells, air enters by a small valve, and the columns of liquid on the two sides fall to the level of the liquid in the cells, which are thus insulated from one another. On lowering the bend, communication is again established and all the cells can be emptied or filled simultaneously.

—E. T.

Improvements in the Reduction of Zinc Oxides. C. A. Burghardt, Manchester. Eng. Pat. 13,182, September 12, 1888. 4d.

THIS is an improvement on Eng. Pat. 9886 of 1888 (this Journal, 1889, 551 and 624), for obtaining pure zinc by the electrolysis of an alkaline zincate solution. The improvement consists in preparing the zincate by adding the roasted ore, or oxide of zinc, to melted caustic potash or soda. The fused mixture is well agitated and afterwards dissolved in water.—E. T.

Improvements in the Construction of Secondary Batteries. S. A. Varley, London. Eng. Pat. 13,102, September 17, 1888. 8d.

ALTERNATE sheets of thin lead and canvas are enclosed in a strong vessel and raised to a temperature of about 400° F. The vessel is then exhausted of air and melted lead run in so as to completely fill it. Pressure is then applied by a screwed cylinder passing through the cover. The temperature is then raised to the melting-point of the contents, which unite more perfectly; at the same time the canvas chars and the gas evolved is allowed to expand by partially unscrewing the cylinder. The whole is then allowed to cool slowly, when the lead crystallises in small crystals, this operation having been facilitated by the charred material and gas rendering the mass porous.

The block thus obtained may be sawn up into plates and formed by Planté's process. Oxide of lead may be introduced with the canvas, which may itself be replaced by other materials.—E. T.

Improvements in or relating to Cases for Electrical Batteries or Cells. G. B. Satterlee, New York, U.S.A. Eng. Pat. 13,615, September 20, 1888. 8d.

THE invention applies to a method of hermetically sealing the containing cells of small portable batteries, such as are placed in gun-stocks. The top is closed by a tightly-fitting plug or stopper, with a head of rather less diameter than that of the outside of the case. Under this head, between it and the case, one or more rings of pure soft india-rubber are compressed by a ferrule screwing on the outside of the case and provided at the top with an inturned flange which

forces the stopper downwards. Grooves or channels may be turned in either the case or the stopper to grip the india-rubber better, and luting may be employed in addition if desired.—E. T.

Means for Producing suitable Acid or Salt Solutions for Feeding Electric Batteries. S. Eloesser, Berlin, Germany. Eng. Pat. 13,717, September 22, 1888. 8d.

WATER entering at the bottom of a mixing vessel is met by acid descending through a vertical tube from a second vessel placed above, the supply of both being regulated by suitable cocks. The mixture flows out near the top of the first vessel, and may, if desired, be more thoroughly mixed by passing through a third vessel containing broken coke or pumice stone. It finally trickles into the cells of the battery from a distributing pipe placed above them. The spent battery liquor passes from the bottom of the cell to a trough at the side, whence it can flow away. In another arrangement, the first mixing vessel is replaced by a T-tube, the acid entering by the vertical arm, the water by one horizontal one, and the mixture leaving by the other.

When a solid salt is employed it is contained in a vessel which is partly immersed in the mixing vessel. The immersed portion is perforated to allow the salt to dissolve.—E. T.

Improvements in Copper Amalgamating Plates. R. I. Atcherley and A. E. Sarti, London. Eng. Pat. 15,172, October 22, 1888. 4d.

To increase the amalgamating surface of plates used for the extracting of gold, and to render it more sensitive, a granular deposit of copper is effected electrolytically. This is then coated electrolytically with silver and the whole amalgamated.—B. T.

Improvements in Electric Batteries. P. Schoop, Oerlikon, Switzerland. Eng. Pat. 15,626, October 30, 1888. 8d.

THE sides and bottom of the containing case are provided with grooved ribs or fillets, resembling those used in boxes for storing photographic plates, microscopic slides, &c.; the electrodes slide into these grooves. One set of electrodes—the negatives, say—are provided with feet which are connected by lead strips passing out of the cell. The other set of electrodes are similarly connected, by lugs, to lead strips above the surface of the electrolyte. Or the current may enter at centres of one set of plates and leave at the circumferences of the other set.—E. T.

A New or Improved Method of Treating the Effluent Waters from Mines or other Waters holding Metals in Solution. M. Yglesias, London. Eng. Pat. 15,708, October 31, 1888. 4d.

THE waters are used as the electrolyte of a voltaic cell, with suitable electrodes, such as iron and carbon, a current of electricity being produced with deposition of the metal. Manganese, iron pyrites, slag, &c. as waste products, may be coated with graphite and used as the carbon electrode.—E. T.

Improvements in the Charging of Secondary Electric Batteries from Primary Batteries, and Apparatus for that Purpose. E. Tyer, London. Eng. Pat. 16,140, November 7, 1888. 8d.

THE secondary cells are divided into two or more groups, the terminals of which are connected to a suitable series of mercury cups. A commutator driven by clockwork is connected with the primary, and opens and closes the circuit between the primary and each group of secondary at regular intervals, giving the primary intervals of repose, which help to keep its plates from polarising excessively.—B. T.

Improvements in the Production of Pure Zinc. C. A. Burghardt, Manchester. Eng. Pat. 18,440, December 18, 1888. 4d.

IMPURE zinc is employed as anode in an electrolytic cell, the deposit of pure zinc being received on a suitable cathode. Zincate of sodium or potassium is used as electrolyte, and may be obtained by charging the cell with caustic alkali, and passing a current of electricity until pure zinc is deposited.—E. T.

Improvements in the Reduction of Zinc and Tin from their Ores. C. A. Burghardt, Manchester. Eng. Pat. 659, January 14, 1889. 6d.

FROM three to seven per cent. of carbonaceous material, such as powdered coal or charcoal, is mixed with the crushed and roasted zinc or tin ore, and the mixture is passed into a heated pot or vessel containing a fused mass of caustic soda or potash. The contents of the pot are stirred and kept hot until gases, chiefly carbon monoxide and dioxide, are no longer evolved, whereupon the mass is poured out, allowed to cool, and treated with water to dissolve out the soluble part. This solution is then subjected to the action of an electric current, and the metal is deposited upon the cathode. The caustic alkali may be obtained from the resulting liquid, and used for a further treatment of ore.—B. T.

Improvements in Primary and Secondary Transportable Galvanic Dry Elements. C. Smith, London. From W. L. F. Helleeson, Copenhagen, Denmark. Eng. Pat. 2297, February 8, 1889. 6d.

A DOUBLE containing case is used, the space between the two cells being filled with a material capable of absorbing moisture, such as sawdust, &c. Any gases generated pass through a plaster of Paris stopper near the top of the inner cell to perforations in its side walls, and are dried by the absorbent material, and thus rendered less harmful to the fittings of the battery. The electrolyte is made solid by the use of some such material as gum tragacanth, which by its sticky nature will always adhere to the electrodes, in spite of changes in the form or size of the latter, the materials ordinarily employed not being suitable when the cell is not hermetically sealed. The inner cell is closed in above the plaster of Paris by a layer of pitch or other suitable material.—E. T.

Improvements in Secondary Batteries. C. B. Askew and J. K. Pumpelly, Chicago, U.S.A. Eng. Pat. 7215, April 30, 1889. 8d.

To prevent any disintegration of the active material, one or both of the faces of each plate is covered by an insulating porous material, such as asbestos. Between the insulating coverings of contiguous plates are parallel ribs, formed either on the coatings or furnished by a separate frame. These ribs leave channels in which the liquid can circulate. To connect the plates—which are shown horizontal in the specification's drawings—each anode is furnished on one side with a lug, so thickened as to fill the space between the anodes immediately above and below. These lugs are bored, and all held firmly pressed together by a rod passing through the holes. The rod is smaller than the holes, and after being placed in position is protected from the electrolyte by pouring in melted lead to fill up the space round it. The cathodes are similarly connected on the other side of the cell.—E. T.

An Improved Process for the Electrolytic Separation of Aluminium, Aluminium Alloys, and Magnesium from Solutions of their Salts. G. Nahsen, Hanover, Germany. Eng. Pat. 8552, May 23, 1889, 4d.

THE inventor states that the production of "hydrate of metallic oxide" in all attempts to electrolyse aqueous or alcoholic solutions of aluminium or magnesium salts, is due to the fact that these metals decompose water at temperatures of 80° C. or less, and that when produced in the nascent

state by electrolysis (during which operation heat is evolved) this decomposition goes on at a much lower temperature. He has found, however, that below 4° C. all the aluminium is obtained as metal, and that hydrogen ceases to be evolved as a secondary reaction. His improvement, therefore, consists in cooling the electrolyte, especially in the neighbourhood of the cathode, by any suitable means, such as worms through which brine or salt lye circulate at a low temperature. Special means are taken to keep the solutions highly and equally concentrated. The positive and negative electrodes used are carbon and aluminium respectively.

—E. T.

Improvements in Secondary Batteries or Accumulators. T. Harris and H. F. de B. Cameron, Detroit, U.S.A. Eng. Pat. 8855, May 28, 1889. 6d.

THE plates of the battery consist of lead in which holes have been punched and tapped, so as to better retain the active material. The plates are held together by transverse rods of vulcanite with vulcanite washers of suitable thickness to act as distance pieces, and the whole rests upon a plate of india-rubber provided with bosses in order to reduce the jarring attendant upon transportation.—B. T.

An Improved Dry Galvanic Battery. D. J. Arnold and H. B. Coryell, Omaha, U.S.A. Eng. Pat. 9153, June 3, 1889. 6d.

THE containing case is of zinc and forms the positive element. The negative element is made up of round carbons, bunched together, and clamped at the top. Litharge, zinc chloride, ammonium chloride, oxide of mercury, and a body-former such as plaster of Paris, are mixed with water, and poured in a semi-fluid condition into the space between the carbons and the zinc containing cell, and allowed to set. The cell is closed hermetically by a layer of pitch or asphaltum.—E. T.

Improvements in and relating to Incandescent Electric Lamps. H. H. Lake, London. From S. F. Van Choate, Boston, U.S.A. Eng. Pat. 9576, June 8, 1889. 11d.

THE inventor describes a lamp holder and lamp cap, features of which are that the shade or reflector is held by a flange on the base of the lamp cap and is therefore secured by the act of placing the lamp in position, while the lamp itself is held by its wires being secured in sockets on the lamp holder. Two methods of sealing the tops of lamps are described, in one of which, a metal cap bearing the wires and filament is cemented on the open end of the lamp; while in the other method, the wires are sealed into a cup-shaped glass stem, which fits closely the open cylindrical end of the lamp, and is sealed thereto, mouth upwards, by fusion of the glass. The latter lamp fits at once, without any cap into the inventor's lamp holder. Lastly, the inventor describes a switch to be attached to each lamp, and provided, to reduce sparking, with a resistance coil common to all the lamps in the installation, and which is substituted for each lamp in the act of turning it off.—E. T.

Improvements in the Electrolytic Production of Hypochlorite of Sodium. E. M. H. Andreoli, London. Eng. Pat. 10,889, July 5, 1889. 6d.

TO increase the yield of the hypochlorite from chloride of sodium and to minimise the reducing action of the nascent hydrogen, the cathodes are made of much less area than the anodes and an oxidising material such as manganese dioxide is introduced into the bath in a retaining network placed between the anodes and cathodes. The anodes are made of carbon or manganese dioxide plates, and the cathodes of iron in the form of a gauze or trellis.—B. T.

Improvements in Storage Batteries. W. P. Thompson, Liverpool. From F. H. Alexander, Hyde Park, Mass., U.S.A. Eng. Pat. 11,044, July 9, 1889. 6d.

THE object of this invention is to construct a battery of high electro-motive force in a small space. Consecutive lead plates are separated from each other by a rubber packing going round the sides and bottom, and thus dividing the space between each pair of plates into a water-tight cell. These cells are filled with the electrolyte and charged in series, one side of each plate becoming positive and the other negative—the number of cells in series being always one less than the number of plates.—E. T.

Improvement in Insulation for Electric Conductors. C. T. Snedeker, St. Louis, Missouri, U.S.A. Eng. Pat. 11,067, July 9, 1889. 4d.

THE conductor is first coated with liquid shellac, and while this is still wet, a fibrous material, such as jute or silk, which has been well saturated in alum is served round it. A coat of a suitable liquid glue is then applied, and while the glue is still damp it is dusted with the following composition: four parts powdered glass, one part powdered alum, one part powdered asbestos. Next a fibrous material which has been well saturated with a paste of linseed oil, litharge, white lead, ground asbestos, and alum, is served round, and the whole is covered with more alum-treated fibrous material. When dry, this coating is treated with a varnish gum dissolved in linseed oil, and into this is pressed a thin coat of asbestos fibre. Finally, when hard and dry, a coat of suitable varnish is applied.—B. T.

An Improved Method and Apparatus for Connecting Carbon Filaments to Metallic Conductors and for similar Purposes. H. H. Lake, London. From H. Kemp, Lynn, U.S.A. Eng. Pat. 11,071, July 9, 1889. 8d.

JOINTS between metallic conductors and carbon filaments are generally weak mechanically on account of the carbon deposit obtained in a hydrocarbon chiefly falling upon the filament itself. To obviate this, the inventor flattens out the conductor, pierces a hole through it, passes the filament through the hole, and then by sending an electric current through the filament, immersed in a hydrocarbon, builds up a mass of carbon about the metal in the form of a rivet, making good electrical contact and a strong mechanical joint. Various methods of jointing in a similar manner are described, together with apparatus for holding the filament and conductors.—B. T.

Improved Grids or Supporting Frames of Electric Accumulators. E. Correns, Berlin, Germany. Eng. Pat. 11,328, July 15, 1889. 6d.

EACH plate is made up of two grids superposed, each having tapering square holes. The grids are put together so that the centre of each hole on one plate is opposite the boundaries of four holes on the other. In the process of manufacture, the wedge shape is given to the holes, after the superposition of the plates, by dies which pass through the perforations in the upper plate and give the required shape to the boundaries of the holes in the lower.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

On Palm-nut Oil and its Composition. E. Valenta. Zeits. f. angew. Chem. 1889, 334—337.

THE amount of free acid in palm-nut oil was found to vary, according to its origin and age, between 7 and 58 per cent., and the melting point between 23° and 28°. Shadler has stated in his "Technologie der Fette," that palm-nut oil consists only of palmitin and olein, but this is inaccurate. A mixture of several samples of palm-nut oil from various sources was saponified, the soap acidified, and the fatty acids liberated distilled in a current of steam. The fatty acids in the distillate were submitted to fractional distillation, and at 185° to 200°, a fatty acid passed over which was found to be caproic acid. The residue in the flask was too small for identification. The fatty acids in the residue from the first distillation were submitted to fractional distillation at a pressure of 100 mm. The different distillates were purified by crystallisation from alcohol and fractional precipitation

with acetate of barium or of lead. In this manner acids of constant melting point were separated which were identified from their chemical and physical properties as caproic, caprylic, capric, lauric, myristic, palmitic, and oleic acids, the chief portion consisting of lauric acid.—E. E. B.

Amount of Free Fatty Acids in Oils and Fats. H. Noerdlinger. Zeits. Anal. Chem. 28, 183—187.

THE oils and fats examined were dissolved in a carefully neutralised mixture of alcohol and ether, containing phenolphthalein, and titrated with decinormal potash solution. The acidity found was calculated as oleic acid according to Salkowski's example (this Journal, 1888, 37). Different qualities of the various oils and fats were examined, namely pressed salad oils, common pressed qualities as used for technical purposes, and crude extracted oils. The extracted oils were obtained in the laboratory by the use of petroleum spirit in preference to ether. Except where otherwise mentioned freshly prepared samples were used for the tests. The author's results are given below:—

	Percentage of Free Fatty Acid as found by		Average Percentage of Free Fatty Acid in		
	Salkowski.	v. Rechenberg.	Salad Oil.	Common Oil.	Crude Oil.
Liquid oils:—					
Rape.....	4.28	6.64	1.19	2.88	0.93
Olive.....	1.17	2.25	1.66	12.97 (purity doubtful)	.. ..
Poppy.....	2.29	2.09	1.92	15.37	4.72
Earth-nut.....	1.66	.. ..	1.94	6.52	4.02
Sesame.....	.. ..	.. ..	1.97	17.94	4.89
Cotton-seed	0.29	.. ..	0.15	0.46	.. ..
Mustard .....	.. ..	.. ..	.. ..	0.85	.. ..
Castor .....	.. ..	.. ..	.. ..	9.28	2.78
Linseed	3.45	1.74	.. ..	1.57	.. ..
Candle nut (sample about 3 years old).....	.. ..	.. ..	.. ..	56.45	.. ..
Solid oils and fats:—					
Palm-nut	13.33	.. ..	.. ..	6.91	8.49
Palm (old sample; method of extraction unknown) .....	.. ..	.. ..	.. ..	50.82	.. ..
Cocoa-nut.....	2.96	.. ..	.. ..	7.92	4.26
Illipe (from seeds of a species of <i>bassia</i> ; sample 3 years old).....	.. ..	.. ..	.. ..	28.54	.. ..
Niam (from <i>Lophira alata</i> Banks.) .....	.. ..	.. ..	.. ..	.. ..	24.56
Bicuhyba (from <i>Myristica bicuhyba</i> ; sample 3 years old).....	.. ..	.. ..	.. ..	18.55	.. ..
Japan wax (method of extraction unknown) .....	.. ..	.. ..	.. ..	9.25	.. ..

The quantity of free fatty acid present in vegetable oils varies between pretty wide limits. In the case of the cotton-seed oil tested, the small amount of free acid found is explained by the fact that the oil was refined by means of caustic alkali, which almost entirely removed the fatty acid. The average percentage of acidity of the salad oils is 1.74. This fact may, in certain circumstances, lead to the detection of an adulteration with cotton-seed oil, as it may also be frequently of service in indicating the quality of a salad oil, which is most pleasant to the taste when only a small amount of free acid is present, but is very insipid when quite free from acid.—E. B.

On the Fatty Acids of Drying Oils. K. Hazura. Monatsh. Chem. 10, 190—195.

A CONTINUATION of previous researches (this Journal 1888, 680—681). The present paper deals with the con-

stitution of *sunflower oil*, which the author finds to consist of a mixture of the glycerides of linoleic acid, $C_{18}H_{32}O_2$, and of oleic acid, $C_{18}H_{34}O_2$. As the latter glyceride is present only in small quantity, sunflower oil would be a suitable material for the study of linoleic acid. The fatty acids were identified, through their products of oxidation, as obtained by the method previously employed by the author and described in the reference cited above.—G. H. B.

On the Oxidation of Unsaturated Fatty Acids with Potassium Permanganate. A. Grüssner and K. Hazura. Monatsh. Chem. 10, 196—199.

THIS paper treats of the oxidation of brassidinic and ricinelaidic acids. The employment of potassium permanganate for the oxidation of fatty acids has been described in previous communications. (Compare this Journal, 1888, 680 and 681.) Brassidinic acid, $C_{22}H_{42}O_2$, was obtained by

the action of nitrous acid on erucic acid, and yielded by oxidation a substance of the formula $C_{22}H_{42}O_2(OH)_2$, which the authors have named isodioxybehenic acid. It crystallises from dilute alcoholic solutions in microscopically small rhombic tables, melting at 98° – 99° C. Ricinelaïdic acid, $C_{18}H_{34}O_2(OH)_2$, yields by oxidation the substance $C_{16}H_{30}O_2(OH)_2$, termed β -isotrihydroxystearic acid. This substance crystallises from glacial acetic acid in long needles, and from benzol in rhombic prisms, melting at 114° – 115° C. Brassidinic and ricinelaïdic acids are thus found to comport themselves on oxidation like oleic, linoleic, linolenic, erucic, and the acids from castor oil, which were examined in previous researches.—G. H. B.

Observations on some Non-drying Oils. K. Hazura and A. Grüssner. *Monatsh. Chem.* **10**, 242–249.

THE authors have previously expressed the opinion that most of the non-drying oils contain, besides oleic acid, some other unsaturated acids, and for the purpose of differentiating the components of various oils they employ the method of oxidation with alkaline potassium permanganate. Earth-nut oil, examined by this method, yielded as oxidation products, sativinic acid, $C_{18}H_{32}O_2(OH)_4$, dioxyerucic acid, $C_{18}H_{34}O_2(OH)_2$, and probably also dioxy palmitic acid, $C_{16}H_{30}O_2(OH)_2$, from which it is inferred that the unsaturated fatty acids of earth-nut oil are linoleic acid, oleic acid, and probably hypogeic acid. In a similar manner it is shown that almond oil and sesame oil contain the glycerides of oleic and linoleic acids. Olive oil was examined by Oudemans's method and found to contain 13 per cent. of glycerides of saturated fatty acids and 87 per cent. of glycerides of unsaturated fatty acids.—G. H. B.

Composition of Solid Fats of Animal and of Vegetable Origin. R. Benedikt and K. Hazura. *Monatsh. Chem.* **10**, 353–356. (Compare this Journal 1888, 506–681.)

THE authors have investigated fats of the former class by means of their method of oxidation with alkaline permanganate, and the study of the products. The entire absence of sativic acid, the characteristic product of the oxidation of linoleic acid, proves the absence of the latter, and establishes a general distinction, in proximate composition, between the two classes of fats, those of vegetable origin invariably containing linoleic acid.—C. F. C.

PATENTS.

An Improved Method of Marking or Branding Transparent and other kinds of Soap, and a Machine for accomplishing the same. F. W. M. Bateman, London. Eng. Pat. 13,373, September 17, 1888. 8d.

SOAPS of all kinds are at present branded on the surface only, either by impressed or raised letters, which speedily disappear when in use. By this invention, opaque soaps are branded with the mark by perforating the cake with small holes right through. The method for marking transparent soaps is by the insertion in the centre of the cake, in a horizontal position, of a tablet of soap or other suitable material through which is perforated the desired brand or mark. Drawings are given of the machine used for accomplishing this.—B. H.

Improvements in and relating to the Purification of Glycerin. J. C. A. Brunner, Munich, Germany. Eng. Pat. 15,124, October 20, 1888. 4d.

CRUDE glycerin is heated with 8 per cent. of zinc sulphate, which may or may not have been roasted. When cool, 2.7 per cent. of lime is added, and the mixture filtered. Any lime in solution is removed by carbonic acid; traces of metals are precipitated with hydrogen sulphide, and the excess of this is removed by blowing in air.—E. J. B.

An Improved Soap Powder. H. C. Foulsham, Brondesbury. Eng. Pat. 15,558, October 29, 1888. 4d.

THE improved soap powder consists of 20 lb. soap, 12 lb. alkali, 10 lb. carbonate of soda, 70 lb. soda crystals, and 1 gallon of petroleum.—E. J. B.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

The Modifications of Cadmium Sulphide obtained in the Wet Way. N. v. Klobukow J. Prakt. Chem. **39**, 412–425.

IN preparing cadmium sulphide in the wet way several coloured products, the shade of which varies from bright yellow to dark reddish-brown according to the conditions employed, are obtained, and it was formerly thought that the variations in the colour and density of the precipitates was due to a difference in chemical composition.

Follenius (*Zeits. Anal. Chem.* **13**, 411) and Buchner (*Chem. Zeit.* **11**, 1087 and 1107; this Journal 1887, 665–666) have proved however that the compounds formed in aqueous solutions have the same chemical composition whatever the conditions of the experiment, so that the various precipitates are either physically isomeric or perhaps simply physical modifications of one and the same sulphide. Buchner found that two, and only two modifications of cadmium sulphide are obtained in the wet way, namely, a lemon-yellow α -modification and a specifically heavier vermilion β -modification which he considers to be a polymer $(CdS)_4$ or $(CdS)_6$ of the former. Both modifications are chemically identical and, according to Buchner, can be converted one into the other under the influence of heat or chemical agents. According to Zsigmondy (*Dingl. Polyt. J.* **266**, 364; this Journal, 1888, 122–123) the two modifications show the same behaviour towards heat even when they are dissolved in glass.

The author determined the specific gravity of various (slightly impure) samples of the α - and β -modifications, dried at 105° – 107° , and the results are given in a table. The specific gravity of the α -modification was found to be about 3.9, that of the β -modification about 4.5, so that the difference cannot be due simply to their having been prepared under different conditions, and shows clearly that the two substances are really polymeric. The α - is much more hygroscopic than the β -modification.

A crystallographic investigation showed that the modifications of cadmium sulphide obtained in the wet way may exist in at least two, perhaps even in three distinct crystalline forms. The α -modification is entirely crystalline, but the crystals are not well-defined. A vermilion sample of the β -modification showed crystals similar to, but smaller than, those of the α -modification; another vermilion sample seemed to consist of spherical aggregates. A bright orange-red sample consisted of large well-defined crystals, and differed from all others examined.

The α -modification can be gradually converted into the β -modification by rubbing or by pressure, but the β -modification is not changed by mechanical agents.

The conversion of the α - into the β -modification by rubbing can be effected with the most varied surfaces (agate, glass, porcelain, paper, asbestos, &c.), and either the slightly moist or the perfectly dry substance can be employed; the change is gradual, the colour passing through all the various shades and finally becoming vermilion, but the portions immediately in contact with the rubbing surface are bright red. The β -modification obtained in this way is identical with the pure β -modification prepared by Buchner. If the sample is very damp or made into a paste with water the conversion takes place extremely slowly and only with very energetic rubbing.

The conversion of the α - into the β -modification by pressure is readily effected by placing the air-dried substance in a steel mortar, covering it with a well-fitting stamp and giving the latter several powerful blows. The interior of the compact shining mass thus obtained is vermilion, but parts of the surface most exposed to the pressure have a rather darker shade.

The moist α -modification is also partially converted into the β -modification by the action of induction sparks and by nascent hydrogen, but a considerable proportion is reduced.—F. S. K.

PATENTS.

An Improved Enamel or Varnish for rendering Casks and analogous Articles Damp-proof, and for other useful Purposes. E. Hipwell and B. B. Hofmann, London. Eng. Pat. 13,007, September 8, 1888. 4d.

A "thick enamel" and an "enamel wash" are made. To produce the former, 1 lb. of white shellac is dissolved in two pints of absolute alcohol, and 1 lb. of the solution mixed with $1\frac{1}{2}$ lb. of methylated spirit. To $1\frac{1}{2}$ lb. of the mixture is added 2 lb. of "Creta Gallica or Alanin," continually stirring with a glass rod. The "enamel wash" is made by boiling 1 lb. of ground rice in 1 gal. of water for two hours, allowing to cool, adding while tepid 1 lb. of gelatin, and when cold $\frac{1}{4}$ lb. of salt, adding to $\frac{1}{2}$ gal. of this mixture 2 lb. of "Creta Gallica or Alanin," "dissolved" in 1 gal. of water, and incorporating $\frac{1}{4}$ pint of methylated spirit mixed with $\frac{1}{4}$ pint of water in which $\frac{1}{4}$ lb. of gum arabic or isinglass has been dissolved. Either composition is used, as circumstances may direct, and is applied with a brush.—B. B.

The Manufacture of a New or Improved Fabric, and its Application for the Making and Repairing of Boots and Shoes, and for other Purposes. R. Dick, Glasgow. Eng. Pat. 13,285, September 14, 1888. 1s. 1d.

THE inventor claims the manufacture of a waterproof material made by coating sheets of a suitable fabric with solution of india-rubber. Two or more sheets may be joined together. The material may be employed for a variety of purposes, such as insertion between sheets of leather, to form the soles of boots, waterproof coverings for saddles, covers for books, dressing cloth for hospitals, &c.

Complete drawings of the machinery used in the preparation of the material, and descriptive drawings of various manufactured articles, are given.—E. J. B.

A New or Improved Composition or Paint to be used for Coating and Preserving Metal, Wood, and other Substances and Materials. W. C. Nangle, London. Eng. Pat. 13,721, September 22, 1888. 4d.

FIFTY-SIX galls. of coal tar, pitch, or bitumen is boiled for an hour with "8 galls. of cow-dung," the latter strained off, and the filtrate boiled with "8 galls. of bark" for $2\frac{1}{2}$ hours. The tanning material is then strained off, "8 galls. of sulphur" and "6 galls. of rosin," and finally 70 lb. of gypsum added, the whole stirred and ground free from lumps, allowed to cool, and 26 galls. of turpentine mixed in. The resulting composition may be used for coating wood or metal to prevent corrosion and decay, the surface to be treated having been previously rubbed with chalk; it may also be employed for covering hot surfaces.—B. B.

Improvements in the Process of Cementing Asbestos. J. Dewrance and B. E. Church, London. Eng. Pat. 15,236, October 23, 1888. 4d.

THE chief expense in cementing asbestos with india-rubber arises from the waste of rubber solvent which has to be used to saturate the asbestos, to allow of its mixture with the solution of india-rubber. The patentees claim to have overcome the difficulty by using warm distilled water as the incorporating agent, either making an emulsion of it and the solution of india-rubber, and saturating the asbestos with this, or soaking the asbestos in water and then mixing it with the rubber solution, the principle underlying each method being the substitution of water for solvent naphtha as a saturating agent. Sulphur, plumbago, or litharge may be mixed in at this or a later stage, the bulk of the water squeezed out, the rest evaporated, together with the rubber solvent, and the mass vulcanised by any ordinary process.

The material may be mounded, rolled, or pressed into the form required, or the fibres may be separated and caulked into the grooves of cocks, in the manner described by one of the patentees in Eng. Pat. 4282 of 1883.—B. B.

An Improved Paint or Composition especially suitable for Coating Ships' Bottoms, and the Process of Manufacturing the same. J. Baynes, W. H. Doughty, and H. T. Greaves, Hull. Eng. Pat. 15,564, October 29, 1888. 4d.

FIFTY parts of copper scales are kept in contact with 17 parts of carbolic acid for several days in an air-tight vessel, until carbolate of copper has formed, when 21 parts of zinc oxide, 28 parts of "oxide of iron," 4 parts of red lead, 4 parts of "arsenic," and $5\frac{1}{2}$ parts of "boiled seed oil," are mixed in, and the whole passed through granite rollers. The mixture is transferred to a pan, and kept "near boiling heat" for two hours. Meanwhile, 7 parts of "shellac or other gums" are melted in a second pan, "the boiled seed oil" added, the mixture kept at a gentle heat for 30 minutes, 3 parts of spirits of turpentine added, and the whole run into the first pan. In a third pan 56 parts of "resin" are "dissolved," 2 parts of sugar of lead added, the mixture boiled gently for 30 minutes, 17 parts of turpentine added, and the whole run into the first pan, the contents of which is well stirred until the temperature falls to 70° F., when 36 parts of "mineral naphtha" are stirred in. In using this paint for iron or steel, it is necessary to cover the structure to be protected with a coat of priming composition containing "for its basis a metallic oxide electro positive (*sic*) to iron or steel," "to prevent actual contact between the iron and copper."—B. B.

An Improved Knife or Mechanical Contrivance for Cutting or Bleeding India-rubber Trees. C. Melhado, Upper Norwood. From H. B. de Blancaneaux, Belize, British Honduras. Eng. Pat. 15,604, October 30, 1888. 6d.

A STRONG knife with a curved blade, of which the cutting edge is convex, has bolted to it parallel to the blade close to the end remote from the handle, a piece of steel bent into the shape of a U or pot-hook, one side of which is sharpened to a cutting edge. By means of this grooves can readily be cut in the bark of india-rubber trees of a depth governed by the position of the second blade with respect to the first, a slot in which work a nut and bolt allowing of adjustment in this respect.—B. B.

Improvements in Dentists' and other Vulcanising Flasks. T. Wilson, Glasgow. Eng. Pat. 4360, March 13, 1889. 6d.

THE flasks are in halves bolted together by their lugs when in use; each half is in section a truncated cone, with its base at the plane of juncture. Viewed as a separate vessel, each half has a removable bottom which slides into position through a slot in the side and rests on a rim or ledge running partly round the bottom of the half flask on the inside. By means of this device, on separating the halves, the contents of each can be readily knocked out by tapping on the removable bottom, the process being facilitated by the conical shape of the flask.—B. B.

A New Composition for Waterproofing Textile Fabrics, and as a Paint for Wood and other Surfaces. E. S. Baldwin, Loughborough. From J. Smith, Marton, New Zealand. Eng. Pat. 10,858, July 5, 1889. 4d.

A COMPOSITION is made containing 56 lb. of white lead, 3 galls. of boiled linseed oil, 3 lb. of "patent dryers," 20 lb. of "whitening," 4 lb. of sulphate of lime, 3 oz. of alum, $1\frac{1}{4}$ lb. of glue, mixed in a manner varying with the "quality of the ingredients." The mixture can be applied to wood, iron, plaster, or other materials, as a paint, or spread over textile fabrics in one or more layers, preferably rolling the article treated between each application. It is said to be to a certain extent fire-proof.—B. B.

Improvements relating to the Treatment of Lead and other Fumes in the Manufacture of Pigments, and to Apparatus therefor. F. L. Bartlett, Portland, Maine, U.S.A. Eng. Pat. 11,405, July 16, 1889. 8d.

THE bulky character of lead fume and the dark colour due to the presence (according to the patentee) of cadmium, sele-

nium, vanadium, tellurium, "sulphur compounds, carbonaceous matter, and acids," which it possesses, hinder its use as a pigment, until it has been refined by sublimation or similar expensive processes. The method now proposed consists in heating it in an iron tube set horizontally in a furnace and containing a coreless screw concentric with the tube, and rotated in it by a shaft and pulley. The fume is fed in by a hopper at one end, and is carried slowly by the screw to the other, where it is discharged; on its way it meets a gentle current of air drawn in at one end and discharged at a point near the hopper at the other end, such current being obtained by the use of a hood fitting on the top of the furnace, and furnished with an exit pipe, thus inducing a slight draught. The result of this treatment is that the fume becomes dense and white and suitable for use as a pigment. In order to prevent the fume sticking to the screw and becoming partly converted into litharge, a rod is occasionally introduced and allowed to tumble round with the motion of the screw. Care must be taken to prevent more fume passing in through the hopper than is enough to form a thin even layer in the tube.

The screw is preferably made of cast iron, stayed by longitudinal rods, and has the form of a flat bar coiled lengthwise. It may be rotated in the tube as described above, or the tube may be rotated about it, without altering the principle of the apparatus or the nature of the product.

—B. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENTS.

Improvements in the Utilisation of Leather Waste. W. A. Burrows, London. Eng. Pat. 14,235, October 3, 1888. 6d.

THIS is an improvement of Eng. Pat. 11,880 of 1885 (this Journal, 1886, 329). The waste leather, after being disintegrated, is submitted to the action of an acid, such as oxalic, citric, tartaric or acetic, or of an alkali, such as soda, potash or ammonia. The leather flock is then mixed with a suitable proportion of fibrous material, such as spent tan, wood pulp, jute, oakum, &c. &c.

When the flock is to be used for the manufacture of hard articles, such as door-knobs or boot-heels, it is mixed with a solution of gelatin to which has been added some alum or other astringent. The mixture, while damp, may be moulded or otherwise formed, and when dry is perfectly hard. The leather flock may also be mixed with solution of various gums or resins in linseed or other oil, and after mixing, the product may be rolled into sheets or forced into moulds.

—B. H.

Means for Freeing Skins, Kips, and Hides from Lime, and for causing the same to Swell. J. Hauff, Feuerbach, Germany. Eng. Pat. 10,110, June 20, 1889. 1d.

IT has been found that cresotinic acid had too powerful an effect on very soft skins when used for neutralising the lime. Oxynaphthoic acid (hydroxynaphthoic acid), which is soluble in 20,000—30,000 parts of water, has been successfully tried. Salicylic acid, or a mixture of salicylic and cresotinic acids, can also be used for causing the hides to swell. "As cresotinic acids should be understood the carbonic acids from the three cresols, and as oxynaphthoic acids the carbonic acids from the naphthols."—B. H.

XV.—AGRICULTURE, MANURES, Etc.

Manurial Experiments in Hanover. Salfeld. Jour. f. Landw. 1889, 25—33.

THE experiments the results of which are given below were carried out on the old Eschland.

1. Winter rye, after unmanured buckwheat, grown on plots of 1 hectare each.

(a.) Unmanured produced 358 lb. (b.) Thomas phosphate powder produced 901 lb. (c.) Thomas phosphate powder and horn-meat produced 935 lb. (d.) Thomas phosphate and sulphate of ammonia produced 972 lb. (e.) Thomas phosphate and Chili saltpetre produced 1,008 lb. (f.) Bone-meal produced 1,027 lb. These various manures were applied in such quantities that 900 grms. of phosphoric acid and 222 grms. of nitrogen were supplied per hectare. The Thomas phosphate, horn-meat, and bone-meal were applied 11 days previous to sowing; the ammonium sulphate was drilled with the seed, and the sodium nitrate was top-dressed.

II. A series of experiments were made with a view to determine whether, in growing a crop of winter rye on the old Eschland, it would be an economy to use a nitrogenous manure in addition to the Thomas phosphate powder. The average of three unmanured plots was 5·033 kilos. of grain and 14·683 kilos. of straw. The average of four plots manured with Thomas phosphate was 7·382 kilos. of grain and 19·912 kilos. of straw. Four plots manured with Thomas phosphate powder and ammonium sulphate averaged 8·995 kilos. of grain and 22·35 kilos. of straw, and other four manured with Thomas phosphate and sodium nitrate averaged 13·532 kilos. of grain and 31·225 kilos. of straw. The manures were applied so that 180 lb. of phosphoric acid, 60 lb. of nitrogen, and 216 lb. of potash were present per hectare. Reckoning the grain and straw at the then prevailing prices, the gain in excess of the value of the unmanured plots of the other three was respectively 59·08 M., 59·28 M., and 167·25 M.

III. A series of experiments were made to test the manurial value of kainite and Thomas phosphate powder for buck-wheat and sporgel, the result being that while with both of these manures when used singly an increased crop was obtained, a very much better crop was produced by the application of the two together.—J. W. L.

Mineral Value of several Sea Coast Products. A. Mayer. Jour. f. Landw. 1889, 42—47.

	Moisture.	Organic Matter.	Nitrogen.	Potash.	Phosphoric Acid.	Calcium Carbonate in Ash.	Sodium Chloride.	Sand.	Total Ash.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Algae	11·8	79·2	0·89	0·72	0·14	1·11	7·0	4·4	18·0
Mussel shells	1·8	7·5	0·08	0·11	0·10	90·8	0·05	0·9	92·2
Star fish	1·8	35·5	1·92	0·16	0·45	17·8	0·4	16·8	62·7
Shells of <i>Buccinum undatum</i> ...	3·0	52·1	3·10	0·18	0·16	4·9	5·2	27·0	44·9
<i>Polypenstiele artularia</i>	4·8	38·0	3·23	0·35	0·67	19·4	4·7	17·6	57·2
Shells of sea-roach	7·7	78·2	10·56	0·48	0·40	0·9	2·2	4·5	14·1

—J. W. L.

Comparative Value of various Phosphates as Manures for the Cereals. J. Raulin. J. d'agric. pratique, 1889, 105—106.

FROM a series of experiments made with several finely-ground insoluble phosphates (phosphatic minerals) with superphosphate and precipitated phosphate, the author finds that the superphosphate and precipitated phosphate can be successfully replaced by mineral phosphate, when in the first year from five to six times the usual amount of phosphoric acid is employed. In these experiments, which were made on a soil rich in humus and lime, maize was grown in 1887, and wheat followed in 1888. The amounts of phosphoric acid in the first year were: In the case of superphosphate and precipitated phosphate 40 kilos. per

hectare; in the case of the finely-ground minerals 200 kilos. per hectare. In the following year all the plots received the same amounts, namely, 40 kilos. of phosphoric acid per hectare.

Comparative Experiments on the Manurial Value of Sodium Nitrate and Ammonium Sulphate. C. Rolland. J. d'agric. pratique, 1889, 423—426.

WHEAT was grown on three plots, one of which was left unmanured, whilst of the other two, one received ammonium sulphate, equivalent to 30 kilos. of nitrogen per hectare, the other sodium nitrate containing the same amount of nitrogen. The following table contains the principal results:—

Manure per Hectare.	Cost of Manure.	Produce per Hectare.		Increased Produce.		Value of Increased Produce.		Profit.
		Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	
200 kilos. of sodium nitrate.....	M. 43'20	Kilos. 1,835	Kilos. 4,835	Kilos. 605	Kilos. 2,375	M. 135'20	M. 66'50	158'50
150 kilos. of ammonium sulphate.....	37'20	1,500	2,870	270	410	60'48	11'48	34'75
Unmanured .....	..	1,230	2,460	..	..	..	..	..

(1 hectare = 2·47 acres.)

—J. W. L.

The Effect of Common Salt on Vegetation. A. Stood. Landw. Vers. Stats. 36, 113—118.

THE damaging effect of salt on vegetation is most noticeable when the ground is so badly drained that the salt water remains about the roots of the plant, and also where, during the hot summer months, it rises towards the surface and there becomes concentrated. The author records two cases where in the lower parts of two fields there were ditches containing more or less salty water. In the neighbourhood of these both the grass and also the trees suffered, whereas on the higher ground away from the influence of the ditch, a luxuriant herbage prevailed.

The analyses of the soil taken from those parts of the fields near the salty ditch and away from the same, showed a very considerable excess of sodium and chlorine in the former over that of the latter. In the ash of the plants from the respective parts of the two fields, that of the diseased plants contained very considerable quantities of sodium and chlorine, whilst the ash of the healthy herbage contained comparatively but very little of these ingredients.—J. W. L.

PATENT.

A New or Improved Composition for Destroying Insects and Protecting Trees and the like therefrom. G. I. MacMunn, St. Mary Cray. Eng. Pat. 11,721, July 23, 1889, 4d.

ONE pint of "Oil Mentha Viridis (or oil of Spearmint)," 1 oz. of arsenious acid, and 7 oz. of carbolic acid are mixed with 1 cwt. of a mixture consisting of two parts of "resin oil," and one part of carbonate of lime. The viscid composition thus obtained can be smeared on the trunks of trees and stems of plants to prevent insect ravages.

—B. B.

XVI.—SUGAR, STARCH, GUM, Etc.

PATENTS.

Improvements in Means or Apparatus for Drying Slabs of Sugar, applicable for Heating and Cooling other Articles and for Analogous Operations. B. E. R. Newlands, London. Eng. Pat. 12,784, September 4, 1888. 8d.

ON two shafts arranged (preferably) vertically one above the other and parallel to each other are mounted sprocket wheels or drums, over which pass endless chains. Attached to these chains are a series of boxes made of perforated metal sheets, the outer end of each box being open, the inner end attached to the chains. The whole is so cased in that the sugar slabs or other articles, which are automatically fed into the boxes at one point of their circuit and discharged at another, are exposed during the time they are in the boxes to a current of hot air. The speed of the chains and of the carriers or boxes is so arranged that the time occupied by the passage of each block is just sufficient to effect the necessary desiccation. Drawings are given.—A. J. K.

Improvements in the Manufacture of Sugar and in Apparatus therefor. G. Adant, Molenbeck-St.-Jean, Belgium. Eng. Pat. 13,084, September 10, 1888. 8d.

THIS invention relates to the manufacture of sugar in slabs, flat cakes, or blocks. The details of the apparatus are such as can only be described intelligibly by reference to the drawings which are provided with the specification.

—A. J. K.

Improvements in the Treatment of Sugar Solutions. J. G. Lorrain, London. Eng. Pat. 13,595, September 20, 1888. 6d.

INSTEAD of concentrating sugar solutions in the ordinary way by evaporation, the water is resolved into its constituent gases by means of electrolysis.—A. J. K.

Improvements in Centrifugal Apparatus for Drying Sugar or other Granular Matters. D. Stewart, Glasgow. Eng. Pat. 13,655, September 21, 1888. 8d.

THE invention relates to centrifugal apparatus somewhat similar to that described in Eng. Pat. 6931 of 1884, and has for its object to improve and simplify the construction of such apparatus. The turbine or rotating basket is placed with its axis horizontal and has within it a hollow drum fixed on a central shaft, leaving an annular cylindrical space between it and the inner surface of the turbine. The moist sugar is supplied by a hopper into one end of the annular space and is gradually propelled along that space to the other end of the turbine by helical flanges or blades fixed on the outside of the inner hollow drum. The turbine and drum are driven at slightly different speeds, and the movement of the sugar through the turbine is due to this difference of speed, which can be regulated to the best advantage. "The inside of the wire-gauze surface of the turbine" is slightly taper, and the turbine and hollow drum can be so adjusted as to have the helical blades at the most convenient distance from the wire gauze. The shaft of the hollow drum passes through a tubular shaft on which the turbine is fixed, and the driving pulleys may both be fixed on their respective shafts at one and either end of the turbine or one at each end. The axis may be in any other position than horizontal, but the latter is preferred.

—A. J. K.

An Improved Apparatus for Producing White Sugar. C. Steffen, Vienna, Austria. Eng. Pat. 8622, May 24, 1889. 8d.

THE sugar mass is lixiviated in moulds with an aqueous solution of pure white sugar. The moulds are so arranged that they can be worked in battery, the slightly impure syrup from the first series passing on to the top of the second series, and so on. The final white syrup is driven out by compressed air.—A. J. K.

Improvements in Apparatus for the Manufacture of Sugar by Electricity. E. Maigrot and J. Sabates, Havana, Cuba. Eng. Pat. 9994, June 18, 1889. 8d.

THE treatment of the juice takes place in a series of troughs, each of which is divided by parchment paper or some other suitable material. The saccharine liquor is in the middle compartment and the outer compartments contain water to the same level. The positive pole of the dynamo is connected with carbon electrodes placed in the sugar liquor, whilst the negative pole is connected with carbon electrodes placed in the water in the two outer compartments. The action of the current decomposes the salts in solution, liberating the bases (potassium, sodium, magnesium, calcium, &c.) at the negative poles. In addition, it is claimed that the organic impurities are decomposed or rendered insoluble by the action of the current.—A. J. K.

XVII.—BREWING, WINES, SPIRITS, Etc.

Action of Maltose in presence of Diastase during Saccharification. L. Lindet. Bull. Soc. Chim. [3] 1, 425—429.

WHEN starch is treated with diastase under the ordinary conditions the starch is first converted into maltose and dextrin and the diastase then, by some ulterior action, changes the dextrin into maltose. This secondary reaction ceases, however, when the wort contains a certain percentage of maltose, so that a considerable quantity of dextrin always remains unchanged. Payen showed that the accumulation of maltose in the wort is the cause of the cessation of saccharification, and that if the maltose is fermented by the addition of yeast the action of the diastase recommences.

O'Sullivan attributed this subsequent saccharification to the joint action of the yeast and diastase on the dextrin, whilst Kjeldahl assumed that it was due, not to the removal of the maltose, but simply to a prolongation of the time during which the diastase is allowed to act, so that if a wort were kept long enough saccharification would be as complete as is the case after it has been fermented.

A wort that had been treated with excess of diastase and contained in consequence the maximum quantity of maltose was kept at 62° for several days in contact with diastase and a mixture of phenylhydrazine hydrochloride and sodium acetate, sufficient to combine not only with the maltose (2.73 per cent.) present in solution, but also with that which would be formed by the subsequent saccharification of the dextrin (1.163 per cent.) added to the mixture. 3.236 grms. of maltose were precipitated in the form of the phenylhydrazine derivative, proving that about 50 per cent. of the dextrin which remained unchanged in presence of maltose was converted into sugar as soon as the maltose was precipitated from the solution.

A wort, previously treated with excess of diastase, was divided into two equal parts (A. and B.) and unequal quantities of the maltose precipitated by means of phenylhydrazine. The wort (A.) then contained 2.66 per cent. of maltose and 5.12 per cent. of dextrin; the other (B.) 6.34 per cent. of maltose and 4.112 per cent. of dextrin. Diastase was then added to both (A. and B.), and the solutions kept at 25°; after 48 hours A. contained 2.431 per cent. of dextrin, showing that 46.7 per cent. of the quantity present had been converted into maltose, whilst B. contained 0.545 per cent., 13 per cent. of the dextrin present having been saccharified. The ratio of maltose to dextrose in the two worts had thus become almost identical.

A wort, previously treated with excess of diastase, was divided into two equal portions (A. and B.) of 100 cc. each, from one of which the whole of the maltose was precipitated with phenylhydrazine; their composition was then—

	Per Cent.
A. { Maltose	Traces.
{ Dextrin	5.06
B. { Maltose	2.44
{ Dextrin	4.52

The same quantity of diastase was added to each, and the solutions kept at 25°. After 24 hours 1.998 grms., and after 72 hours 3.187 grms. of dextrin had been saccharified in A., whilst in B. 2.125 grms. of dextrin were converted into maltose in 24 hours, and no subsequent saccharification occurred. The composition of the solutions was then—

	Per Cent.
A. { Maltose	3.363
{ Dextrin	1.873
B. { Maltose	4.603
{ Dextrin	2.396

These results show that Payen's view is correct, and that, as soon as the sugar is removed with yeast or phenylhydrazine the diastase commences to act on the dextrin again.—F. S. K.

Mucic Fermentation. E. Kramer. Monatsh. Chem. 10, 467—505.

BY mucic fermentation the author understands the process which causes solutions containing sugar (saccharose, glucose, lactose, &c.), or other carbohydrates (mannite, starch, &c.), to become viscid in presence of the necessary quantities of albuminoids and mineral substances (sodium and potassium phosphate being essential). Besides this mucous matter, which must be regarded as a hydrocarbon of the formula $C_6H_{10}O_5$, mannite and carbon dioxide are nearly always produced. The occasional appearance of lactic and butyric acids, or of free hydrogen, in mucous liquids has no connexion with mucic fermentation. The latter is induced by certain bacteria, which differ according to the nature of the sugar contained in the fluid. *Micrococcus viscosus*, as described by Pasteur, is not one of these bacteria.

Liquids containing hydrocarbons may be divided into three groups as regards their becoming viscid. (1.) Liquids containing saccharoses, so long as they show a neutral or

slightly alkaline reaction, *e.g.*, solutions containing saccharose along with albuminoids and mineral substances; decoctions of barley, rice, wheat, &c. in presence of saccharose; the juice of carrots, sugar-beet, onions, &c. The fermentation is induced by Kramer's *Bacillus viscosus sacchari*. (2.) Acid glucose solutions containing the required albuminoids and mineral substances. Wine is the chief representative of this group. The viscosity in this case is brought about by Kramer's *Bacillus viscosus vini*. (3.) Neutral or nearly neutral solutions containing milk sugar besides albumen and mineral substances. Milk belongs to this category. The micro-organisms inducing this fermentation differs from those which cause that process in the (1.) and (2.) group. The characteristics of the two above-mentioned bacteria are described. The mucous product of this fermentation is a result of the assimilation of the ferment, and probably consists essentially of external layers of the membrane which have swelled or been converted into mucous matter. The mannite formed in mucic fermentation must be regarded as a secondary product of an inner respiration of the above bacteria. The primary products are carbon dioxide and hydrogen, which latter converts the glucose into mannite. The mucous substance is not a gum, but a carbohydrate of the formula $C_6H_{10}O_5$, possibly a metamorphosis of cellulose. Alcohol precipitates it from the viscid fluid as a white, amorphous substance, which swells but does not dissolve in water. It is not coloured by iodine. Caustic alkalis dissolve it, giving yellow solutions, from which alcohol precipitates white scales. The specific rotatory power for $\alpha_D = +195^\circ$.—A. R.

PATENTS.

Improvements in the Treatment of Spirits, Wines, and Beer for the Purpose of Ageing or Maturing them. Brin's Oxygen Co., Limited, London. Eng. Pat. September 22, 1888. 4d.

THIS invention has for its object the maturing or ageing of spirits, wine, and beer by treating them with oxygen under pressure. Any convenient apparatus may be used.

—A. L. S.

Improvements relating to the Production of Pure Ethylic Alcohol from Crude Spirits. H. H. Lake, London. From C. E. T. Müller, Berlin, Germany. Eng. Pat. 13,892, September 26, 1888. 8d.

THE invention is based on the fact that aldehyde, amyl alcohol, and the like impurities of crude spirit are less soluble than ethyl alcohol in a solution of certain alkaline salts of a certain concentration and temperature.

Among the salts which may be practically used are carbonates and hydrates of potassium and sodium, phosphate of sodium, sulphates of sodium, ammonium, magnesium, and zinc, and potash or ammonia-alum.

The apparatus consists of a series of settling vessels, three being a convenient number, and the process is conducted as follows:—

The first vessel is partly filled with crude spirit, when a solution of one of the above-mentioned salts of a specific gravity 1.19—1.24 is run on to a screen or grating placed at the top of this so that the solution falls through the crude spirit in a finely divided state. The solution settles to the bottom and then contains about 15 per cent. ethyl alcohol with some aldehyde, amyl alcohol, &c.; but the proportion of these latter to the ethyl alcohol is much less than in the crude spirit. This solution is then led through a pipe to the top of a second settling vessel similar to the first, but filled with refined spirit; the solution which settles to the bottom contains ethyl alcohol, aldehyde, &c., but in diminished proportion.

The same operation may be repeated in a third settling vessel if necessary.

The solution finally obtained is then distilled in any of the usual type of column stills, and the alkaline solution remaining in the still may be used in succeeding operations. The settling vessels are provided with suitable pipes, taps, &c., so that the operation may go on continuously; thus when the settlings are withdrawn from the first vessel further

quantities of crude spirit and alkaline solution are allowed to flow in at the top. When the crude spirit in the upper portion of the first vessel has become very rich in aldehyde, amyl alcohol, &c., the vessel is emptied, and being filled with refined spirit it becomes the third of the series, and so on.—A. L. S.

An Improved Apparatus for Acetifying Alcoholic Wash and Liquor in the Manufacture of Vinegar. J. C. Shears and A. Manbré, London. Eng. Pat. 14,328, October 5, 1888. 6d.

THE invention relates to a modification of "The Quick Process," by which it is claimed that the loss arising from the evaporation of aldehyde, &c., is diminished from 20—25 per cent. to 4—6 per cent. The acetifying chambers are arranged in columns. Each chamber is two-thirds filled with beech-wood shavings; a series of holes is bored in the upper third of each chamber for the free admission of atmospheric air, and the bottoms of the chambers are finely perforated. On the top of the column is placed a delivery box with a finely perforated bottom, and at the bottom of the column is placed a tub to receive the vinegar.

The process is conducted as follows:—The alcoholic liquid is heated to a temperature of 85° — 100° F. in a tub half-full of beech shavings until acetification commences; the liquor is then run into the delivery box and allowed to run down the column. If the alcoholic liquid be not of greater strength than 5 per cent. absolute alcohol, it will be completely converted into vinegar by running through a column of four chambers; but if the strength be greater than this it must be run through once or twice more until the acetification is completed.—A. L. S.

Improvements in the Preparation of Fermentable, especially Brewers', Worts. C. R. Bonne, London. Eng. Pat. 1,582, January 29, 1889. 6d.

THIS is an invention for producing from brewers' grains and other similar products a solution of albuminoids which may be added to wort in cases where this latter does not contain sufficient nitrogenous material for the healthy growth of the yeast. The refuse (spent cereals from breweries, distilleries, vinegar breweries, starch manufactories, and such like) is washed with water to remove all traces of saccharine matter which it may contain, and which if allowed to remain would tend to discolour the product; it is then mixed with water to the consistency of a gruel (*i.e.*, 6—7 parts water to 1 part of dry matter), and introduced into a closed vessel capable of withstanding a pressure of four atmospheres and heated to 300° F., the heat being maintained 3—5 hours. The undissolved matter is then filtered off and the solution containing peptonised albuminoids added to the wort in the quantity required. The addition may be made at any stage between the mashing and fermenting, but the inventor recommends it at the mash tun. The beer brewer will find it sufficient to treat 3—10 per cent. of the grain in this way. In the case of distillers' wash, instead of washing the refuse to remove sugar, it is more convenient to add .05—.01 per cent. of tartaric acid or its equivalent of hydrochloric acid, this obviously could not be done by the beer brewer.—A. L. S.

Improvements in the Distillation of Alcoholic Liquids. J. Leslie, Belfast. Eng. Pat. 8277, May 18, 1889. 4d.

THE inventor claims that by the introduction of free or nascent oxygen or ozonised air into the liquid during distillation or into the alcoholic vapour during rectification, a spirit is obtained which is at once mellowed, and rapidly matures, as the fusel oil and other high alcohols are thus converted into aromatic ethers.

The following process is recommended:—

Barium dioxide is introduced into the pot together with the charge, and when the distillation is about to commence, a continuous flow of dilute hydrochloric acid is admitted by a pipe reaching nearly to the bottom of the still.

A similar result may be obtained in the "patent still" by continuously admitting into the rectifying column an acidified solution of barium dioxide or a solution of hydrogen dioxide previously prepared by dissolving barium dioxide in hydrochloric acid under pressure.

The quantity of barium dioxide to be used varies with the nature and requirements of the spirit operated upon; for every 100 gallons of "pot still spirit" to be drawn, from 50—100 oz. of barium dioxide treated with its equivalent of dilute hydrochloric acid may be taken as a basis.

—A. L. S.

Improvements in Treating and Utilising Spent Hops.
W. F. Snee, Weston-super-Mare. Eng. Pat. 10,656,
July 2, 1889. 6d.

A HORIZONTAL steam boiler (Cornish pattern) is erected, having a cylinder through it sloping from front to back at an angle of about 10°. Within this, and forming its inner lining, is a revolving wire drum ($\frac{1}{8}$ -inch mesh), and through the centre of this a fixed Archimedian screw.

The cylinder is heated to about 200° F., either by steam injected into the boiler, or by means of steam generated in the boiler by a furnace beneath it. The spent hops are introduced into the upper end of the cylinder by a hopper, and the wire drum being made to rotate, they pass continuously along the cylinder to its lower end, where they are ejected dry, and may be used as a litter for horses and cattle, for packing, and other purposes.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A)—CHEMISTRY OF FOOD.

Decomposition Products of Casein. E. Drechsel. Jour. prakt. Chem. 39, 425—429.

THE author has previously drawn attention to the fact that strong acids and bases have not, as is generally supposed, an identical action on albumen, but that, although ammonia and amido-acids are always formed, carbonic anhydride, acetic acid and oxalic acid are only produced when baryta is employed. Hlasiwetz and Habermann found that when casein is heated with concentrated hydrochloric acid, in presence of stannous chloride, ammonia and several crystalline products, namely, leucine, tyrosine, glutamic acid and asparaginic acid are obtained, but no other crystalline compounds can be isolated. Horbaezewski showed later that other albuminoids give, under the same conditions, identical decomposition products, and sometimes sulphuretted hydrogen as well; Schützenberger, by treating various albuminoids with baryta at a high temperature, obtained the same products and, in addition, amido-acids, carbonic anhydride, oxalic acid, and acetic acid.

The author repeated the experiments of Hlasiwetz and Habermann; after boiling for three days the amido-acids were separated, and on treating the filtrate with phosphomolybdic acid, a dense precipitate was obtained. The precipitate was washed with 5 per cent. sulphuric acid, decomposed with baryta, the filtrate freed from baryta with sulphuric acid, and the solution evaporated with excess of hydrochloric acid. The residue was treated with a little water, dissolved in absolute alcohol, and the solution mixed with ether, whereon a large quantity of an oily substance was precipitated, and after a time partially crystallised. The crystals were separated, washed with absolute alcohol, in which they are only sparingly soluble, and dried over sulphuric acid. This compound is the hydrochloride of a strong base, and when treated with silver carbonate in aqueous solution it yields an alkaline liquid which, on evaporation, gives a crystalline residue. The *platinochloride* of the base crystallises in reddish-yellow prisms and has the composition $C_7H_{12}N_2O_2$, $H_2PtCl_6 + 4H_2O$. On adding alcoholic platinum chloride to the mother-liquors from the

crystalline hydrochloride a lighter coloured, hygroscopic *platinochloride*, $C_8H_{14}N_2O_2$, $H_2PtCl_6 + H_2O$, of another base is precipitated.

The crude mixture of chlorides is not decomposed by concentrated hydrochloric acid at 150°, but at 120°—130° it is decomposed by baryta with liberation of carbonic anhydride.—F. S. K.

Influence of Saccharine on the Digestion. A. Stift. Bied. Centr. 18, 458—460.

CONTRARY to the experience of Bruylants, the author finds that saccharine is not absorbed by the blood, but that it is wholly expelled from the system unchanged.

In one experiment, the author took saccharine daily for eight days in doses of 3 grms. per diem, when he found that it acted as a slight purgative, without however affecting the general health in any other way.

Other experiments conducted by the author were made with a view of ascertaining the effect of saccharine on the artificial digestion of albuminous and pepsin substances. These experiments point to the conclusion that a retardation of the digestion of such substances as meat-fibrin and egg-albumen is experienced in the presence of saccharine, the extent of such retardation depending on the time and quantity of saccharine present. Similar effects were noticeable in the case of starch and diastase, the fermentation being retarded.—J. W. L.

PATENT.

Improvements relating to Thermometers. A. Keddle, Belfast.
Eng. Pat. 9200, June 3, 1889. 6d.

THE invention consists in the adaptation of thermometers to testing the temperature of mixtures, either dry or liquid, such as bread-stuffs, in the state of "sponge." The thermometer is fixed at the lower end of a pointed holder, and is protected by a zinc shield which gives ready access to, and allows free contact with the "sponge" or mixture the temperature of which is desired. The thermometer may be further protected by a glass over the scale.—E. S.

XIX.—PAPER, PASTEBOARD, Etc.

Esparto. Chem. Trade J. 1889, 97—98, 115—116 and 130—131.

THE use of this raw material in paper manufacture continues to be confined, for the most part, to the United Kingdom. The annual import exceeds a quarter of a million tons.

In the first operation of dusting and picking, the raw material sustains a loss of about 6 per cent. in weight. The fine dust from an *esparto* "willow" was found to have the following composition:—

Water	6.2
Organic matter	64.6
Mineral matter	29.2

The organic matter consisted chiefly (90 per cent.) of the cuticular waxes and resins; the mineral matter left after ignition was analysed with subjoined results:—

Silica	56.42
Calcium carbonate	19.17
Magnesium carbonate	3.76
Alumina	20.57
Total	99.92

The silica in this dust is chiefly adventitious, *i.e.*, due to adherent sand. The silica of the grass itself preponderates in the ash, the proportion of which is about 3.5 per cent. of the weight of the *esparto*, after cleaning by dusting.

The percentage of cellulose isolated by the laboratory process varies from 45, in the African sorts, to 48 in the Spanish. The yield of pulp to the paper maker is consider-

ably lower than their "theoretical" numbers, viz., about 40 per cent. in the case of the Spanish varieties, and less for Arzew, Oran, and Tripoli, in the order named. The higher proportion of caustic soda required for boiling the

coarser varieties, prejudicially affects the yield of cellulose in correspondence.

The subjoined table sets forth the chief laboratory and working data of treatment of the various kinds of esparto:—

Variety.	Composition of Esparto.			Per Cwt. of Grass.		Lb. of 60 per Cent. Caustic Soda on 100 lb. of Extractable Organic Matter.
	Fibre or Cellulose.	Water and Ash.	Extractable Organic Matter.	Extractable Organic Matter.	Caustic Soda, 60 per Cent. used in Digesting.	
Spanish.....	Per Cent. 48·6	Per Cent. 12·6	Per Cent. 38·8	43·45	13·5	31·07
Oran.....	44·1	14·6	41·3	46·30	16·5	35·67
Tripoli.....	40·3	16·1	43·6	48·83	20·0	40·55

To remove a given quantity of the extractable organic matter, 15 per cent. more soda is required for Oran, and 32 per cent. more for Tripoli, than for the Spanish varieties. The increased quantity is partly accounted for by the increased volume of lye necessary to cover the coarser kinds; this again will depend upon the construction of the boilers. The points requiring special study with the view to the most economical adjustment of the conditions of the digestion are: (1) concentration of lye; (2) quantity of lye, *i.e.*, proportion to grass; (3) steam pressure, *i.e.*, temperature of digestion; (4) duration. From the general discussion of these contained in the paper, valuable information should be obtained in regard to the solution of the problem in particular cases.—C. F. C.

The Utilisation of Fibrous Peat for the Manufacture of Brown Paper, Wrappers, and Millboards. J. A. London. (Paper read before the Mechanical Science Section, Brit. Assoc., Newcastle Meeting, 1889.)

THE author stated that there were 3,000,000 acres of bog land in Ireland, in a great part of which the necessary fibrous variety of peat could be found, and pointed out the benefits which would accrue from its utilisation. The machine used for treating the material was a "Willow," or "Devil," having a drum 3 ft. in diameter and 12 in. on the face. The drum was covered with a cone-shaped casing. Both drum and casing had cone-shaped teeth, this shape preventing the fibre from adhering to the teeth, but the latter could be adjusted to produce fibre of any degree of fineness. The fibre could be treated in either a wet or dry state. The author further stated that paper made from peat fibre was stronger than that in which wood-pulp was used. White papers on the other hand could not be prepared from peat fibre. So far five mills were working on peat fibre.

PATENTS.

A New and Improved Blowing-out and Washing Process in Making Paper Pulp from Esparto, Straw, and other similar Vegetable Substances. C. F. Dahl, London. Eng. Pat. 11,150, August 1, 1888. 6d.

ACCORDING to this invention esparto, straw or other fibrous materials is boiled under a pressure of 45 lb. per square inch. When the boiling is completed the contents of the boiler is forced under pressure into a cylindrical vessel furnished with safety-valves loaded to 8 lb. This causes the material to be broken up into the state of pulp. Water is forced into this second vessel for the purpose of washing the pulp.—E. J. B.

An Improved Method of Producing Pure Cellulose. H. and C. Bache-Wug and V. B. Drewsen, Böhm, Norway. Eng. Pat. 11,458, August 8, 1888. 4d.

THE inventors treat crude cellulose from wood, straw, esparto, &c. with a solution of a permanganate acidified with sulphuric acid. The precipitated manganese dioxide is removed with sulphurous acid, sodium thio-sulphate or oxalic acid. The process may in certain cases be preceded by a treatment with bleaching powder solution.—E. J. B.

Improved Method of Destroying the Noxious Fumes or Gases arising from Chemical Manufactures or Processes. A. N. Bertram, Milngavie. Eng. Pat. 11,841, August 16, 1888. 6d.

THE gases (especially those arising from the recovery of soda from paper-mill lyes) are drawn into an air-tight brick chamber by a rotary fan, upon the blades and boss of which impinge jets of water. They next pass over one baffle wall and under another, encountering at each wall further jets of water. Water is also allowed to stand upon the floor to a depth of say 12 in.—A. R. D.

Improvements in Apparatus for Straining Paper Pulp and the like. W. Hall, Darwen. Eng. Pat. 12,502, August 30, 1888. 6d.

THE patent strainer consists of two boxes, one of which works inside the other. The moveable box is furnished with strainer plates, and is raised and lowered by a cam placed on a revolving shaft underneath.—E. J. B.

An Improved Method of and Means for Protecting Apparatus used in the Manufacture of Sulphite Cellulose. F. Salomon, Berlin, and H. Brünger, Cunnorsdorf, Germany. Eng. Pat. 13,396, September 17, 1888.

THE improved method consists in exposing the iron boiler plates while heated to the action of a solution of calcium bisulphite.

The latter "boils where it is in contact with the hot walls, and is thereby partly decomposed, the result being the deposition of a firm, dense, permanent crust of about $\frac{1}{2}$ to 2 mm. in thickness. This crust is composed mainly of gypsum (formed by the oxidation of calcium sulphite) and calcium monosulphite, and is so dense that it protects the underlying surface from the destructive action of the lye."—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Mandragora Alkaloids. F. B. Ahrens, Annalen, 251, 312—316.

THIS paper describes two alkaloids which have been obtained from the mandragora root possessing physiological properties very similar to those of atropin, and presumably closely related to it in their chemical constitution. The roots were powdered, macerated eight days with alcohol, and pressed. The alcohol was distilled off from the filtrate, the residue extracted with very dilute acid, and this solution, after neutralisation with potassium carbonate, extracted with ether. On distilling off the ether, the alkaloid remained as a slightly coloured brittle gum, after standing over sulphuric acid. It melts at 77°—79°, becomes moist on exposure to air, and its ethereal solution reacts alkaline. The sulphate

crystallises in small white deliquescent plates, and a solution introduced into the eye caused an enlargement of the pupil. The name *Mandragorin* is proposed for this alkaloid, which was further characterised by the following salts:—The gold chloride double salt, $C_{17}H_{23}NO_3 \cdot HClAuCl_2$ melts at 153° — 155° , and crystallises in shining plates from water, in which it is sparingly soluble in the cold. The chloro-platinate crystallises in small nodules, and melts at 194° — 196° . The mercuric chloride double salt melts at 160 — 161° , and crystallises from water in white needles. Mandragorin is not converted into atropin by the action of alkalis. A second alkaloid was obtained from the mandragora root after extraction with alcohol, as described above, by extracting the residue with water containing hydrochloric acid. This solution was evaporated, supersaturated with potassium carbonate, and extracted with ether, which when distilled off left an oily residue. The sulphate was not obtained in a crystalline form, but its solution caused an enlargement of the pupil. The platinum chloride double salt is a yellow crystalline precipitate melting at 179° — 181° . The gold salt melts at 147° — 153° , and crystallises in yellow plates or needles, and the mercuric chloride double salt crystallises in transparent feather-like needles, which become white and opaque when dried on the water-bath. The quantity obtained of this alkaloid was too small to allow of its composition being determined, but it is assumed to be isomeric with the atropa alkaloids. The following table gives the properties of the double salts of the isomeric alkaloids $C_{17}H_{23}NO_3$.

—	Gold Chloride Double Salt.	Platinum Chloride Double Salt.	Mercuric Chloride Double Salt.
Atropin.....	Oil gradually crystallising. Melting point 135° — 137° .	Yellow gummy precipitate. Monoclinic crystals by evaporating the solution.	Gummy precipitate.
Hyoseyamin....	Shining irregular plates. Melting point 160° (162°).	Triclinic crystals by evaporating the solution. Melting point 207° — 210° .	Oil solidifying to plates.
Hyosein.....	Flat yellow shining prisms. Melting point 198° .	Small octahedra soluble in ether alcohol.	Amorphous or oily.
Mandragorin....	Shining yellow plates. Melting point 153° — 155° .	Slightly soluble nodules. Melting point 194° — 196° .	Slightly soluble needles. Melting point 160° — 161° .
(?)	Plates or needles. Melting point 147° — 153° .	Bright yellow crystalline powder. Melting point 197° — 181° .	Transparent, flat feather-like needles.

—T. A. L.

On the Constituents of Herniaria. L. Barth and G. Herzig. Monatsh. Chem. **10**, 161—173.

Herniaria glabra and *Herniaria hirsuta* are herbaceous plants belonging to the family of the *Caryophyllaceae*, which have long been used as a popular remedy for ruptures, and have been included in the last edition of the Austrian pharmacopœia. The authors have experimented with a carefully selected quantity of *Herniaria hirsuta* with the result that the alcoholic extract contained various extractive matters and herniarin, which is the methylic ether of umbelliferone, and a glucoside which in character and toxic action resembles saponin, but with the difference that a splitting up by means of hydrochloric acid separates sugar and a substance containing one atom more of oxygen than saponin and hence named oxy-sapogenin, $C_{15}H_{25}O_3$. Herniarin forms a white crystalline powder easily soluble in alcohol and ether. It has the formula $C_{16}H_{15}O_3$, and melts at 117 — 118° C. When shaken with water or heated to 100° C. it

gives off an odour like that of coumarin. Its solubility in water is so small that one litre dissolved only 0.133 grm. herniarin, whence the authors observe that the active properties of the aqueous infusion of the plant cannot be due to this substance, but more probably to the glucoside which is present in the aqueous extract. Herniarin dissolves in concentrated sulphuric acid with a bluish-violet fluorescence and in caustic potash solution without fluorescence from which it is precipitated unchanged on acidifying. One kilo. of the plant yielded about 2 grms. of pure herniarin.—G. H. B.

On Caffeine. R. Leipen. Monatsh. Chem. **10**, 184—189.

This paper treats chiefly of the nature of the action of ozone on caffeine. The products of the reaction were ammonia, methylamine, carbonic acid, and dimethylparabanic acid, the decomposition being in all respects similar to that effected by potassium chromate and sulphuric acid. Theobromine treated in a similar manner remained for the most part unchanged by the ozone. In the course of this research the author had occasion to notice the exceptional stability of the oxalate of caffeine, which underwent repeated crystallisation from aqueous solution without decomposition, differing essentially in this respect from other salts of caffeine with inorganic and fatty acids.—G. H. B.

On the Constitution of the Cinchona Alkaloids. Z. H. Skraup and J. Würstl. Monatsh. Chem. **10**, 220—230.

A COMPARISON of the oxidation products of cinchonine, quinine, cinchonidine, and quinidine shows that in the first stage two different quinoline derivatives, cinchonic acid and quinic acid, are produced, but a further stage of oxidation yields the same two products from all four, namely, cincholoipon, $C_9H_{17}NO_2$, and cincholoiponic acid, $C_9H_{13}NO_4$. The authors now find that these products are yielded also by cinchonine and quinine. A part of the paper is devoted to a discussion of the relations between the cinchona alkaloids, but the matter is unsuitable for abstraction.

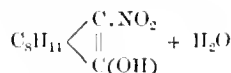
—G. H. B.

On Acid Salts of Mercury and the Halogens. G. Neumann. Monatsh. Chem. **10**, 236—241.

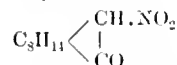
THE compounds here described are prepared by saturating the halogen acid with the mercury halogen salt at the ordinary temperature, and exposing the solution to a temperature of 0° C., or below, in an exsiccator over sulphuric acid and quicklime. The crystals thus obtained will decompose at a slight elevation of temperature or in presence of moisture. Compounds of the following formulae were obtained in crystals:— $HgCl_2$, HCl ; $HgBr_2$, HBr ; HgI_2 , HI . At a temperature of -12° C. the crystals contained a further molecule of acid, for example, $HgCl_2 \cdot 2HCl$.—G. H. B.

Camphonitrophenol. P. Cazeneuve. Bull. Soc. Chim. [3] **1**, 417—425.

Camphonitrophenol—

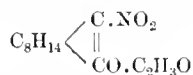


isomeric with nitrocamphor—

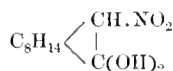


is obtained when α -nitrocamphor is boiled for half an hour with 10 times its weight of pure concentrated hydrochloric acid, but about 10 per cent. of the camphor is converted into an insoluble compound. The solution is diluted with three times its volume of water, agitated with animal charcoal, filtered, evaporated to dryness, and the residue recrystallised from boiling water. It loses its water at 30° , volatilises slowly at 100° , is soluble in water, alcohol, ether, chloroform, and benzene, and dissolves in boiling water in all proportions; it softens at 60° and melts at 70° , but the

anhydrous crystals melt at 220° with partial decomposition. Its specific rotatory power in 1.8 per cent. absolute alcoholic or benzene solution is $\alpha_D = +10^{\circ}$. It reddens litmus, gives a reddish colouration with ferric chloride solution, decomposes carbonates, and yields an acetyl derivative—



and an ethyl ether. When boiled with concentrated potash or when treated with sodium amalgam in the cold it takes up one molecule of water, and is converted into the compound—



Camphonitrophenol as an Antiseptic.—The author studied the antiseptic action of camphonitrophenol on *bacillus anthracis* and *staphylococcus pyrogenes aureus*, and found that 20 centigrammes are required to sterilise 15 cc. of aqueous salt-beef extract; it is only poisonous to higher animals when administered in large doses.

The camphonitrophenates are isomeric with the nitro-camphrates, but, unlike the latter, they are dextro-rotatory. The potassium, sodium, ammonium, copper, lead, zinc, iron, and barium salts are soluble in water, but the silver and mercury salts are only sparingly soluble, and the calcium salt is insoluble; the salts of quinine and cinchonine are also insoluble in water, but many alkaloids, morphine, for example, give soluble salts. The sodium salt—



prepared by boiling camphonitrophenol with excess of sodium carbonate, crystallises in needles, loses its water at 100° , and is readily soluble in alcohol. The calcium salt, $(\text{C}_{10}\text{H}_{14}\text{O.NO}_2)_2\text{Ca}$, can be prepared by precipitating aqueous solutions with lime water. The ammonium salt crystallises in colourless needles and sublimes at about 150° with slight decomposition.—F. S. K.

On some Bases found in the Shoots of *Solanum Tuberosum*. R. Fribas. Monatsh. Chem. 10, 541—560.

FRESH potato shoots were macerated and extracted with water containing 2 per cent. of acetic acid; the filtrate was rendered alkaline with ammonia, and the precipitate which collected dried, extracted with 85 per cent. alcohol, and filtered hot. A small quantity of ammonia being now added until just turbid, the solution on cooling deposited crystals and an amorphous body, the former solanine, the latter called by the author solanaine. These were further purified by frequent recrystallisation from alcohol. Both bodies are glucosides. Solanine melts at 244° , dissolves readily in dilute hydrochloric acid and 85 per cent. alcohol. Its composition is represented by the formula $\text{C}_{55}\text{H}_{93}\text{NO}_{18} + 4\frac{1}{2} \text{aq}$. Solanaine melts at 208° , it is more soluble in alcohol than solanine. It was not obtained in the crystalline form. The formula deduced from various analyses is $\text{C}_{52}\text{H}_{83}\text{NO}_3 + 4 \text{H}_2\text{O}$.

Both solanine and solanaine are, however, split up into the same substances by heating with dilute hydrochloric acid, viz., a sugar and solanidine hydrochloride. The sugar differs from dextrose in its action on polarised light, but its percentage composition is the same. The glucosazone prepared from it also resembles the corresponding dextrose compound. Heated with nitric acid neither mucic nor saccharic acid could be detected. The other product of the decomposition of the two bases is a crystalline colourless powder. Its formula is $\text{C}_{10}\text{H}_{13}\text{NO}_2 + \text{HCl}$. On treating its dilute alcoholic solution with potash, crystals of the free base solanidine were obtained, melting at 191° . The sulphate crystallises in colourless leaflets. A diacetyl-derivative was also prepared, melting at 203° .—A. R.

Betel Oil. J. Bertram and E. Gildemeister. J. Prakt. Chem. 39, 349—355.

THE leaves of *Piper betle* (L) from Southern China and Malay Archipelago yield an ethereal oil, betel oil, from which, using fresh leaves, Eykman (Chem. Zeit. 1888, 81) obtained a liquid phenol, "chavicol"—



a parahydroxyallylbenzene.

The authors, working on the dried leaves, found an entirely different phenol. The oil (of which .5 per cent. was obtained from the leaves) had a specific gravity of 1.024 at 15°C ., and yielded 70—75 per cent. of a phenol extracted by agitation with alkali and subsequently set free with acid.

The phenol distilled in vacuum yielded *Betelphenol*, $\text{C}_{10}\text{H}_{12}\text{O}_2$, boiling point 254° — 255° , sp. gr. 1.067 at 15° . Pure *Betelphenol* is an oily, colourless, highly-refractive liquid, with strong and persistent odour, and differing entirely from eugenol. Both give a green colour in alcoholic solution with ferric chloride, *Betelphenol* giving the deeper tint. The percentage composition is the same, but eugenol has sp. gr. 1.072 at 15° , and boils at 250° — 251° .

The authors prepared the acetyl-derivative, boiling at 275° — 277° and setting at -20° , remelting at -5° , the corresponding eugenol derivative boils at 270° and melts at 30° — 31° .

The Benzoyl-derivative crystallises in thin plates melting at 49° — 50° , the eugenol benzoate when pure melts only at 69° — 70° .

Acetylisoranillic acid, $\text{C}_{20}\text{H}_{10}\text{O}_5$, crystallising in slender needles or scales, soluble in water, melting at 250° , obtained by oxidation of the acetyl derivative with potassium permanganate. It is isomeric with the analogous acetylvanillic acid prepared in same way from eugenol. Thus the formula for *Betelphenol* will be—

$\text{C}_3\text{H}_5.\text{C}_6\text{H}_3(\text{OCH}_3).\text{OH}$ [$\text{C}_3\text{H}_5:\text{OH}:\text{OCH}_3 = 1:3:4$]
eugenol being—

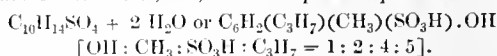
$\text{C}_3\text{H}_5.\text{C}_6\text{H}_3(\text{OCH}_3).\text{OH}$ [$\text{C}_3\text{H}_5:\text{OCH}_3:\text{OH} = 1:3:4$]

Methyl ether of betelphenol. This was prepared and found to be identical with the corresponding derivative of eugenol and boiling at 247° to 248° . This confirms the correctness of the above formula. The methyl ether was also oxidised, and a crystalline salt obtained corresponding with that from eugenol methyl ether.

The second portion of the betel oil unaffected by agitation with alkali was fractionated, distilling mostly between 250° — 270° . This fraction was clear yellow, with a very pleasant odour of tea; on being mixed with double its volume of ether, and treated with hydrochloric acid and cooled in a freezing mixture, needle-shaped crystals slowly separated, melting at 117° — 118° . A sesqui-terpene dihydrochloride, $\text{C}_{15}\text{H}_{24} + 2 \text{HCl}$, of the same melting point has been obtained from a similar fraction of the oils of cubeb, saffron, patchouli, and others.—D. A. S.

On Carvol and Carvacrol Sulphonic Acid. A. Claus and W. Fahrion. J. Prakt. Chem. 39, 256—266.

EQUAL parts carvol and strong sulphuric acid 1.84 are gently mixed, vigorous action takes place, the pungent odour of carvacrol being evolved. By subsequent treatment the authors prepare an acid which they find to be identical with that from carvacrol, viz., *Carvacrolpara-sulphonic acid*—



It crystallises readily in large tables or flattened monoclinic prisms, easily soluble in water and alcohol, and soluble also in ether, melting at 65° — 69° (uncorr.) By further heating it is decomposed, giving off the odour of carvacrol. The authors describe the potassium, sodium, calcium, barium, and lead salts. The chloride is a viscid reddish-brown oil entirely uncrystallisable. The amide is insoluble in ether and benzene. On oxidation thymoquinone is obtained, pointing to the para-position of the sulphonic group to the hydroxyl.

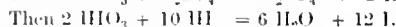
Acetylcareacrol is a thick pale-yellow oil of not unpleasant odour.

The remainder of the paper is devoted to consideration of the constitution of carvol which shows the properties of a ketone.—D. A. S.

PATENTS.

Improvements in the Manufacture of Iodine by Electrolysis. T. Parker and A. E. Robinson, Wolverhampton. Eng. Pat. 11,479, August 9, 1888. 4d.

ELECTROLYSIS is carried on in a vessel divided into two by a porous partition. In one compartment is an iron or other suitable cathode, immersed in a solution of a (preferably) caustic alkali. In the other is a platinum or other inoxidisable anode immersed in an acid solution of an iodide, preferably that of sodium or potassium. The iodide solution may be acidified by hydrochloric or sulphuric acid; or a soluble sulphate, such as that of magnesium, sodium, or potassium may be used, such sulphate being decomposed simultaneously with the iodide, and liberating the necessary acid. The reactions, which also indicate the proportions to be used, are given as follows:—



The solutions should be moderately concentrated. The iodine which collects at the positive plate is removed, washed, and then dried in a current of warm air.—E. T.

Improvements in the Manufacture of Salols and Analogous Ethers. C. Kolbe, Radheul, Germany. Eng. Pat. 13,169, September 12, 1888.

THIS is an improvement on M. von Nencki, Eng. Pat. 8018 of 1886 (this Journal, 1886, 577, and 1887, 561), referring to the manufacture of salols, by treating phenols and salicylic acid with dehydrating agents. In the present invention salicylic acid is replaced by the homologues, cresotic acids, and the isomeric compounds of *p*-hydroxybenzoic acid, or *p*-methoxybenzoic acid, or *p*-ethoxybenzoic acid.

In place of phenol or naphthol, cresol, thiophenol, and resorcinol monomethyl ether, $\text{C}_6\text{H}_4(\text{OCH}_3)\text{OH}$, may be employed.

Twenty-four new compounds are thus obtained, as for instance *o*-cresol salicylate, $\text{C}_6\text{H}_3(\text{CO}_2\text{C}_6\text{H}_4\text{CH}_3)\text{OH}$.

The compounds produced according to this invention are intended for use as medicaments and for the production of colouring matters.—O. J. S.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Certain Organic Reducing Agents as Developers. J. H. Stebbings. Meeting Soc. of Amateur Phot. New York.

Resorcinol.—The author has experimented with this substance, using carbonate of soda and carbonate of potassium, without, however, obtaining any satisfactory results. H. Tóth and Eder (Phot. Corresp. 17, 191), however, state that in an ammoniacal or caustic soda solution it reduces gelatinobromide plates very well, although somewhat slower than pyrogallol.

Amido-β-Naphthol-α-Sulphonic Acid.—This compound is slightly soluble in boiling water, but a trifle more so in an aqueous solution of acetate of soda, from which, on cooling, it crystallises out again. Alkalis and alkaline earths dissolve it very readily, and the solutions thus obtained, when left exposed to the air, rapidly turn orange-

brown. Oxidation products colour either the neutral or alkaline solutions of this acid yellow to brown. The most peculiar feature of this salt, as well as of those that are yet to be described, is that of the reduction of silver salts either in acid or alkaline solutions to extremely finely-divided metallic silver. This peculiarity would, in the author's opinion, make the new compound an extremely valuable one for use in developers.

Amido-β-Naphthol-β-Sulphonic Acid.—This compound is isomeric with the foregoing one, and may be obtained by reducing the orange dye-stuff produced by combining diazobenzene chloride with Schäffer's β-naphthol-β-sulphonic acid. It is obtained in small white crystals. In small quantities it may be dissolved in boiling water, without decomposition; and if the solution thus obtained be rapidly cooled down with ice, the amido-acid crystallises out unaltered in little snow-white needles. By slow cooling of the aqueous solution it is decomposed, gradually turning brown. In alkaline solutions it behaves similarly to alkaline pyrogallol. It likewise reduces silver salts to metallic silver.

Pyrocatechin (catechol), the third isomer of hydroquinone (quinol), is said to work very well. This substance crystallises in rectangular prisms belonging to the orthorhombic system. Eder and H. Tóth, in their experiments, used a 5 per cent. catechol solution, to which they added two or three drops of ammonia for every 20 cc.

Phloroglucol, $\text{C}_6\text{H}_3(\text{OH})_3$, an isomeride of pyrogallol, has also been tried by Eder, who states that even in a strong ammoniacal solution it works very poorly, as the reducing action is very slight. Perhaps in a caustic soda solution it might work better. This substance is best prepared by fusing resorcinol with caustic soda. It crystallises in hard rhombic prisms, having a very sweet taste.

Some time ago the author made a few tests with phenylhydrazine hydrochloride, and found that this substance in a caustic soda solution reduces chloride of silver very easily. He did not extend these experiments to bromide of silver, but has no doubt that it will reduce this too.

This compound may be prepared by reducing diazobenzene chloride with tin and hydrochloric acid. It crystallises in little pearly plates, which are quite soluble in water, and altogether it is a very remarkable compound.

In Ber. 21, 3468, is an article by O. N. Witt, entitled, "*Reduction Products from the Azo-colouring Matters of the Naphthalene Series.*" This article describes a number of compounds, which it would appear are likely to prove useful in photography, though the author has not heard of their being used, or even experimented with, for this purpose. (This Journal, 1889, 276.)

No doubt good results might be obtained, moreover, from paraphenylenediamine, which may be obtained by reducing paraniacetanilide with tin and hydrochloric acid; and from dimethyl-para-phenylenediamine, which may be obtained by reducing nitroso-dimethyl aniline with zinc dust. Both compounds, especially the latter, absorb oxygen from the air, and for this reason they might make good reducing agents.

XXII.—EXPLOSIVES, MATCHES, Etc.

Novelties in the Explosives Industry. O. Guttman. Dingl. Polyt. J. 273, 62—69.

An improved pattern of *Lauer's* friction tube is shown in Fig. 1. Each tube is tested with a strain equal to 8—10 kilos. before leaving the works. They are now being largely and successfully employed in the place of electric detonators. Figs. 2—3 represent Roth's safety fuse igniter. The fuse is surrounded either by a metallic case or wire gauze. The igniting composition in the globular form is fired either by means of a needle or by a drop of sulphuric acid, or by means of a friction rod.

Bickford and Co.'s safety fuse igniter is similar to Roth's, the ignition of the fuse being brought about by the breaking of a glass ball containing sulphuric acid.

In Zschokke's pneumatic igniter the needle, which is kept in position by means of a spring, is driven into the friction composition by air pressure.

As regards Zschokke's chemical igniter, a drop of sulphuric acid contained in a U-tube is blown into the chamber containing the friction composition.

Two explosions of blasting gelatin occurred in the magazines at Aden within a few weeks of each other. It seems probable that these explosions were due to the decomposition of the gelatin. The temperature alone is not sufficient to explain this accident. It is evident, however, that the construction of the magazine was favourable to the concentration of the sun's rays and that it was badly ventilated.

The author states that if blasting gelatin be exposed to a temperature of 70° for a length of time, the gun-cotton contained in it suffers decomposition, which under favourable circumstances may result in ignition.—C. N. H.

PATENTS.

Improvements in the Manufacture of Explosives. J. H. Johnson, London. From F. Engel, Hamburg, Germany. Eng. Pat. 6022, April 25, 1887. 6d.

This invention has for its object the manufacture of explosives for use in small arms and ordnance. It consists in nitrating woody matter, vegetable fibre, or cellulose, and then completely dissolving them in acetic ether or like solvent until they assume a plastic consistency. By distilling off the solvent the mass is reduced to a powdered or granular form.—C. N. H.

Smokeless Gunpowder. C. F. Hengst, Plunstead. Eng. Pat. 16,783, December 6, 1887. (Second Edition.) 6d.

Compare this Journal, 1889, 478.

Improvements in Smokeless Explosives. J. A. Wanklyn, London. Eng. Pat. 9799, July 5, 1888. 4d.

This invention relates to improvements in smokeless powders and consists in the admixture of dynamite or gun-cotton with nitrate of urea.—C. N. H.

Improvements in the Manufacture of Explosives. I. M. T. Anderson, Combs, and A. Anderson, Woolwich. Eng. Pat. 13,308, September 14, 1888. 6d.

This invention relates to the treatment of nitro-cellulose by acetic ether or other suitable solvent, the object being to form the explosive material into threads, strips, cylinders, tubes, or other forms by forcing it through slits or holes in a plate, and then, if required, cutting the threads, &c. into grains or rings.—C. N. H.

An Improved Explosive Compound. P. M. Justice, London. Eng. Pat. 13,789, September 24, 1888. 4d.

This invention relates to an explosive composed of "a suitable nitrate" coated with a hydrocarbon, such as paraffin or naphthalene, and rendered sensitive to detonation at the desired time by admixture with potassium chlorate.—C. N. H.

Improvements in the Manufacture of Dynamite. C. O. Lundholm, Ardeer. Eng. Pat. 14,027, September 29, 1888. 4d.

The object of this invention is to render dynamite not liable to injury or deterioration by water or moisture, and even capable of acting effectively whilst immersed in water. The invention consists in employing as the absorbent of the nitroglycerin the substance obtained by carbonising without access of air, a siliceous earth naturally containing organic or carbonaceous matter.—C. N. H.

Improved Methods or Means of Treating High Explosives, such as Dynamite, and for the Utilisation, Protection, and Firing of such Explosives in Projectiles, Torpedoes, Cartridges, and the like. R. S. Lawrence, London. Eng. Pat. 236, January 5, 1889. 1s. 3d.

This invention has reference to the treatment of high explosives, with a view to their employment in the charging of projectiles, torpedoes, mines, &c. The patentee encloses the high explosive within an envelope or hollow rope of flexible or elastic material. When the high explosive is in the form of dynamite it may be applied to one or both surfaces of a "sheet material." When nitroglycerin is used the material may be saturated with it. The sheet thus prepared may be cut up into suitable forms, fully described and illustrated in the specification. The projectiles charged with high explosives treated according to this invention are fired by specially-constructed time fuses.

The specification contains 20 claims and five sheets of drawings.—C. N. H.

A New Explosive. W. H. A. Kitchen and J. G. A. Kitchen, St. Helens. Eng. Pat. 11,102, July 10, 1889. 4d.

This invention relates to a mixture of chlorate of potassium, coal dust, and resin or sulphur.—C. N. H.

An Improved Manufacture of Smokeless Powder. W. Schückher, Vienna, Austria. Eng. Pat. 11,665, July 22, 1889. 4d.

This invention relates to smokeless powder of the following composition:—

	Parts.
"Nitro-starch".....	50
Saltpetre.....	40
"Nitrobenzol".....	10

The nitro-starch is subjected to the action of a solvent during the process, with a view to harden the finished product.—C. N. H.

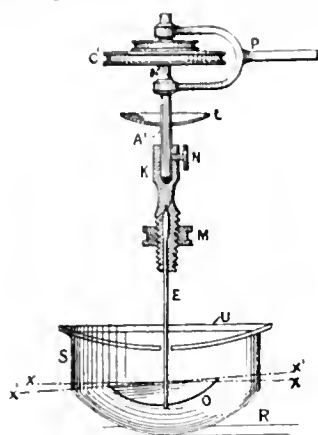
XXIII.—ANALYTICAL CHEMISTRY.

Apparatus for Electrolytic Work. N. v. Klobulow. J. Prakt. Chem. 1889, 40, 121—127.

The author has previously drawn attention to the importance of agitating an electrolyte when a metal is being determined quantitatively by electrolysis. This may be done either by a mechanical agitator or by blowing in air (after the manner which has been suggested as a means of reducing polarisation in single fluid batteries). The latter method appears at first sight to be easy, but it has serious defects, arising partly from the small dimensions of the electrolytic cell (a platinum basin) and partly from the difficulty of distributing the air or other gases uniformly. When air is used care has to be taken to avoid oxidation of the metal or the electrolyte; CO₂ cannot be used with alkaline liquids, and when the electrolyte contains volatile matters such as ammonia, ammonium sulphide, or hydrocyanic acid, the method appears to be inapplicable. Levoir has described an apparatus in which the positive electrode is placed beneath the negative, and the agitation of the electrolyte is effected by the ascent of the oxygen evolved on the lower electrode. But in many cases this is insufficient, and except where the metallic deposit adheres firmly it is not advisable to make the negative electrode the upper one.

The author therefore recommends that the deposition should take place in a platinum basin (which at the same time forms the negative electrode), and describes an arrangement in which the positive electrode acts as a

mechanical agitator. Reference is made to an "universal holder" described in the *J. Prakt. Chem.* **33**, 473, and figures are given illustrating a system of imparting motion to a number of agitators.



In the figure the apparatus for a single one is shown, and the agitator can be easily set in motion by a clockwork arrangement or a small electromotor. For a series of apparatus a running cord bearing against the pulleys C, can be used. K M is a kind of self-centring chuck which is attached to the spindle by the screw N; the electrode is fixed in the chuck by tightening the nut M. L is a cup-shaped guard which prevents dirt, &c. from falling into the electrolyte. The electrode O is slightly tipped as shown by the line *x x'*; this ensures a thorough mixing of the contents without any turbulent motion. Electrical connexion with the positive pole of the battery is made through the arm P. The negative pole is connected with the platinum dish R, upon which the metal is deposited.

There are some instances in which the above arrangement is impossible, e.g., where the electrolysis takes place between two flat plates or two concentric cylinders, or where mercury is used as one electrode. In such cases the form and disposition of the agitator must be altered. Where it need not at the same time be used as an electrode it can be conveniently made of thin glass rod which is easily bent to the required shape.—D. E. J.

Detection of Phosphoric Acid of Mineral Origin. J. Stocklasa. *Bied. Centr.* **18**, 444–446.

LORENZ's method for the detection of phosphoric acid of mineral origin is based on the supposition that mineral phosphates contain a considerable quantity of fluoride, whilst those of animal origin contain not more than a trace; the author finds, however, that some of the phosphatic minerals, such as Norwegian apatite, also contain but a trace of this element, and hence concludes that Lorenz's method cannot be relied upon in all cases.—J. W. L.

Use of Nitroso-β-Naphthol in Quantitative Analysis. *Zeits. Anal. Chem.* **28**, 234–238.

Separation of Copper from Lead, Cadmium, Magnesium, Manganese, Mercury, Zinc, &c. (See this Journal, 1887, 384.)—The following additional notes may be useful. In igniting comparatively large quantities of the precipitated and dried copper nitroso-β-naphthol, it is advisable to add a little pure ammonium oxalate or oxalic acid. Silver, should it be present in the solution, is precipitated along with the copper.

Separation of Iron from Chromium, Manganese, Nickel, Zinc, &c. (See this Journal, 1886, 41.)—At least 1 gm. of nitroso-β-naphthol is required in the precipitation of 0.1 gm. of iron. Small quantities of ferrous iron do not interfere with the quantitative separation of the iron. Not

more than 0.3 gm. of iron should be contained in the volume employed for precipitation. The filtrate from the precipitated ferri-nitroso-β-naphthol is rinsed into a good-sized Erlenmeyer's flask, an excess of ammonium hydrate and chloride added, and the manganese precipitated as manganic hydrate by a stream of air containing vapours of bromine. When chromium is present, 5 cc. of strong hydrochloric acid must be added to each 100 cc. of the solution, to prevent this metal being precipitated as chromium nitroso-β-naphthol, $(C_{10}H_7O.NO)_3Cr$.

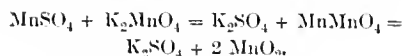
Meineke points out that in the precipitation of iron, copper and cobalt, as well as phosphoric acid, are liable to be contained in the precipitate. (See also this Journal, 1885, 370, and 1888, 525.)—E. B.

Use of Potassium Manganate in Analytical Chemistry. *Zeits. Anal. Chem.* **28**, 238–239.

Ad. Jolles recommends potassium manganate for use in analytical work. It is prepared in the pure state by heating equivalent quantities of pure potassium permanganate and hydrate in a crucible, the potassium hydrate being first added and dissolved in a little distilled water, and whilst the crucible is gently heated the powdered permanganate stirred in. The crucible is then heated at a dull red heat for about two hours, allowed to cool, and the potassium manganate formed put into a glass-stoppered bottle. In presence of alkalis, potassium manganate dissolves in water without decomposition. Its alkaline solution is characterised by the property of yielding insoluble compounds of regular composition with certain metallic oxides. On this property the author bases processes for the volumetric estimation of manganese and cobalt.

To estimate manganese, the manganous salt to be tested is added to a weak alkaline solution of potassium manganate, whilst constantly shaking, till the green colour has disappeared and the upper portion of the liquid is colourless. In this manner and without using a zinc salt, a precipitate of manganese dioxide, which settles quickly and renders the end reaction easily perceptible, is obtained free from manganous oxide.

The change is represented by the following equation:



Cobalt is determined in similar manner; a precipitate of cobaltous manganate, $CoMnO_3$, being obtained.—E. B.

On the Estimation of Sulphuric Acid in the Presence of Iron. P. Jannasch and Th. W. Richards. *J. Prakt. Chem.* **39**, 321–334.

THIS is the first of a series of researches undertaken at the request of Victor Meyer on some irregularities in quantitative analysis. On account of its great practical importance the estimation of sulphur in pyrites was first investigated.

Fresenius (*Zeits. Anal. Chem.* **16**, 339; *Chem. Soc. J.* 1878, 650) recommended determination of sulphur in pyrites by fusion with a mixture of sodium carbonate and potassium nitrate, solution, separation of insoluble peroxide and precipitation with barium chloride in usual way. Lunge (*Handb. der Soda Industrie*, **1**, 96) objects to foregoing as being too complicated, and prefers the wet way, i.e., solution in nitric acid and subsequent precipitation. Fresenius (*Zeits. Anal. Chem.* **19**, 53) in reply made a series of pyrites analyses by Lunge's method; he found an average result of 1 per cent. too low, and indicated two sources of error, viz., the invariable presence of iron in the precipitate and the solubility of barium sulphate in acid, especially in presence of ferric chloride. Lunge (*Zeits. Anal. Chem.* **19**, 419) explained that this solubility occurred only in hot solutions and that the barium sulphate separated on cooling. He ascribed the high result of Fresenius to the decomposition in fusing, and consequent estimation of the useless sulphur (Heavyspar and Galena).

The authors, as the result of a long and careful series of experiments (directed in the first place to prevent precipitation of iron), condemn Lange's process and insist on that of Fresenius being the only accurate and reliable method of estimating sulphur in pyrites.

Four experiments were made with absolutely pure prepared ammonium ferrous sulphate, in two of which the iron was oxidised; in each case the barium sulphate was more or less coloured, and in the ferrous solutions 0.8 per cent. too low of SO_3 was obtained, and 0.002 per cent. of peroxide present, while from the ferric solutions the SO_3 found was 1 to 2 per cent. below the theoretical amount, while an average of 0.0157 of Fe_2O_3 was present.

Three experiments with organic acids, citric, acetic, and formic acids being used, were made, but without effect in preventing precipitation of iron. Complete reduction with zinc was tried, but both zinc and iron oxides were found in the precipitate.

A second series of experiments was made. 10 cc. of normal sulphuric acid were diluted to same proportions as in previous series of experiments and the same amount of hydrochloric acid added. The result of four experiments showed an average of 0.3984, as against the theoretical 0.3995. 2.5 cc. of a standard Fe_2Cl_6 solution (made by dissolving 56.1 grms. piano wire in hydrochloric acid and oxidising with chlorine) were added to each 10 cc. of $\text{N.H}_4\text{SO}_4$ and the determination made. The average of five experiments showed 0.3833 only, as against the former series 0.3984; a loss of 0.051, while 0.0144 grm. of Fe_2O_3 was found in the precipitate.

Other experiments showed there was no barium sulphate in the filtrate, and since, though soluble in hot ferric chloride, it separates on cooling, the error must lie not in loss by solution, but in loss on ignition. Ferric oxide and barium sulphate were mixed and ignited, but no loss was sustained. A portion of iron-contaminated precipitate was ignited in a Gooch's crucible, and weighed successively after heating at 150° , 250° , 500° , 700° , and after ignition; the colour gradually darkened and from 250° the loss of weight was apparent.

Finally, another portion was ignited in a platinum boat in a current of air and the gas absorbed in water. The water was acid to litmus and gave a strong precipitate with barium chloride, showing the loss was due to escape of sulphuric anhydride.

The authors advance the theory that a double sulphate of iron and barium is precipitated, and that this decomposes at 250° , leaving ferric oxide. If the figures of the experiments with $\text{N.H}_4\text{SO}_4$ in absence and presence of iron be calculated out to Fe_2SO_4 and thence to BaO , a striking confirmation of this theory is obtained. Thus the authors support the process of Fresenius.—D. A. S.

Determination of Nitric Acid by means of Ferrous Sulphate. Bailhache. Bull. Soc. Chim. [3], 2, 9—13.

This is a modification of Pelouze's method in which ferrous sulphate is substituted for ferrous chloride. 50 cc. of a ferrous sulphate solution containing 100 grms. of the salt and 75 cc. of monohydrated sulphuric acid are placed in a 250 cc. flask, and 25 cc. more of the sulphuric acid added. The flask is provided with a rubber stopper fitted with a stop-cock funnel and an exit tube. It is placed in a hot sand-bath capable of heating five flasks at once. 25 cc. of a saturated solution of sodium bicarbonate are first added by means of the funnel to expel the air, and when this has been effected the solution of nitrate is run in. The nitric oxide comes off quietly, and when the evolution is ended another 25 cc. of the bicarbonate solution are added to drive out the last traces of the gas. The boiling is then continued for five minutes, the contents of the flask allowed to cool and made up with previously boiled water to the containing mark. The unoxidised ferrous sulphate is then titrated by potassium bichromate in an aliquot portion of the solution. Satisfactory analyses are given, the results obtained by this method compared with those got by the Schloesing-Grandean modification of Pelouze's method agreeing very well. The

ferrous sulphate solution keeps well when preserved in a flask attached to a CO_2 generator; its value must be fixed by the bichromate from time to time; five determinations can be effected within an hour if they are carried on simultaneously.—C. A. K.

On the Use of Standard Solutions of Ammonia. R. Rempel. Zeits. f. angew. Chem. 1889, 331—332.

If a normal or semi-normal solution of ammonia be titrated with standard acid the amount of ammonia found will be too low owing to its volatility, and the amount of loss is influenced by the time allowed to elapse before the titration is performed and also by the nature of the vessel in which the ammonia is titrated. Solutions were accurately standardised by adding the ammonia solution from a burette to the solution of acid. Titrations were then made by the reverse process, i.e., adding the standard acid to solution of ammonia, with the following results:—

Vessel in which the Ammonia Solution was Titrated.	Number of cc. of Normal Acid required to Neutralise 20 cc. Semi-Normal Ammonia.			
	Titration performed at once.	Titration performed after standing Five Minutes.		
	Litmus.	Methyl- Orange.	Litmus.	Methyl- Orange.
Erlenmeyer flask of 200 cc. capacity.....	10.00	10.00	10.00	9.97
Beaker of 200 cc. capacity.....	9.90	9.94	9.75	9.80
Deep porcelain basin...	9.70	9.75	8.90	8.80
Shallow porcelain basin	9.43	9.50	7.81	7.75

The author is of opinion that a semi-normal solution of ammonia is the strongest that should ever be used and prefers a weaker solution, and recommends that the standard ammonia be always added to the acid and the burette filled without allowing the ammonia solution to come in contact with the outside air.—E. E. B.

Examination of Sodium Carbonate. R. Kissling. Zeits. f. angew. Chem. 1889, 332—334.

Sodium carbonate is frequently used for standardising solutions of acid for volumetric analysis, although the author prefers potassium tetra-oxalate ($\text{KHC}_2\text{O}_4 \cdot \text{H}_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$), as its purity can be easily tested by igniting it and weighing the potassium carbonate. To render sodium carbonate quite anhydrous it is usual to heat it to redness before weighing out the quantity required for the standard solution, but the author has proved that sodium carbonate loses carbonic acid at as low a temperature as 500° , and that sodium carbonate which has been heated to that temperature invariably contains caustic soda. Anhydrous sodium carbonate can, however, be obtained by heating pure sodium bicarbonate in an air-bath at 150°C .

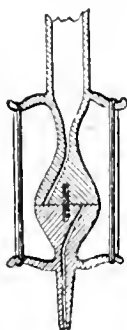
Dobbin's process for detecting sodium hydrate in the presence of sodium carbonate (this Journal, 1888, 829—830) is considered good, but it is pointed out that it cannot be used for determining sodium hydrate quantitatively in the presence of a large excess of carbonate. The addition of a trace of caustic ammonia to the double iodide solution is preferred to the trace of ammonium chloride recommended by Dobbin, and the solution should not contain an excess of potassium iodide. If a larger quantity of free ammonia be added ammonium carbonate and sodium hydrate would be formed.—E. E. B.

Determination of Lime in Presence of Phosphoric Acid, Iron, Aluminium, and Manganese. O. Reitmar. *Zeits. f. angew. Chem.* 1889, 357—362.

AFTER numerous experiments with Thomas slag as a convenient material, the author formulates the following process:—

The substance to be analysed is dissolved and the silica separated in the usual way, the solution containing all the bases being treated by Classen's process for the direct estimation of lime (Classen, *Quant. Analyse*, 2nd edit., p. 24, and *Zeits. Anal. Chem.* 1879, 391). The method described by Classen consists in treating the hydrochloric acid solution containing the substances enumerated in the heading with potassium oxalate in quantity sufficient to make oxalic acid the only free acid in solution; calcium oxalate separates, phosphoric acid being left in solution. The resulting calcium oxalate is free from phosphoric acid, but contains traces of the oxalates of the other bases present, especially that of manganese; after ignition and a repetition of Classen's process it is obtained pure, and can be weighed as oxide, or the oxalic acid titrated with permanganate solution. A shorter plan, but one somewhat less accurate, is to dissolve the first precipitate of calcium oxalate in hydrochloric acid, and to reprecipitate it in acetic acid solution. Using either method, filtration takes place readily.

The author recommends the use of the burette-tap shown in the figure, in place of the ordinary stop-cock for titrations



with permanganate. As will be seen, the upper and lower surfaces move over each other in a horizontal plane, being held in position by the central pivot and by the rubber bands at the side. These latter enhance, by their action under torsion, the ease with which the liquid may be allowed to fall in distinct single drops when nearing the end of a titration.—B. B.

Detection of Cochineal in Foodstuffs. *Jour. de Pharm. et de Chim.* 18, 489.

Lagorge makes an aqueous or dilute alcoholic solution of the foodstuff, acidifies with a few drops of acetic acid, and extracts with amyl alcohol. Water is added to the amyl alcohol solution and the mixture evaporated on the water-bath till the alcohol is expelled, and an aqueous solution remains. According to the amount of the colouring matter of cochineal present, a green-blue colouration or precipitate is produced on the addition of a 3 per cent. aqueous solution of uranium acetate. The colour changes to orange when acid is added. Ammoniacal carmine under the same conditions gives a red- or blue-violet, logwood a violet, peach-wood a brown-red, and elder berries a violet, precipitate or colouration.—E. B.

Colour-Reactions of Organic Compounds. *Zeits. Anal. Chem.* 28, 244—252.

E. NICKEL, in a recent publication, classifies in the order below the colour-tests commonly applied for the detection of organic bodies.

Colour-tests with Nitrous Acid, excluding the Formation of Azo-Compounds.—The reagents of Millon, Hoffmann, and Plügge, produce almost identical colourations with the mono-hydroxy- and methoxy-derivatives of aromatic hydrocarbons. The same reagents also give colourations with aromatic hydroxy-compounds, containing aldehyde- or carboxyl-groups, or side-chains in which hydroxyl- or amido-groups are present. One or two drops of the reagent are added to 1 cc. of the solution to be tested; usually the colouration is most intense when the mixture is heated to 60° or 70° or even 100°, but frequently, as with thymol, for example, heat destroys the colouration first produced. Only monophenols yield full colourations with Liebermann's reagent, the majority of polyphenols giving pale yellow tints, but, exceptionally, a full red colouration is obtained with orcinol. As the reaction proceeds in two stages, nitroso-phenols being formed in the first stage, which are then condensed with the unaltered phenols, the test can be so modified that phenols and sulphuric acid may be employed to detect nitrophenols. The author finds that, in some cases, a condensation in Liebermann's reaction may be effected with metallic salts. Thus vanillin gives a fine violet colouration on being heated with a solution of mercuric chloride containing potassium nitrite, and a solution of phlorizin becomes blue or violet when heated after the addition of zinc sulphate and a fairly large amount of potassium nitrite.

Colour-tests in which Azo-Compounds are produced.—

The sulphates of aniline and its homologues may be advantageously used along with potassium nitrite in Weselsky's reaction, instead of the nitrate of aniline and potassium nitrite recommended, or the diazo-salts may be directly used. Among substances of minor technical importance, red colourations are obtained with phloroglucinol, catechin, and maelurin. Phenols almost invariably yield yellow or brown colours, but resorcinol and phlorizin give red colours, as also do several aldehydes. To this group of reactions belongs also Ehrlich's test with para-diazobenzenesulphonic acid.

Colour-tests with Formation of Triphenylmethane- and similar Compounds.—

In the presence of acid such phenols as common phenol, catechol, resorcinol, quinol, pyrogallol, and phloroglucinol act as excellent colour reagents for aldehydes, and conversely aldehydes may be used to detect the phenols mentioned. As a reagent for detecting lignine, the author assigns the foremost place to phloroglucinol, which he considers better for the purpose than orcinol and resorcinol. Many aldehydes give colourations with the sulphates of aniline, toluidine, &c.; vanillin, for instance, as was shown by Singer, gives a yellow colour with aniline sulphate, as does also salicylaldehyde; on the other hand, no colouration is obtained with cinnamol. Of the glucosides coniferin alone gives a pale yellow colouration, when tested in solution with aniline hydrochloride, but a much deeper yellow when tested in the dry state, and especially after the addition of acid. The salts of aniline, &c. can also be used as reagents for lignine. Potassium hydrogen sulphite, it is stated, interferes with these tests. The reactions of Lustgarten and the furfural reaction of Stenhouse belong to this group.

Colour-tests with Salts of Iron and Chromic Acid.—

Ferric chloride gives colourations with a large number of organic bodies; it should be applied in the form of a dilute aqueous solution. Three classes of aromatic compounds yield colourations with ferric chloride, namely, compounds containing a hydroxyl- or an amido-group in the benzene nucleus and carboxylic acids. The influences of other additional hydrogen-replacing groups, both from the natures of the groups and their positions in the benzene nucleus, on the colourations obtained with the aromatic hydroxy-compounds, are fully considered in the original paper. In connexion with Sanio's proposal to employ potassium bichromate in the micro-chemical testing of astringent matters when dark red or brown precipitates are obtained, the author discusses the extent of reliance which may be placed on the indications of this reaction. Several phenols, namely, catechol, quinol, pyrogallol, and hot solution of α -naphthol, give brown colourations or precipitates; resorcinol does not give a colouration,

nor do guaiacol, oreinol, and phloroglucinol. Gallie acid gives a copious precipitate, but protoeatechnic acid gives only a colouration and no precipitate even in a concentrated solution. Certain amines, notably aniline and xyldine, also give brown colourations with bichromate solution. Lastly, attention is called to the colourations induced by the oxidising influence on the alkaloids of the chromic acid liberated by the use of an acid with bichromate solution.—E. B.

Test for Lanolin. Zeits. Anal. Chem. **28**, 256—257.

G. Vulpinus dispenses with the use of acetic anhydride in the detection of lanolin by the following test:—The solution of a few centigrammes of lanolin in 5 cc. of chloroform is carefully poured on to the surface of an equal volume of concentrated sulphuric acid, when a brown-red ring is produced, which increases in intensity for 24 hours, by which time small red-brown solid particles attach themselves to the sides of the test-tube immediately round the coloured ring, and the chloroform above the dark-coloured layer has a violet tint. On treating in the same way lard, wax, oil of almonds, olive oil, mineral grease, and tallow, only more or less yellow-coloured rings are produced; darker rings are produced with sperm oil and American vaselin, but the colouration obtained with vaselin is a pure brown, the chloroform being tinted similarly, whilst sperm oil alone gives a coloured ring resembling that obtained with lanolin when it is present in larger proportion than the latter.—E. B.

A New Reaction for Proteids. C. Reichl. Monatsh. Chem. **10**, 317—320.

THE proteids react with benzaldehyde in presence of sulphuric acid to form blue colouring matters. In testing a solution for the presence of proteids the aldehyde is added in small quantity; afterwards, sulphuric acid (50 per cent.) in large quantity; lastly, one drop of a solution of ferri-sulphate, the latter serving to intensify the reaction. Solid proteids are coloured blue under similar conditions of treatment. The reactions have been obtained with all the well-known proteids. In the case of dissolved proteids the limit of the reaction is reached with solutions of 0.03 per cent.

Similar reactions are obtainable with salicylic aldehyde and salicin; also with benzoyl chloride and benzotrichloride.

—C. F. C.

Estimation of Theine in Tea. Arch. de Pharm. **223**, 828.

Hilger recommends the following plan:—10 to 20 grms. of the sample of tea are submitted to three successive treatments with boiling water. A slight excess of basic lead acetate is added to the filtered extract, the precipitate being collected, washed, and decomposed with hydrogen sulphide. The filtered solution, from which the lead has thus been removed, is evaporated to dryness with addition of pure sand, granular marble, magnesia, or chalk. The dried mass is now thoroughly extracted with chloroform in a Soxhlet's apparatus, the residue, left after evaporation of the chloroform, being dried for three hours at 100° and weighed. By repeatedly crystallising the residue from water or alcohol, it may be obtained colourless.

Waage has examined 37 methods proposed or used for the determination of theine, and gives preference to the methods of Mulder, Fricke, Stahl Schmidt, and the one described above, but considers Mulder's method, with some slight modifications, the best. The modified method is as follows:—10 grms. of tea are extracted by four treatments with boiling water, taking altogether four hours' time. The filtered extract, measuring about 2 litres, is evaporated to a syrup, mixed with 2 grms. of pure calcined magnesia and 5 grms. of sand, and, after being thoroughly dried, is submitted to extraction with anhydrous chloroform in a Soxhlet's apparatus. The chloroform is evaporated, a slightly coloured residue being left, which contains fatty and resinous matters. These impurities are removed by

dissolving the residue in hot water and filtering; the filtrate is evaporated to dryness and weighed after being heated to 100° for two hours.

M. Hoffmann and R. Tittelbach also recommend Mulder's method, but the former considers it necessary to treat the aqueous extract with lead acetate to remove tannin and colouring matters as much as possible, precipitating the lead from the filtrate with hydrogen sulphide.—E. B.

On Testing the Purity of Commercial Reagents employed in Elementary Analysis. M. Nencki. Monatsh. Chem. **10**, 233—235.

THE author observes that a pamphlet by Dr. C. Krauch, "On the Testing of Chemical Reagents," omits to notice some of the impurities commonly found in the reagents used in organic analysis. The author finds that lime is a common impurity of cupric oxide, and has in one case found as much as 1.02 per cent. CaO, whilst a quantity of lead chromate obtained from a well-known chemical manufactory contained 13.27 per cent. of lead sulphate. He advocates the testing of these reagents, to avoid misleading results.—G. H. B.

Butter Analysis. L. F. Nilson. Zeits. Anal. Chem. **28**, 175—183.

THE author recommends the following method for determining the amount of volatile fatty acids in butter as being more accurate than the methods of Reichert, Hehner, and Koettstorfer. The clear ethereal solution of the butter-fat, separated from the milk by treatment with ether and potassium hydrate, according to Soxhlet's method, is poured into a beaker, the ether evaporated and the residue dried at 100° C. for half an hour. Whilst the residue is still warm, 2.5 grms. of it are weighed out into a Bohemian-glass flask of 200 cc. capacity, which is then placed in the balance case to cool, and when cold the weight of the butter-fat is adjusted to exactly 2.5 grms., then 5 cc. of a solution of alcoholic potash, made by dissolving 20 grms. of pure potassium hydrate in 100 cc. of 70 per cent. alcohol, are added. The butter-fat is next saponified by gently warming the flask for two minutes or so, and by continuing the heating for a similar length of time, the greater portion of the alcohol is driven off, what remains being removed by a stream of air passed through the flask whilst it is held in boiling water. It is very important that the last traces of alcohol be removed as otherwise ethereal salts are formed in the subsequent operations, and the percentages of volatile fatty acids found are too low. The saponified butter-fat, rendered free from alcohol in the above manner, is dissolved in 50 cc. of distilled water, a few bits of pumice added to prevent frothing, and then 20 cc. of an aqueous solution of pure phosphoric acid, containing 20 per cent. of orthophosphoric acid. The flask is then connected with a tube, about 1 metre in length, bent twice at obtuse angles at distances of 20 cm. and 10 cm. from the ends; the portion nearest the flask has preferably a bulb blown on it, the middle portion is surrounded by a Liebig's condenser. The flask is heated by a small flame and a volume of 50 cc. is distilled over at the rate of 1 cc. per minute. As a certain quantity of insoluble non-volatile fatty acids is always carried over with the steam, it is necessary to filter the distillate and to wash the filter-paper, condenser-tube, and measuring cylinder, with hot water free from ammonia; sometimes ether must be used to cleanse the condenser-tube. The water used for washing is added to the distillate, and the total volume made up to 100 cc.: two drops of phenolphthalein solution are added, and the solution titrated with decinormal potash solution which has been carefully standardised with the same indicator against a decinormal solution of sulphuric acid. The volume of standard alkali required indicates the quantity of fatty acids in the butter-fat. Very reliable results are obtained by this method, the volumes of standard alkali required in a number of tests of the same sample of

butter-fat differing by less than 0.1 cc. But the volatile fatty acids are not entirely separated by one distillation, for further but smaller quantities are obtained by repeating the distillation after adding 50 cc. of water to the residue in the flask. The volume of standard alkali required to neutralise the fatty acids obtained by repeatedly distilling the butter-fat from the morning and evening milk of two cows is shown below:—

	I.		II.	
	Morning.	Evening.	Morning.	Evening.
	Cc.	Cc.	Cc.	Cc.
1	14.27	14.35	16.00	15.92
2	1.35	1.40	1.45	1.51
3	0.58	0.60	0.60	0.58
4	0.35	0.38	0.37	0.39
5	..	0.27	..	..

According to Heintz the presence of the difficultly soluble lauric acid renders it impossible to completely separate the soluble from the insoluble fatty acids in Lehner's method, and the author suggests that it is this acid which is only partially distilled at one operation.

The following notes are appended:—

1. The amount of volatile fatty acids contained in colostrum-fat is very low; in two cases where tests were made the volumes of alkali required were respectively 9.27 and 10.0 cc.

2. The maximum amount of volatile fatty acids in butter is reached in from five to seven days after the calving of the cows, remaining constant a short time, then gradually diminishing till the close of the lactation period, at the end of which time the alkali index is rarely less than 12 cc., independently of the season of the year or the fodder.

3. Individuality also bears influence. One cow, for example, from the second month onwards yielded milk containing almost as good a quality of fat as that yielded by other cows at later periods.

4. The alkali index of the fat of normal milk varied between 20.5 and 11.45 cc. Out of 797 tests which were made, only 44 cases were met with in which a lower value than 12.5 cc. was found, and of these 12 were between 11.33 and 11.45 cc. From this it would appear that Reichert's minimum value, namely, 12.5 cc., is too high.

5. In disease the amount of volatile fatty acid is considerably reduced; in one instance, where a cow became ill, the alkali index fell from 16.85 to 10.10 cc.—E. B.

A Modification of Kjeldahl's Method. J. W. Gunning. Zeits. Anal. Chem. 28, 188—191.

The author recommends the use of a mixture of one part of potassium sulphate and two parts of sulphuric acid, instead of sulphuric acid alone, as employed in Kjeldahl's process. The two substances are fused together, forming when cold a semi-solid mass, which can be easily melted and poured from a warm vessel. 0.5 to 1 gram. of the substance to be analysed is heated in a round-bottomed flask of about 300 cc. capacity. Liquids after being acidified are evaporated down almost to dryness. There is considerable frothing at the commencement of the reaction, accompanied by the evolution of at first weak, then stronger, acid. The escape of acid may be prevented by employing an arrangement for condensing the vapours and returning them to the flask. The concentration of the acid in the flask must not be carried too far. As soon as the frothing begins to cease the reaction may be left to go on by itself, the heat, of course, being first regulated. The time necessary to complete the reaction varies, but has never, with the author, exceeded

1½ to 2 hours. Below are some of the results obtained by this method:—

	Weight of Substance Taken.	Percentage of Nitrogen	
		Found.	Calculated.
Bread.....	2 grms.	1.22	..
Milk.....	25 cc.	0.449	..
Uric acid.....	1 gram.	33.3	33.33
Acetanilide.....	1 gram.	10.34	10.37
Morphine.....	0.5 gram.	4.60	4.62
Aniline oxalate.....	..	10.0	10.1

It is pointed out that the success of the determination depends largely on the construction of the distilling apparatus. The author's experience leads him to use a wide (15—20 mm. diameter) distillation-tube, consisting solely of one piece, leading into the vessel which contains the acid. It is worthy of note that a small amount of alkali is extracted from the glass by the condensing water-vapour. This may be prevented by repeatedly rinsing the tube with hot acid before use. Lastly, the author finds that a titration, more exact than with litmus, may be made by the addition to the sulphuric acid used for condensing the ammonia, of a mixture of suitable amounts of potassium iodide and iodate, the liberated iodine being afterwards determined with a standard solution of sodium thiosulphate.—E. B.

Method for the Quantitative Estimation of Fat in Milk. T. Dietrich. Zeits. f. angew. Chem. 1889, 413—414.

The author uses the following method for the determination of fat in milk when many samples have to be treated at the same time:—

A strip of filter-paper about 27 cm. long and 8 cm. broad is tightly wound round a solid wooden cylinder 28 mm. in diameter, thus making a paper shell closed at the bottom and some 5—6 cm. high, like that used by Soxhlet for the determination of fat in feeding-stuffs. A similar shell of cotton wool is now made by winding a strip of prepared cotton wool (such as is used for surgical bandages), of the same dimensions, round a wooden cylinder 20 mm. in diameter. This is rammed into the paper shell, thus lining it with a layer of cotton wool 4—5 mm. thick; the hole in the centre is then loosely filled with cotton wool.

From 15—20 grms. of the milk, which, if sour, are first shaken with a few drops of strong ammonia, to make the liquid homogeneous, are poured into a weighing bottle, weighed, and then poured into the prepared shell, the bottle being weighed again. The shell is then placed upon a small glass dish, and dried at 60°—80°. If the shell has been carefully made, no milk will pass through on to the dish. When total solids are to be determined, the shell is dried till of constant weight; otherwise it is transferred directly to the Soxhlet extractor.

The author finds that his shells, which, on an average, consist of 1.5 grms. of paper and 2—2.2 grms. of cotton wool, contain nearly 0.01 gram. of fat, which must be allowed for in accurate analysis.

The Soxhlet extraction tubes are ground into the condensers, and also into the weighed ether flasks, three of which are supplied to each extractor, thus preventing loss of time.—A. G. B.

New Books.

WATTS' DICTIONARY OF CHEMISTRY. Revised and entirely rewritten by H. FOSTER MORLEY, M.A., D.Sc., and M. M. PATTISON MUIR, M.A., assisted by eminent contributors. In four volumes. Vol. II. London: Longmans, Green, & Co. New York: 15, East 16th Street. 1889.

OCTAVO volume strongly and handsomely bound, price 42s. This, the second volume issued, contains Introduction to the Articles relating to Organic Chemistry by Dr. Morley, List of the Special Contributors, Table of Abbreviations used in the work, and text covering 760 pages, commencing with C (Chenocholic Acid) and ending with I (Indigo). With regard to the strictly systematic and methodic manner of treating a subject this requires to be utilised by frequent practical reference in order to be properly appreciated, and doubtless it will be found to be of the greatest service in the rapid search after facts where time is limited and practical investigation is waiting. For a brief *exposé* of this method given in our notice of Vol. I. see this Journal, 1888, 351. In the present volume, as an example of concise and method treatment of a subject at once of theoretic and technical interest, see article CITRIC ACID, whilst that on CHEMICAL CLASSIFICATION is clearly and ably expounded, withal condensed into a surprisingly brief space. Of considerable importance and value are the articles on Crystallisation, Dissociation, Chemical Equilibrium, Equivalency, Explosion, Fermentation and Putrefaction, and Flame. An important contribution is also that on "Geological Chemistry."

Attention may also be called to the articles on "GLYCERIN" and "INDIGO," which latter concludes the volume. In two cases the observance of the rules as to terminology of late years adopted by the Chemical Society is missed, for we find here the terms "Glycerin" and "Resorein," instead of Glycerol and Resorcinol.

WATTS' MANUAL OF CHEMISTRY. (Based on Fownes' Manual.) Vol. I. Physical and Inorganic Chemistry. Second Edition. (Fourteenth Edition of Fownes.) By WILLIAM A. TILDEN, D.Sc., F.R.S., Professor of Chemistry in the Mason College, Birmingham. London: J. and A. Churchill, 11, New Burlington Street. 1889.

THIS volume commences with a short sketch of the more important Elementary Bodies, the principal Laws of Chemical Combination, and the representation of the constitution and reactions of bodies by Symbolic Notation. The next section contains a description of the Non-metallic Elements, and the more important compounds which they form with one another; and this is followed by a discussion of the general principles of Chemical Philosophy. In this part of the work the Laws of Chemical Combination and Decomposition and the principles of the Atomic Theory are more fully developed. The last section is devoted to the Chemistry of the Metals. Tables of Hydrometer and Thermometric degrees, &c., are given at the end of the book, and a full Alphabetical Index.

The work commences with the author's preface, and then follows a somewhat novel though exceedingly desirable feature, viz., a few "Directions to the Student" in reading and using the book. The TABLE OF CONTENTS follows, then comes the INTRODUCTION, and then the general text, covering 525 pages, and interspersed with 122 effective wood-engravings.

The book is bound in black cloth, is of 8vo. size, and its price is 8s. 6d.

A TEXT-BOOK OF ORGANIC CHEMISTRY. By A. BERNTHSEN, Ph.D., formerly Professor of Organic Chemistry in the University of Heidelberg, &c. Translated by GEORGE MCGOWAN, Ph.D., Demonstrator in Chemistry, University College of N. Wales (Bangor). [The original text specially brought up to date by the Author for this edition.] London: Blackie & Son, 49 and 50, Old Bailey, E.C., Glasgow, Edinburgh, and Dublin. 1889.

The German edition of this work was noticed on its appearance (this Journal, 1888, 405). It has been highly

praised in the German press, and hence an English translation was to be looked for as a desirable consummation. The present book resembles in size and style the German one, and that the accurate expression of the author's views might be secured, Dr. McGowan submitted the proof-slips to Professor Bernthsen's personal revision.

It will be observed that type of two sizes has been employed in the work, in order that the matter which is of the greatest importance, either in itself or for the purposes of a general review, may be readily distinguished.

The treatment of the theoretical matter is, especially in the first half of the book, purely inductive; the isomeric relations of the paraffins, for instance, are first referred to under Butane, and no constitutional formula of any important compound is given without the grounds for it being indicated. The inductive method is also retained even where, as in the case of the theory of the benzene derivatives, the historical development has run on other lines. In accordance with this the class definitions are based not on theoretical but on actual relations. After the Table of Contents, preceded by Author's and Translator's Prefaces, comes a list of "Additions and Corrections," and this is followed by the text, covering 519 pages, and a full Alphabetical Index. For the general sub-division of the subject, we refer to the notice of the German edition (this Journal, 1888, 405). The size is medium 8vo., and the price 9s.

CHEMICAL TECHNOLOGY, OR CHEMISTRY IN ITS APPLICATIONS TO ARTS AND MANUFACTURES. Edited by CHAS. EDWARD GROVES, F.R.S., Editor of the Journal of the Chemical Society, and WILLIAM THORP, B.Sc. With which is incorporated Richardson and Watts' Chemical Technology. Vol. I.—FUEL AND ITS APPLICATIONS. By E. J. MILLS, D.Sc., F.R.S., and F. J. ROWAN, C.E. Edited by C. E. GROVES, F.R.S. London: J. and A. Churchill, 11, New Burlington Street. 1889.

LARGE 8vo. volume, strongly bound in red cloth, price 30s. The work is based upon that of Richardson and Watts, which was itself based on that of Ronalds and Richardson, which was again founded on the German work of Knapp.

It is now announced, and the announcement will be welcomed, that the entire work, of which the present issue forms the first volume, will be divided into sections, of which the most important are—Fuel and its Applications; Lighting; Acids and Alkalis; Glass and Pottery; Metallurgy; Textile Fabrics; Leather, Paper, &c.; Colouring Matters and Dyes; Oils and Varnishes; Brewing and Distilling; Sugar, Starch, Flour, &c.

The present comprehensive work comprises Table of Contents, and a still larger one of Illustrations, which form an important feature of the book, and most of them are splendidly executed. There are no less than 607, and, besides these, five plates, that on page 36 representing Microscopic Sections of Coal, being beautifully executed and coloured.

To give an idea of the extent of the treatment of the subjects, the sub-divisional headings are now given—Wood; Turf or Peat; Coal; Effect of Heat on Fuels; Wood Charcoal; Coke; Distillation of Peat; Artificial or Patent Fuel, Briquettes; Gaseous Combustibles; Liquid Fuel; Minor Fuels; Theory of Heat; Flame; Application of Fuel; Domestic Heating; Heating by Means of Hot Air; Hot-blast Stoves; Heating by Water and Steam; Application of Fuel to Vaporisation; Evaporation; Distillation; Drying; Ovens for baking Bread; Brick and Porcelain Kilns; Furnaces; Gas Furnaces; the practical Effect of Fuel; Analytical Tables of various kinds of Coal and other Fuel. APPENDIX. The General Principles of Coal Washing.

The illustrations represent—I. Boiler Furnaces. II. Briquette Apparatus. III. Calorimeters and Pyrometers. IV. Charcoal Ovens and Apparatus. V. Chemical Furnaces. VI. Coal Washing Apparatus. VII. Coke Ovens. VIII. Evaporating and Distilling Apparatus. IX. Fire-damp Indicators. X. Fire-places, Grates, and Stoves. XI. Furnaces and Cupolas. XII. Gas-fired Boilers. XIII. Gas Producers. XIV. Gas Stoves and Gas Fires. XV. Heating Apparatus. XVI. Heating Gas Retorts. XVII. Hot blast Ovens and Stoves. XVIII. Kilns and Ovens. XIX. Liquid Fuel Apparatus. XX. Mechanical Stokers. XXI. Miscellaneous.

AMMONIA AND AMMONIUM COMPOUNDS. Comprising their Manufacture from Gas Liquor, and from Spent Oxide (with the recovery from the latter of the by-products, Sulphur, Sulphocyanides, Prussian blue, &c.), special attention being given to the analysis, properties, and treatment of the raw materials and fuel products. By Dr. R. ARNOLD. Translated from the German by HAROLD G. COLMAN, Ph.D., M.Sc. London: Sampson Low, Marston, Searle, and Rivington, Limited, Fetter Lane, Fleet Street, E.C. 1889.

This is a small 8vo volume, bound in cloth, price 5s., containing Preface, Table of Contents, text covering 126 pages, and an Alphabetical Index. With the text are interspersed nine wood engravings, and the Appendix, from pages 111 to 120, comprises a useful series of Tables of Specific Gravities of Ammonium Sulphate Solutions, with corresponding percentages of real Sulphate; of Sal-ammoniac Solutions, Caustic Ammonia Solutions (Carius), Sulphuric Acid (Kolb), Hydrochloric Acid and Nitric Acid (Kolb), &c.

A Synopsis of Recent Literature and Recent Patents is finally given.

Trade Report.

(From Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

RUSSIA.

Importation of Oil of Bitter Almonds.

According to a decision of the Imperial Council approved by the Emperor of Russia, Article 250 of the Customs Tariff, which prohibits the importation of oil of bitter almonds, is abolished, and this article will in future pay import duty according to paragraph 2 of Article 144, or 15 roubles 85 copecks gold per pond.

THE NETHERLANDS.

Classification of Articles in Customs Tariff.

According to the *Moniteur Belge*, the following decisions affecting the classification of articles in the Netherlands Customs Tariff have recently been given by the Netherlands Customs authorities:—

Medicinal capsules are free from import duties.

Liquid creoline is assimilated to oils not specially distinguished, and pays, consequently, 0.55 florin per 100 kilogrammes.

SWITZERLAND.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220.4 lb. avoirdupois. Franc = $9\frac{5}{16}$ d.

The following decisions affecting the classification of articles in the Swiss Customs Tariff were given by the Swiss Customs authorities during the month of August last:—

Liquid ammonia, in receptacles of wrought iron.—Category 9a. Duty, 7 francs per quintal.

Gun-cotton, for the manufacture of collodion (*collodum-*

wolle) (less explosive, and containing less nitric acid than gun-cotton used as an explosive material).—Category 21. Duty, 40 francs per quintal.

Apparatus of copper for distillation.—Category 105. Duty, 4 francs per quintal. This article is taken out of Category 139.

FRANCE.

Customs Decisions.

Circulars have been issued by the French Customs Department giving the following decisions in regard to the classification of articles in the French Customs Tariff, and to the application of the Customs Law:—

The duty of 5 per cent. *ad valorem* at present applicable, according to the general tariff, on sulphate of quinine imported from abroad, will in future be converted into a specific duty of 250 francs per 100 kilogrammes, without distinction of quality.

Bronze of silicium is assimilated, for payment of duties, to ordinary bronze.

Wine lees declared for temporary admission for the purpose of making cream of tartar and tartaric acid to be re-exported, are to be analysed by the Customs official in order to determine the strength of the lees.

PORTUGAL.

The Customs Treatment of Saccharin.

A despatch, dated the 4th September last, has been received at the Foreign Office from Mr. Petre, Her Majesty's Minister at Lisbon, enclosing copies and translation of a Royal Decree of the 20th August, fixing the import duty on saccharin for consumption in apothecaries' shops in Portugal at 15,000 reis (3*l.* 6*s.* 8*d.*) per kilogramme. Saccharin, where pure or mixed, and any articles of food containing the same, is, according to the decree notified in p. 249 of the September (1888) number of the *Board of Trade Journal*, and subject to the above exception, prohibited to be imported into the continental part of the kingdom of Portugal or into the adjacent islands.

ROUMANIA.

Reduction of Import Duty on Pharmaceutical Preparations and Compounded Medicines.

The *Deutsches Handels-Archiv* for the month of September says that a Roumanian law of the 22nd June last, provides as follows:—

The Customs duty on pharmaceutical preparations or compounded medicines provided for in Article 146 of the "Autonomous" Tariff is reduced from 10 francs to 3 francs per kilogramme.

DUTY ON BUTYRIC ETHER.

A general order has been issued by Her Majesty's Customs to the effect that the Treasury have directed, with reference to the provision contained in the Schedule to the Act 39 & 40 Vict. cap. 35, that a duty of 15*s.* a gallon be charged on butyric ether, upon importation into Great Britain and Ireland, that being the sum which may be taken as equivalent to the duty on the quantity of spirit used in its manufacture.

This duty will be levied on and after the 1st day of October 1889.—*London Chamber of Commerce.*

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

1. IMPORTS INTO THE UNITED KINGDOM FROM SPAIN.

PRINCIPAL ARTICLES.	Three Months ending September	
	1888.	1889.
Chemical products unenumerated .Value £	9,393	4,248
Copper ore and regulus { Tons 21,757 20,949		
{ Value £ 542,480 362,561		
Manganese ore { Tons .. 3,630		
{ Value £ .. 9,210		
Oil, olive..... { Tons 27 1,004		
{ Value £ 972 37,280		
Pyrites of iron or copper { Tons 127,027 115,414		
{ Value £ 241,695 225,643		
Quicksilver { Lb. .. 132,186		
{ Value £ .. 12,027		
Rags and esparto..... { Tons 16,782 13,916		
{ Value £ 100,424 82,989		
Total Value..... £	2,327,633	2,316,390

2. EXPORTS OF BRITISH AND IRISH PRODUCE FROM THE UNITED KINGDOM TO SPAIN.

PRINCIPAL ARTICLES.	Three Months ending September	
	1888.	1889.
Alkali..... { Cwt. 67,759 79,439		
{ Value £ 19,688 22,797		
Caoutchouc, manufactures of..... Value £ 5,414 5,526		
Cement { Tons 3,245 1,737		
{ Value £ 5,963 3,497		
Chemical products (including dye-stuffs) Value £ 16,321 14,684		
Coal, products of (including paraffin and petroleum) Value £ 9,271 3,855		
Glass manufactures Value £ 2,190 2,682		
Grease, tallow, and animal fat... { Cwt. 7,745 771		
{ Value £ 7,378 704		
Manure Value £ 30,537 27,360		
Oil, seed { Tons 94 79		
{ Value £ 1,913 1,728		
„ other sorts..... Value £ 5,025 7,014		
Painters' colours and materials.... Value £ 8,314 8,734		
Soap { Cwt. 544 702		
{ Value £ 575 789		
Total Value..... £	922,242	1,076,120

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

POISONING FROM CANNED PROVISIONS.

The following is an extract from a report to the Foreign Office, dated the 23rd August last, by Captain W. F. Segrave, Her Majesty's Consul at Baltimore, on the subject of canned goods deleterious to health put up in the United States:—

“Commercially all canned provisions that are hermetically sealed are packed in cans made of tinplate, *i.e.*, sheet iron superficially alloyed with tin.

“This article is imported exclusively from England, and is subject to an import duty of one cent per pound. The

average import for the past three years has been 3,600,000 boxes, which paid in duties 3,960,000 dollars. There is no tinplate manufactured in the United States, and yet, with nothing in the tinplate trade to protect, the duty of a cent a pound is still imposed on it.

“One hundred and thirty millions of cans are every year manufactured in Baltimore city alone, and two million pounds of solder are consumed in making them.

“Equal parts of block tin and lead form the best solder, but no doubt a baser description of solder, composed of a larger proportion of lead, is by no means uncommon. A flux of powdered resin, or a much more deleterious flux composed of chloride of zinc, containing free muriatic acid, is applied to the tinned surface to be soldered, and this the unfortunate and dangerous practice is, to apply on the *inside*.

“The use of an acid flux for inside soldering is objected to as a possible source of danger, whereas in cans where resin is used, it is asserted, and no doubt with good reason, that it communicates its taste to the contents of the can.

“To obviate both objections, the law, which is compulsory as well in France as in Germany, should be passed and enforced in this country, to the effect that all cans containing articles of food should be soldered on the *outside*.

“Laudable efforts have no doubt been made by the trade to abolish entirely *inside* soldering, but not as yet with such entire success as they deserve.

“The first danger from the inside surface of solder is the direct solvent action on the lead of an acid fluid, when acid vegetables or fruit are preserved without syrup. The second source of danger is from galvanic action.

“There is one special hermetically sealed product which even in this country and in the trade has a peculiarly evil reputation, and that is the American sardine, in which there is great possibility of danger as at present put up.

“Notwithstanding the label is French, in the well-known yellow and black letters, the contents are not sardines, nor are they put up in ‘huile d’olive pure,’ but in cotton-seed oil.

“Professor Tonry, of this city, states in a report: ‘I have now before me one of these sardine tins, with the solder on the inside, and fully one quarter of the interior surface of the metal eaten away.’

“The fish that were contained in this tin were nearly all eaten by three persons, two of whom were children, and all were taken sick within half an hour after consuming them. The child who had eaten most freely died in 24 hours.

“I made a chemical examination of the viscera and found lead; lead was also found in the oil and remaining contents of the tin. A coroner's inquest was subsequently held, the verdict found being that death resulted from lead poisoning from a sardine tin improperly soldered.”

THE PRODUCTION OF HENEQUEN IN MEXICO.

With reference to the notice on pp. 421—22 of the April number of the *Board of Trade Journal*, a further despatch, dated the 27th August last, has been received from Sir F. C. E. Denys, Her Majesty's Chargé d'Affaires at Mexico, giving the following information on the subject of the production of henequen in Mexico, but more particularly in Yucatan:—

“The great activity in the henequen industry of Yucatan is steadily maintained, the value of the fibre exported during the first seven months of the year amounting to over 7,000,000 dols. (1,005,100*l.*).

“The ports to which it has been chiefly sent are New York, New Orleans, Boston, Havana, Hamburg.

“The small outlay required to make a plantation of henequen, the little care necessary when once the plant has begun to yield, and the immense profits to be derived from the sale of the fibre at the current price, namely, 26 reals the arroba (9*s.* 8*d.* for 25 lbs.), have naturally attracted much attention, and efforts are being made to introduce the plant into other parts of the Republic where the soil offers the necessary features for its successful cultivation.

“The *Diario Comercial*, in a recent number, states that samples of fibre taken from plants grown at Solidad, in the State of Vera Cruz, have been pronounced in New York to be of a superior quality, and to have realised higher prices than the fibre from Yucatan.

"In the neighbourhood of Alvarado, in the same State, the *Diario Comercial* mentions that some 140,000 plants have already been planted, and it is considered probable that the cultivation of henequen, if it prove successful, will here supersede that of cotton, which the dampness of the climate and the ravages of the numerous insects have been rendering less profitable year by year.

"The planters of Yucatan, who are now making large fortunes, may therefore have to contend with a brisk competition in the near future."

THE REIHLEN CHAMPAGNE PROCESS.

United States Consular Reports, May 1889, p. 79.

Champagne, as is well known, is but an ordinary wine charged with carbonic acid gas. The process by which it is made requires time, labour, and skilful manipulation. It begins late in the spring with the wine of the preceding autumn.

In such wine the fungi are still alive and vigorous enough, upon due provocation, to continue the work of fermentation. Older wine, it has been held, could not be employed, because the fungi had, it was thought, become sterilised.

About 2 per cent. of sugar having been put into the bottles they are recorked. Fermentation sets in with production of alcohol and carbonic acid; but there is also at first a muddying of the wine followed by a thick deposit upon the sides of the bottle. Tannin and alum are introduced to loosen this, the bottles are gradually inverted, and at last the whole deposit is collected on the cork. All this is attended with a loss of from 15 to 25 per cent. of the bottles and their contents, so uncontrollable does the pressure become.

The bottles are then "disgorged," that is, the corks are skilfully drawn, the deposit allowed to escape, and sugar brandy and strong wine are added to replace the loss. The champagne is then recorked and is ready for the market.

This involves immense labour, and Herr Adolph Reihlen of Stuttgart set to work to minimise this labour and waste. The method he pursued is based upon the following lines:

In 1833 Schwamm discovered that the deposit thrown down by wine contained countless minute parasitical plants of various orders.

These were recognised as the agent in fermentation, and Reihlen found that these organisms were not confined to wine, but existed throughout the whole vegetable kingdom, and could be induced to settle from the air upon suitably prepared vegetable fibre. Herr Reihlen's apparatus is such that large quantities of wine in one body can be subjected to the fermentation process by means of germs caught from the atmosphere on wood-fibre moistened with sugared water. This fibre is not thrown loosely into the receiver, but is held in a sort of basket, so that it can be withdrawn at pleasure, and with it the sediment which in the old process gave so much trouble.

There being a fixed ratio between the pressure upon the receiver and the advance of the champagne process, it is easy to determine how rapidly the contents can be drawn off as a finished product, and the equivalent of the raw material, wine and sugar, added to make the process continuous.

It was in 1885 that the first bottle of this new champagne was sold. The production is now 6,000 bottles a day. A champagne undistinguishable, it is claimed, from the best French brands is furnished at less than 30 cents. (15*d.*) a bottle.

From the first the new champagne has been in use in the hospitals of Stuttgart and elsewhere, and is pronounced upon authority to be perfectly pure.—C.G.C.

DYEWOODS IN BORDEAUX.

United States Consular Reports, May 1889, p. 84.

There are 15 dye-works in Bordeaux, and the principal dye-wood employed is campeachy wood, imported from Yucatan, the Antilles, Hayti, and South America. Its colour is a vinous red, slightly shading to blue, and produces violet, black, red, yellow, grey, &c., according to the acid substances employed with it.

Yellow wood is also used. The finest comes from Cuba, and is principally used in silk dyeing.

Pernambuco wood or Brazil wood is found near Pernambuco. The price is high, being from 30*s.* to 50*s.* per cwt. owing to which only a small quantity is imported into France. The colour is a positive but beautiful red. Other species, found in the West Indies and Central America, are either reddish-yellow or dark red, which changes to a dark brown when exposed to the air. The derived tints are light red and amaranth, and it is employed to produce a more positive madder-red, and to apply colours on wool, silk, and cotton. The colours, however, are not durable, but can be rendered more so by steaming, or by the addition of gall or sumac. Redwoods are divided into two classes, extractive and non-extractive. The extractive species are imported from Brazil and other parts of America, and includes also the Sapan wood from the East Indies. Chili and Colorado woods are especially esteemed; the colour is pale or brownish-rose. Bahia wood of good quality is violet-red in colour. Sapan wood is pale in colour, but develops a beautiful bright red. Non-extractive woods are sandal, catechou, and camwood. These woods only yield their colouring matter to alkalis. Sandal wood and camwood come from Africa and catechou from the West Indies.

—C. G. C.

IMPORTS AND EXPORTS OF EXOTIC WOOD AT PORT OF BORDEAUX.

Years.	Imports.	Exports.
	Lb.	Lb.
1882	2,158,730	31,602
1883	4,396,336	302,696
1884	3,324,456	19,990
1885	5,319,860	37,976
1886	3,639,468	584,172
1887	5,297,862	1,117,276
Total.....	24,136,712	2,093,712

—C. G. C. 1

MANUFACTURE AND USE OF ALCOHOL IN FRANCE.

United States Consular Reports, May 1889, p. 176.

On the 14th December 1875 the French Assembly enacted a law providing that all farmers and fruit-growers might distil wines, lees, ciders, plums, and cherries grown on their own property without license or previous declaration and free from all supervision by the revenue officers of the State. This system has now endured for 13 years, and, it is alleged, has led to such serious frauds and such deplorable effects upon the wine market, that it is now demanded that free distillation shall be suppressed and all manufactures of alcohol subjected to uniform control and taxation.

The following facts and statistics have been elicited during the discussion. The native wine product of France has declined from 56,405,000 hectolitres (1,490,153,885 gals.) in 1877 to 24,333,000 hectolitres (642,805,861 gals.) in 1887. The point of interest is to examine how the product of alcohol has varied in relation to the yearly vintage.

While, therefore, the production of alcohol has increased nearly 20 per cent. during the 12 years, the annual distillation of alcohol from wine has fallen from 545,994 hectolitres to 32,758 hectolitres, or 1 gal. in 1887 for each 17 gals. in 1876.

It requires from 7 to 8½ gallons of wine to make one of brandy, so that the whole amount made in 1886—87 could not have exceeded 80,000 hectolitres. Comparing this with the quantity of so-called eogne drunk and exported we obtain some idea of the proportion to which the manufacture from other substances has grown. A large part also of the alcohol made by farmers is used for fortification of wines, and this was especially the case in 1888.

Year.	Alcohol produced from the Distillation of								Total.
	Farinaceous Matters.	Molasses.	Beets.	Wine.	Cider.	Lees, Dregs, &c.	Fruits.	Other Matters.	
	Hectolitres.	Hectolitres.	Hectolitres.	Hectolitres.	Hectolitres.	Hectolitres.	Hectolitres.	Hectolitres.	Hectolitres.
1876	101,102	710,670	243,337	545,994	22,388	76,227	1,228	7,929	1,709,175
1877	163,204	642,709	272,883	157,570	9,468	56,191	1,062	5,796	1,308,881
1878	180,469	646,715	331,716	102,952	9,822	51,079	978	3,496	1,417,227
1879	247,171	723,631	364,714	102,651	7,265	36,831	438	5,178	1,487,879
1880	412,585	685,433	429,878	26,200	3,317	17,373	624	4,658	1,581,068
1881	506,273	685,646	563,240	34,324	2,291	24,621	603	4,289	1,821,287
1882	447,066	703,989	556,056	21,962	9,829	22,893	718	4,058	1,766,566
1883	561,932	750,637	629,998	22,710	8,088	28,918	1,408	7,325	2,011,016
1884	481,001	778,714	569,257	35,251	15,567	43,266	2,799	4,609	1,934,464
1885	567,768	728,523	495,451	23,240	20,908	43,853	7,680	7,028	1,864,514
1886	789,963	471,781	683,985	19,513	28,600	49,311	4,124	4,673	2,052,250
1887	765,050	451,826	672,352	32,758	13,595	41,872	2,886	25,796	2,005,635

NOTE.—1 hectolitre = 26·417 gallons.

The present law enables low and deleterious grades of alcohol to be made from figs, dates, beets, and other substances, and to be used while warm from the still in fortifying artificial wine made from dried grapes and water. Accordingly it is proposed to suppress the present right of free distillation by cultivators, and introduce supervision by revenue officers of all distillation, reserving to actual wine-growers a privilege of strengthening their vintage to a limit of 2 per cent. free of tax, with alcohol made from wine grown on their own premises.—C. G. C.

MISCELLANEOUS TRADE NOTICES.

DISCOVERY OF PETROLEUM SPRINGS AT ZANTE.

It is announced in the *Revue de l'Orient* that petroleum springs have been discovered at Zante. The quality of the oil having been found very good for lighting purposes, a foreign company has applied for the concession to work the springs, on condition of having a monopoly of the sale for local consumption.

THE DISCOVERY OF A RICH SILVER MINE IN JAPAN.

The *London and China Telegraph* of the 17th September contains the following particulars of the recent discovery of a rich silver mine in Japan:—

South of the city of Furuhiro, in Shiribishi territory, at a point where the river divides into two branches, the Inakura and Ishinosawa, and familiarly known by the name of Futatsumata (two branches), is situated the Furuhiro mine. It was first discovered on July 10, 1885, by three wood choppers. Ten days afterwards they applied for permission to work the mine. A charter was granted in February of the following year, and on March 2 operations were commenced. Scarcity of capital, however, compelled them to abandon the enterprise when only a depth of 13 feet, by 15 feet wide, had been reached. But immediately their charter had expired an officer of the Hokkaido Mining Company sought and obtained the permission of the discoverers to work the mine, and then renewed the charter. Work was recommenced on May 24 this year, under the superintendence of Mr. Kono, an engineer, and the mine has already proved to be of a most fertile character. Thirteen veins have been struck, and it is expected that more will be found. It is also stated that the precious metal lies in the bed of the river. Five pits are now being worked by the company. One of

these, the Shachihoki (Grampus) was found to be very rich in silver when only a depth of 30 feet had been reached. When analysed, the best yields were found to contain $1\frac{1}{2}$ per cent. of silver, middle .4 per cent., and common .2 per cent. silver and .04 $\frac{1}{2}$ per cent. gold. We cannot expect that the output will continue so abundant, but if experienced engineers were employed it would not be difficult to maintain an average of .5 per cent.

ESTABLISHMENT OF A DYNAMITE, SULPHURIC ACID, AND SULPHATE OF AMMONIA FACTORY IN THE ARGENTINE REPUBLIC.

According to the *Bulletin des Musées Commerciaux* there has been established at Zarate, on the Parana, a factory for dynamite, sulphuric acid, and sulphate of ammonia. This establishment is placed under the direction of an Italian engineer. Up to the present the products in question have been imported from Europe.

CANADIAN SUGAR.

The *Canadian Manufacturer* says that "there is no sufficient reason why Canada should not produce all or the greater part of the sugar it consumes, seeing that the soil and climate are eminently well adapted to the growth and cultivation of the sugar beet. Some spasmodic efforts have been made in this direction in the province of Quebec, and indeed there is now a large and well equipped factory there, at Berthier, for the manufacture of sugar from this vegetable. The fact has been satisfactorily established that beets grown in the vicinity of Berthier possess as large an amount of saccharine matter as any grown under the most favourable circumstances in France, Germany, or Austria; and it is equally certain that not only that particular locality, but about all the available lands in Quebec, Ontario, and the North-West are equally well adapted to that industry."

AGRICULTURAL AND INDUSTRIAL PRODUCTS OF GREECE.

See *Board of Trade Journal* for October, pp. 460—464.

THE MARGARINE TRADE IN SWEDEN.

Ibid., pp. 465—466.

TRADE AND NAVIGATION OF BURMAH.

Ibid., pp. 467—472.

QUICKSILVER IN TUSCANY.

The mining district of Monte Amiata is situated in the province of Grosseto, near the railway station of the same name on the line from Grosseto to Siena.

The Penna mountain consists, beginning at the top, of the following strata:—A circular belt of nummulitic and madreporic limestone of Eocene age; marly manganese shales and limestones of very fine texture and containing calcite in the numerous fissures; marly non-manganese limestones. The principal deposits of cinnabar are found in these limestones in irregularly distributed masses of irregular form; greyish madreporic siliceous beds; small veins filled with very pure cinnabar form an irregular network in these siliceous beds; marls and limestones, similar to alberese limestone, with a network of fissures filled with calcite.

The cinnabar is found in beds and veins. At Siele, the small irregular veins were followed downwards, and at a depth of 360 feet, the most valuable deposits of cinnabar were found in the marly limestones. At Cornacchino the small veins in the siliceous rocks were followed upwards until the deposits were found in the limestones. Usually the clays, impregnated with cinnabar, fill the irregular cavities in the marly limestones. The proportion of cinnabar in the clays is sometimes so small that the ore is only discerned by rubbing the surface of the clay so as to break the particles of cinnabar and produce a red colour. The cavities appear to be all inter-communication, and sometimes contain a breccia of limestone and clay. The clay is sometimes filled with a network of small veins of cinnabar.

The cinnabar is sometimes accompanied by sub-sulphides of mercury (Hg_2S) known as "neri," and native mercury. Iron pyrites and gypsum are associated with the cinnabar in the clays but not in the veins.

Deposits of stibnite (tersulphide of antimony) are found associated with the cinnabar.

The percentage of mercury varies from 2 to 30 per cent. in the mineral, and is concentrated up to 25 or 35 per cent. The ore is washed with rakes in small rectangular boxes. The mineral is then mixed with about 20 per cent. of quicklime and placed in retorts and heated; the mercury which distils over is condensed. The plant appears similar to that used for gas making. One ton of wood is used per ton of mineral, and each operation lasts about seven hours.

The wages paid for 12 hours' shifts (less intervals for meals) are:—Miners, 31 cents; labourers, 25 cents; timberers, 41 cents; waggon-men, 41 cents; women, 12 cents, and an allowance of 4 cents per day to each miner for lamp oil.

The produce of mercury has been:—In 1873, 116 tons of 2,240 pounds; 1876, 111 tons; 1877, 130 tons; 1878, 115 tons, and the production has since gradually increased to 237 tons in 1885.

The cost of production is about 300 dols. per ton or, say, 13 cents per pound, and the selling price in London varies from 37 cents to 50 cents per pound.—*Annales des Mines*.

THE PETROLEUM SITUATION.

Contrary to expectation, the returns from the wells for July show a falling-off in production when contrasted with those of the preceding month. The total number completed was 533, giving a production of 7,022 barrels daily, against 555 wells and a production of 7,650 barrels. The decrease in the number of completed wells is thus 22, and of new production 628 barrels. The average yield from the new wells has fallen to 13·17, which is the smallest yield since December last. A very large number of those drilled proved quite unproductive, and this fact has tended naturally to discourage "wild-cat" ventures. The increased price of certificates has for some time acted as a stimulus to drillers, but the general results are so unsatisfactory that the occupation is by no means a profitable one. Every effort has now been made to bring production in line with consumption; but all these have so far proved unsuccessful, and sanguine operators on the various exchanges confidently predict that in a short time certificates will readily fetch a dollar and a quarter, or even a dollar and a half. There is, however, an almost entire absence of speculation, and as

long as this condition of things exist, the upward movement will be slow. Professor W. T. McGee, of the United States Geological Survey, affirms that the known deposits of coal-oil and natural gas in the United States are not so great as many people suppose. It is impossible, he says, to estimate with any certainty what quantities of oil and gas may be obtained. He is of opinion that it is rather the bituminous matter contained in rocks found all over the country to which America must look in the future for illuminating material. Following the example of oil producers of this country, an effort has been made to combine the candle-makers throughout the States for the purpose of fixing prices and limiting production. The industry at present is not a profitable one, and more, it is said, can be made by selling the raw material than by converting it into candles. Nothing definite has yet been accomplished, but there is reason to believe that an effort will be made in the direction indicated. The candle trade in America is comparatively small, but recently a new factory of some importance has been added, and it is probable that the business will be considerably augmented. It is probable that by the beginning of winter the price of crude scale and candles will be advanced $\frac{1}{2}$ cent per lb. According to the Baku correspondent of a German journal, the Russian petroleum industry is rapidly approaching a crisis owing to the exhaustion of the oil springs. The supply of oil from existing wells is not nearly so great as formerly, and great difficulty is experienced in obtaining a sufficient supply to keep the refineries going. The Messrs. Nobel have been compelled to obtain additional supplies from Bibiebat—a place at a considerable distance from their works. The price of crude oil has been quadrupled during the past month. (See Professor Mendeléeff's Report, this Journal, 1889, p. 753.)—*Oil and Colourman's Journal*.

RUSSIAN PIPE LINES.

Matters are not running smoothly in connexion with the oil wells at Batoum. The fight between the Rothschilds, the owners of the Russian oil wells, and the Russian Government over the right to build a pipe line from the oil wells to the Black Sea has driven a fleet of tank steamships to Philadelphia to secure cargoes of the American product. The dealers in the Russian oils were led to believe that the pipe lines would be built a year ago, and on these assurances a fleet of steamers was chartered, which has been continually added to until the tonnage exceeds the oil output and vessels were forced to go elsewhere for business. The railroad which brings the oil to the seaboard is owned by the Russian Government, which fears if the pipe line is laid the railway will be ruined, as the passenger traffic amounts to nothing.—*Ibid*.

THE RUSSIAN GOVERNMENT AND THE ENGLISH PETROLEUM TRADE.

The Russian Government has despatched to England, to report upon the actual condition of the petroleum trade, M. Gulishambaroff, chief petroleum adviser to the Ministries of Finance and Crown Domains, controlling the Russian petroleum industry. M. Gulishambaroff has edited most of the Russian official literature dealing with petroleum, and is regarded as the leading technical authority in Russia. He ridicules as a canard the statement that the Baku oil supply is decreasing. (See also this Journal, 1889, p. 753.)—*Ironmonger*.

THE ROTHAMSTED EXPERIMENTS.

Sir John Lawes has just issued his annual memoranda of the Rothamsted experiments, bringing the records up to 1888. The tables show that the wheat crop on some plots was above average last year, while barley was below the mark on every plot but one. Where wheat has been grown on the same land every year during 16 years, the average yield is given for the 36 years ending with 1887. The mean yield of two unmanured plots during the period averaged only 13½ bushels per acre; but this is in excess of the average for Russia, America, or India. The highest average yield for the period was 36½ bushels, obtained on a plot to

which was applied a very heavy and costly mixture of nitrogenous, phosphatic, and alkaline manures, and the increase produced, at current prices, would not nearly pay the expense of those fertilisers. The result of applying 14 tons of farmyard manure annually was an average for the 36 years of $33\frac{3}{4}$ bushels, and in this case the increase would pay at current prices, and leave some profit, if the manure were valued at 5s. a ton, without reckoning the increase of straw, but would barely pay if 6s. a ton were allowed for the manure. The use of 275 lb. of nitrate of soda alone gave $23\frac{5}{8}$, the increase of grain paying well for the cost of the manure. It is remarkable that 400 lb. of ammonia salts, a more concentrated manure—in fact, a quantity containing twice as much nitrogen—has given a smaller average yield than the 275 lb. of nitrate of soda during the whole period. The addition of $3\frac{1}{2}$ cwt. of superphosphate raised the yield of the plot receiving the liberal supply of ammonia salts only from $20\frac{1}{4}$ to $25\frac{3}{4}$ bushels; but a further addition of $366\frac{1}{2}$ lb. of sulphate of potash brought the average up to $31\frac{1}{2}$ bushels. In the experiments with barley the mean yield of the unmanured plots averaged $17\frac{3}{4}$ bushels an acre during the 36 years, and the highest average, nearly 49 bushels, was obtained on a plot to which 14 tons per acre of farmyard manure had been annually applied. Other high averages were obtained by means of costly mixtures of nitrogenous

and mineral manures. The use of 275 lb. of nitrate of soda alone brought forth an average of $33\frac{1}{2}$ bushels, and that quantity was increased to nearly 46 bushels by the addition of $3\frac{1}{2}$ cwt. of superphosphate to the nitrate. Each of these two dressings was highly remunerative, the latter especially so. Indeed, no mixture has paid as well as that of nitrate of soda and superphosphate, which happens to be the one most frequently used by farmers. An equivalent to the nitrate, in the form of 200 lb. of salts of ammonia, produced an average of $29\frac{1}{2}$ bushels, and the addition of $3\frac{1}{2}$ cwt. of superphosphate increased the yield to $43\frac{1}{2}$ bushels. These quantities, compared with those just previously mentioned, show that, at Rothamsted, at any rate, nitrate of soda gives better returns in barley than ammonia salts, taking a long course of years, although the latter may prove the better in a wet season. On the other hand, in some experiments with oats, for five years, recorded in the memoranda, but discontinued for some time, ammonia salts gave better results than nitrate of soda; but this was probably because the land was in a very wet condition, which, together with its foulness, led to the discontinuance of the trial.—*Memoranda of the Origin, Plan, and Results of Field and other Experiments conducted on the Farm and in the Laboratory of Sir J. B. Lawes, at Rothamsted.*

YEARLY PRODUCTION OF NITRATES FROM 1884 TO 1888 INCLUSIVE.

	1884.	1885.	1886.	1887.	1888.
Production Tons	550,000	350,000	450,000	700,000	800,000
Average price for cargoes arrived March 31st	s. d. 9 3	s. d. 9 6	s. d. 11 1½	s. d. 10 3	s. d. 10 3
“ „ distant cargoes	9 6	9 9	10 0	8 3	9 0
Freights on March 31st	32 6	37 6	25 0	32 6	32 6

—Foreign Office Report, 1889, No. 142.

MINERAL STATISTICS, 1888.

General Summary of the Mineral Produce of the United Kingdom.

Description of Mineral Raised.	1887.		1888.	
	Quantity.	Value at Mines.	Quantity.	Value at Mines.
	Tons.	£	Tons.	£
Alum clay (Bauxite)	4,169	1,040	9,666	4,833
Alum shale	2,586	323	1,984	248
Antimony ore .....	..	..	*7½	7
Arsenic	4,618	32,458	4,624	35,197
Arsenical pyrites	4,364	3,205	5,325	4,240
Barytes	24,813	26,619	25,191	26,147
Bog iron ore	9,273	4,636	10,927	5,403
Clays (excepting ordinary clay) ..	2,413,633	590,412	2,562,792	653,419
Coal	162,119,812	39,692,850	169,935,219	42,071,276
Cobalt and nickel ore	154	900	152	746
Copper ore	9,079	20,982	15,132½	60,980
Copper precipitate	280	3,075	418	6,539
Fluorspar	283	385	140	153
Gold ore	17½	209	3,844	27,300
Gypsum	120,783	48,293	130,082	58,998
Iron ore	13,098,041	3,235,355	14,590,713	3,501,317

* Cwt.

MINERAL STATISTICS, 1888—continued.

Description of Mineral Raised.	1887.		1888.	
	Quantity.	Value at Mines.	Quantity.	Value at Mines.
	Tons.	£	Tons.	£
Iron pyrites.....	22,007	12,682	23,597	11,502
Jet	*1,448	289	*2,217	332
Lead ore.....	51,563	429,137	51,259	438,383
Lignite	1,764	793	971	437
Manganese ore.....	13,777	11,110	4,342	1,934
Ochre, umber, &c.....	8,293	15,789	7,573	43,387
Oil shale.....	1,411,378	355,085	2,076,469	} 519,126
Petroleum	66	59	35	
Phosphate of lime.....	9,894	15,830	22,500	43,312
Salt.....	2,193,951	730,045	2,305,569	700,829
Slates and slabs.....	464,334	1,118,818	471,788	1,057,535
Stone, &c.....	..	8,609,600	..	8,604,697
Sulphate of strontia.....	15,169	7,584	7,064	3,532
Tin ore	14,189	878,831	14,370	891,665
Tungstate of soda.....	1	24	24	54
Wolfram.....	54	1,269	60	1,625
Zinc ore	25,445	76,182	26,408	96,984
Total values .....	..	55,323,889	..	59,834,997

* Lbs.

SUMMARY OF THE METALS OBTAINABLE FROM ORES PRODUCED IN THE UNITED KINGDOM.

Description of Metal.	Metals obtainable by Smelting.			
	1887.		1888.	
	Quantity.	Value at the Average Market Price.	Quantity.	Value at the Average Market Price.
		£		£
Aluminium Lb.	..	..	5,000	5,000
Antimony..... Cwt.	..	..	34	18
Copper..... Tons	889	12,850	1,456	115,849
Gold..... Oz.	58	210	8,745	29,982
Iron..... Tons	4,768,994	11,000,000	5,130,861	9,492,092
Lead	37,890	186,886	37,578	322,804
Magnesium .....	..	1,000	..	1,000
Silver..... Oz.	320,345	59,564	321,425	57,121
Sodium .....	..	..	30,000	6,000
Tin..... Tons	9,282	1,048,633	9,241	1,683,700
Zinc	9,769	156,850	10,002	191,455
Total values.....	..	12,795,963	..	11,505,321

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ended 30th September	
	1888.	1889.
	£	£
Metals.....	1,793,461	1,823,855
Chemicals, dyestuffs, and tanning materials.....	412,607	464,394
Oils.....	472,662	609,389
Raw materials for non-textile industries.....	3,777,477	4,665,594
Total value of all imports	28,414,372	33,382,561

SUMMARY OF EXPORTS.

	Month ended 30th September	
	1888.	1889.
	£	£
Metals (other than machinery)	3,095,550	3,200,232
Chemicals and medicines.....	628,523	611,152
Miscellaneous articles.....	2,643,092	2,433,475
Total value of all exports.....	19,663,660	19,637,384

IMPORTS OF METALS FOR MONTH ENDED 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
			£	£
Copper:—				
Ore..... Tons	7,348	8,866	72,646	66,628
Regulus and precipitate	7,887	9,581	276,290	231,958
Unwrought "	2,978	3,880	264,017	170,914
Iron and steel:—				
Iron ore	268,097	279,525	192,316	208,657
Bar, bolt, &c. ... "	14,750	11,265	143,362	100,035
Steel, unwrought ..	820	563	8,629	4,967
Lead, pig and sheet ..	11,810	12,828	160,731	161,831
Pyrites	37,119	39,277	74,580	76,283
Quicksilver..... Lb.	125,250	219,690	11,962	30,100
Tin..... Cwt.	33,398	57,739	164,663	261,888
Zinc..... Tons	6,534	6,125	113,697	121,185
Other articles.....	..	..	310,695	386,166
Total value of metals	..	..	1,793,461	1,823,855

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDED 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
			£	£
Alkali..... Cwt.	3,240	3,852	3,189	2,676
Bark (for tanners' and dyers' use) . "	40,057	32,579	17,115	12,376
Brimstone..... "	22,464	40,572	5,812	9,211
Chemicals..... Value £	..	..	87,361	110,364
Cochineal..... Cwt.	419	565	2,993	3,462
Cutch and gambier Tons	1,700	1,877	42,751	53,351
Dyes:—				
Aniline..... Value £	..	..	18,562	24,857
Alizarine .....	..	..	23,979	20,800
Other .....	..	..	1,316	1,353
Indigo..... Cwt.	504	3,727	8,214	47,845
Madder	1,314	475	1,630	520
Nitrate of soda.... "	107,009	53,197	48,959	22,253
Nitrate of potash . "	32,461	19,271	27,691	17,389
Valonia..... Tons	2,181	1,109	31,641	16,431
Other articles... Value £	..	..	91,373	121,506
Total value of chemicals	..	..	412,607	464,394

IMPORTS OF OILS FOR MONTH ENDED 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
			£	£
Cocanut..... Cwt.	6,894	45,496	8,140	58,653
Olive..... Tons	865	862	34,524	33,257
Palm..... Cwt.	79,510	112,312	76,614	123,953
Petroleum..... Gall.	6,608,071	10,343,164	194,254	250,088
Seed of all kinds .. Tons	1,267	1,633	30,279	45,679
Train, &c..... Tons	2,407	2,197	42,641	48,275
Turpentine..... Cwt.	29,813	33,383	42,165	51,627
Other oils..... Value £	..	..	43,445	57,857
Total value of oils ...	..	..	472,062	669,389

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDED 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
			£	£
Bark, Peruvian .. Cwt.	9,414	12,432	31,273	36,464
Bristles..... Lb.	202,984	296,140	22,725	37,523
Caoutchouc..... Cwt.	19,080	22,500	223,065	239,263
Gum:—				
Arabic..... "	6,358	4,076	21,676	12,490
Lac, &c..... "	3,988	4,855	9,515	17,614

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDED 30TH SEPTEMBER—*cont.*

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Gutta-percha Cwt.	2,727	4,702	£ 21,606	£ 42,506
Hides, raw:—				
Dry..... "	34,998	33,123	100,468	87,301
Wet..... "	56,942	76,823	136,156	178,520
Ivory..... "	1,068	833	49,524	37,828
Manures:—				
Guano..... Tons	840	2,361	7,995	14,345
Bones..... "	4,003	2,771	19,600	13,842
Paraffin..... Cwt.	28,116	28,993	39,440	35,346
Linen rags..... Tons	2,935	3,254	35,736	31,100
Esparto, &c. "	17,362	13,888	92,858	66,301
Pulp of wood "	9,126	10,665	55,175	60,615
Rosin..... Cwt.	53,398	69,819	11,603	22,022
Tallow and stearin "	94,924	81,776	120,354	105,594
Tar Barrels	15,160	26,071	10,964	22,366
Wood:—				
Hewn Loads	234,586	286,136	472,980	689,839
Sawn "	671,118	722,491	1,502,505	1,816,173
Staves "	19,163	24,340	49,258	82,885
Mahogany Tons	2,961	2,257	24,239	20,730
Other articles.... Value £	..	..	715,042	994,618
Total value .....	..	..	3,777,477	4,665,594

Besides the above, drugs to the value of 72,283*l.* were imported during the month, as against 75,639*l.* in September 1888.

EXPORTS OF METALS OTHER THAN MACHINERY FOR MONTH ENDED 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Brass..... Cwt.	7,886	7,789	£ 34,369	£ 30,959
Copper:—				
Unwrought..... "	26,534	63,288	100,876	145,331
Wrought..... "	7,952	34,596	35,590	95,459
Mixed metal "	9,555	32,709	34,485	80,141
Hardware Value £	..	..	276,250	209,770
Iron and steel..... Tons	344,631	351,057	2,200,607	2,341,396
Lead "	4,853	3,195	67,731	43,875
Plated wares... Value £	..	..	30,366	36,665
Telegraphic wires. "	..	..	21,032	38,069
Tin Cwt.	9,373	6,698	47,114	31,708
Zinc "	9,831	3,593	7,592	3,288
Other articles .. Value £	..	..	149,578	143,241
Total value .....	..	..	3,095,550	3,200,232

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDED 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Alkali..... Cwt.	542,310	488,933	£ 134,577	£ 126,737
Bleaching materials "	128,857	139,834	50,030	51,257
Chemical manure († Tons)	..	28,918	164,448	165,108
Medicines..... Value £	..	..	78,980	63,473
Other articles ... "	..	..	200,188	204,577
Total value .....	..	..	628,523	611,152

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDED 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Gunpowder..... Lb.	670,500	806,300	£ 16,809	£ 20,671
Other military stores..... Value £	..	..	94,528	119,571
Candles..... Cwt.	853,300	862,400	15,569	15,413
Caoutchouc Value £	..	..	103,922	97,996
Cement..... Tons	49,489	23,006	93,610	46,669
Earthenware ... Value £	..	..	164,366	158,518
Stoneware ..... "	..	..	8,823	11,320
Glass:—				
Plate..... Sq. Ft.	367,447	208,019	23,612	16,132
Flint..... Cwt.	11,359	6,120	27,946	15,993
Bottles..... "	74,891	62,531	37,161	28,992
Other kinds.... "	16,503	20,309	11,112	14,745
Leather:—				
Unwrought "	12,866	12,826	113,858	117,941
Wrought Value £	..	..	35,953	38,096
Seed oil..... Tons	6,477	4,110	131,096	92,484
Floor cloth Sq. Yds.	1,267,800	1,213,200	60,320	56,911
Painters' materials..... Value £	..	..	122,362	99,137
Paper of all kinds. Cwt.	89,109	50,410	155,969	95,116
Rags..... Tons	4,942	3,977	37,214	32,642
Soap Cwt.	42,568	36,138	37,889	36,796
Total value of exports of miscellaneous articles.....	} ..	} ..	2,643,092	2,433,475

BRITISH TRADE IN 1888.

MARGARINE.

The margarine traders do not seem to have seriously felt the pressure of the special enactment by which the name of the article they trade in was legislatively fixed. The imports of butterine under its legal name of margarine was slightly lower than in 1887, and this may have been due to the vigilance of public officers in strictly enforcing the Margarine

Act in all cases of infringement, but towards the close of the year demand was brightening after 12 months of sluggishness and doubtfulness.

MARGARINE IMPORTED AND RE-EXPORTED.

	1886.	1887.	1888.
Imported:			
Quantity, cwt.	886,573	1,273,095	1,138,174
Value £.....	2,958,500	3,869,948	3,263,826
Average value per cwt.....	£3.33	£3.03	£2.86
Re-exported:			
Quantity, cwt.	17,549	22,180	20,457
Value £.....	48,533	53,482	50,614
Average value per cwt.....	£2.76	£2.41	£2.47

The enterprise of Dutch manufacturers has enabled them so far to maintain supremacy in this article of increasing use and widespread consumption. How much the trade is monopolised by Holland will be seen from comparing the above total figures with the appended statement of imports from that country.

From	1886.		1887.		1888.	
	Cwt.	£	Cwt.	£	Cwt.	£
Holland..	833,957	2,767,509	1,172,974	3,546,591	1,093,401	2,951,522

LARD.

Owing to the extra alertness of the officers charged with carrying out the Adulteration of Foods Act, there was considerable disturbance in the lard trade. This disturbance was not very limited in its extent. Prosecutions were fairly general throughout the country, and retailers were awakened to their responsibility in vending articles of consumption. This, of course, recoiled upon the manufacturers, and in view of the desire on the part of the Legislature to protect the consumers' interests to a greater extent than hitherto, approval will far outweigh the objections to the strict enforcement of the laws fulfilling this desire. It would appear that cotton-seed oil—an ingredient which is known to play a very prominent part in the manufacture of of "olive" oil also—has been the principal ingredient introduced into concoctions labelled "lard." "Lardine" is the name attached to a mixture of hogs' fat and cotton-seed oil; and as the Americans claim that the latter ingredient is not injurious to health, it is probable that we may have to add this new mixture to the list of articles of commerce. Since "butterine" was thought too distinct an imitation of "butter" to be devoid of any taint of deception, it will be interesting to see whether "lardine" will be permitted.

LARD IMPORTED AND RE-EXPORTED.

	1886.	1887.	1888.
Imported:			
Quantity, cwt.	8,6324	906,100	883,469
Value £.....	1,546,150	1,601,635	1,815,420
Average value per cwt.....	£1.72	£1.76	£2.05
Re-exported:			
Quantity, cwt.	67,830	13,280	57,502
Value £.....	129,972	28,229	115,989
Average value per cwt.....	£1.91	£1.73	£2.00

It is due to the American Congress to state that a bill was introduced to stamp out adulteration, but it was not passed. The result of the attempt was beneficial, however, and less call for cheap and doubtful goods has probably had its proper effect in restricting their production. Prices for "pure lard" rose considerably, and the United States seem to have participated in the *bona fide* trade, for the imports therefrom in 1888 amounted to 832,126 cwt., compared with 831,790 cwt. in 1887, whilst the value in 1888 was 1,705,339*l.*, against 1,459,055*l.* in 1887. The average value in the first-named year was 2.04*l.* per cwt., and in 1887 only 1.75*l.* per cwt., or a rise of over 16 per cent.

DYESTUFFS IMPORTED AND RE-EXPORTED.

	1886.	1887.	1888.
Imported:			
Cochineal, cwt.	14,710	9,961	7,340
Value £.....	91,285	61,587	48,310
Average value per cwt.....	£6.41	£6.22	£6.58
Indigo, cwt.	81,754	76,698	78,188
Value £.....	1,850,965	1,673,475	1,703,682
Average value per cwt.....	£22.31	£21.81	£21.79
Coal-tar dyes, value £.....	508,711	542,810	564,545
Total £.....	2,468,961	2,278,272	2,316,537
Re-exported:			
Cochineal, cwt.	11,391	8,113	6,197
Value £.....	76,749	51,713	35,264
Average value per cwt.....	£6.78	£6.37	£5.69
Indigo, cwt.	53,959	53,085	51,131
Value £.....	1,170,242	1,179,879	1,084,002
Average value per cwt.....	£21.68	£22.22	£21.20
Total £.....	1,243,991	1,231,592	1,119,266

These figures show an advance in values of dyestuffs imported, both over 1887 and 1886, and lend strength to the other facts adduced in support of the comparative prosperity in 1888 of the industries they supply. Cochineal, it will be observed, is fast disappearing, having decreased in quantity by 50 per cent. compared with 1886, without any like appreciation of value, showing that demand has fallen off almost concurrently. The net receipts of indigo betray an improvement, and coal-tar dyes still progress. We understand, however, that a large proportion of the latter are re-exported. The monthly returns do not register the movement, but the British aniline dye manufacturers are aware that they have not had to compete with such supplies in the home market as would appear from the imports to have been the case.

CHEMICAL TRADES.

The chemical trades are advancing in importance annually, and the enterprise of those concerned in them bids fair to keep pace with the established foreign competition in this division. There was an increased business done last year both in importations of foreign goods and in exports of British chemicals and drugs. Altogether the prices realised were on a somewhat low level, but this gave hope for the future that the bottom had been reached in the main articles, so that the outlook was bright. In alkalis the importations decreased in quantity, but increased in value compared with 1887; whilst in British alkalis exported the position was reversed of a larger quantity being sent out at a decreased value on the preceding year. The returns show the following total results for—

FOREIGN CHEMICALS IMPORTED AND RE-EXPORTED.

—	1886.		1887.		1888.	
Imported:	Cwt.	£	Cwt.	£	Cwt.	£
Alkali	78,797	55,602	61,172	47,809	56,753	50,567
Brimstone	636,596	157,917	661,153	157,188	782,854	175,946
Nitrate of soda	1,097,725	744,513	1,796,802	832,541	2,053,282	984,894
Saltpetre	271,322	240,186	333,918	261,526	353,691	300,663
Various .....	..	1,281,275	..	1,316,853	..	1,310,914
Total £ .....	..	2,482,793	..	2,615,917	..	2,822,084
Re-exported:						
Saltpetre	24,575	21,116	32,856	28,924	42,335	35,679
Various .....	..	149,078	..	283,625	..	392,221
Total £ .....	..	170,224	..	312,549	..	337,900
	..	2,312,569	..	2,303,368	..	2,484,184

Attention may be directed to the fact, that although there was a rise on the importations there was also an increase in the re-exportations, leaving an extension of net receipts of 180,816*l.* value. The average prices calculated on these figures show:—

AVERAGE PRICES PER CWT. OF SUNDRY FOREIGN CHEMICALS.

—	1886.	1887.	1888.
Imported:	£.	£.	£.
Alkali	11.11	14.90	17.82
Brimstone	4.90	4.75	4.47
Nitrate of soda	9.94	9.62	9.59
Saltpetre	17.72	17.21	17.00

The returns of exports of British chemicals are satisfactory as to the values, except in regard to alkalis, as there were advances in the total values declared for bleaching materials and preparations, chemical manures, and the wide

range of articles included under the head of chemicals "unenumerated." For all these goods the statistics tell their own tale of steady growth during the last three years, in bulk if not in value:—

BRITISH CHEMICALS EXPORTED.

—	1886.		1887.		1888.	
Exported:	Cwt.	£	Cwt.	£	Cwt.	£
Alkali	6,242,800	1,788,978	6,161,960	1,742,771	6,347,339	1,638,861
Bleaching materials	1,550,400	502,919	1,578,300	502,961	1,694,146	615,724
Manures (chemical) .....	..	1,614,643	..	1,640,919	..	1,846,536
Various .....	..	1,976,640	..	2,191,915	..	2,405,104
Value £ .....	..	5,881,089	..	6,168,566	..	6,506,225

As to average prices we gather the following details:—

AVERAGE PRICES PER CWT. OF BRITISH CHEMICALS EXPORTED.

—	1886.	1887.	1888.
Exported:	£.	£.	£.
Alkali	5.73	5.81	5.16
Bleaching material	6.48	7.57	7.67

The manufacturing activity of other countries is to a certain extent evidenced by the figures relating to bleaching materials, for which the returns of exports have been so continuously extending in quantities and values.

As chemical manures form a prominent item in a fore-going table, it is interesting to show the extent of the trade in:—

FOREIGN MANURES IMPORTED AND RE-EXPORTED.

—	1886.	1887.	1888.
Imported:			
Guano and bones, value £.....	828,747	439,810	513,114
Re-exported:			
Guano only, value £.....	50,930	96,856	42,952
Net imports £.....	777,817	342,954	470,162

With the development of scientific agriculture, the prospect for chemical manure manufacturers is brighter than that of traders in the other forms of fertilisers. The position of drugs in the total foreign commerce is not a very high one. In 1888 there was a spurt on the part of foreign introductions, after a decline in the preceding 12 months on the trade of 1886, as shown below:—

FOREIGN DRUGS IMPORTED.

—	1886.	1887.	1888.
Imported:			
Value £.....	670,525	650,440	887,422

On the other hand, British drugs sent abroad have in the last three years made steady headway. The official statistics disclose the annexed register of exports in the last three years, by which it will be seen that the clearances in 1888 outwards, exceeded those in 1886 by over 15 per cent. in value:—

BRITISH DRUGS AND MEDICINAL PREPARATIONS EXPORTED.

—	1886.	1887.	1888.
Exported:			
Value £.....	814,213	869,083	938,125

An important development may be anticipated in this branch, too, from the favourable reception given, and concessions made to the demands of chemical traders for greater facilities for manufacturing in bond for export. One concession on the part of the Customs and Inland Revenue effected a definite result in 1888. Owing to the fact that the Germans had been able, and Britishers unable, to clear "waste tea" from the bonded warehouses without payment of duty, the manufacture of caffeine had been practically confined to our neighbours across the North Sea. The advantage thus given to foreigners having been demonstrated to the satisfaction of the financial departments, permission was granted to British manufacturers to clear such waste tea "free of duty" after it had been rendered unfit for domestic consumption as tea. A new industry thus sprang up, and its effect on the manufactories abroad was startlingly sudden, by reason of the reduction in price effected, even before the marketing, on any large scale, of the home-made article.

OILS.

Oils form an increasingly important factor in the aggregate home and foreign trade. On the two largest branches of cotton seed and flax and linseed imported for treatment there was a considerable enlargement both of quantities and values last year:—

COTTON, FLAX AND LINSEED, AND RAPE SEED IMPORTED AND RE-EXPORTED.

—	1886.	1887.	1888.
Imported:			
Cotton.....	£ 1,498,011	£ 1,543,645	£ 1,646,349
Flax and linseed.....	4,266,998	4,296,868	4,800,016
Rape	566,698	457,969	448,254
Total	6,271,707	6,298,512	6,894,619
Re-exported:			
Flax and linseed	362,716	142,713	279,754
Rape	115,808	37,249	56,769
Total	478,524	179,962	336,550
Net imports	5,793,183	6,118,550	6,558,069

Linseed was taken to the extent of beating any previous register of imports, and the British East Indies were the principal participators in sending forward greater quantities. Owing to the shortness of the Egyptian crop, remunerative business was done in cotton seed; but with rape the demand was desultory in the first half of the year, with an improvement in the latter six months. Home crushers are evidently making way, although they have not yet succeeded in permanently decreasing the supplies of oils taken from abroad of this kind, since they amounted to 16,311 tons in 1888, compared with 15,609 in 1887, and 16,327 tons in 1886. The total value of all oils was as follows:—

FOREIGN OILS IMPORTED AND RE-EXPORTED.

—	1886.	1887.	1888.
Imported.....	£ 6,049,148	£ 6,088,246	£ 6,432,871
Re-exported.....	786,968	761,635	967,602
Net imports	5,263,080	5,326,611	5,465,179

Petroleum stands in this total for 2,558,753*l.*, and more detailed figures will be found on pp. 165—67. Of some other divisions of the imports the following statistics are available:—

COCOANUT, PALM AND SEED OILS, AND TURPENTINE IMPORTED AND RE-EXPORTED.

—	1886.	1887.	1888.
Imported:			
Quantity, cwt.	1,771,212	1,851,684	1,838,429
Value £.....	2,041,000	2,041,579	2,130,172
Average value per cwt.....	£1'15	£1'10	£1'15
*Re-exported:			
Quantity, cwt.....	587,534	601,881	791,555
Value £	649,788	626,021	820,330
Average value per cwt.....	£1'10	£1'04	£1'03

* Cocoonut and palm oil only.

In addition to the quantities declared in cwt., we have also to note 18,580 tons of olive and 16,861 tons of train, blubber, and sperm oils imported of the value of 674,472*l.* and 323,579*l.* respectively in 1888. Although the imports of foreign seed oil maintained their position in 1888, the dealers in the home-made article had a satisfactory export trade, on which the increase in 1888 was 3,314 tons compared with 702 tons only on the imports of foreign seed oil.

BRITISH SEED OIL EXPORTED.

—	1886.	1887.	1888.
Exported:			
Quantity, cwt.	1,413,520	1,501,960	1,568,240
Value £.....	1,502,346	1,567,646	1,594,501
Average value per cwt.....	£1'06	£1'04	£1'01

TALLOW.

Tallow dealers had a brisk year, demand being so active in the early part that large arrivals were subsequently the cause of a slight fall in prices. Towards the end of 1888, too, the demand again became great, and much buoyancy in the trade was noted, English varieties maintaining a very steady position, as supplies were far from abundant. Receipts from Russia nearly doubled, rising from 6,532 cwt.

in 1887 to 11,434 in 1888, but this was not one-third of the imports therefrom in 1886, which stood at 35,579 cwt. Australasia sent 559,495 cwt. in 1888, and 416,658 in 1887; the Argentine Republic 80,147 cwt. in 1888, and only 22,209 cwt. in 1887, whilst the United States sent less in 1888 than 1887 by the difference between 311,022 cwt. and 329,367 cwt.

TALLOW AND STEARINE IMPORTED AND RE-EXPORTED.

—	1886.	1887.	1888.
Imported:			
Quantity, cwt.	1,010,396	895,658	1,116,610
Value £	1,296,552	1,071,028	1,192,595
Average value per cwt.	£1.28	£1.20	£1.25
Re-exported:			
Quantity, cwt.	218,416	319,044	315,653
Value £	250,598	351,143	367,597
Average value per cwt.	£1.14	£1.13	£1.16

SOAP.

Connected with these imports, it is interesting to observe the progress of British soap exports, whilst in the home market consumption advances under the stimulus of lower prices and improved production.

BRITISH SOAP EXPORTED.

—	1886.	1887.	1888.
Quantity, cwt.	426,904	452,751	498,155
Value £	416,710	452,244	481,890
Average value per cwt.	£1.01	£1.00	£0.96

CANDLES.

Allied both with these and with imports of oils from tropical climes is the manufacture of candles, in which home producers had not much satisfaction from the export trade, although the magic quantity of 10 million lb. was passed in 1888.

BRITISH CANDLES EXPORTED.

—	1886.	1887.	1888.
Exported:			
Quantity, cwt.	80,063	83,153	96,565
Value £	201,919	180,872	199,174
Average value per cwt.	£2.52	£2.17	£2.06

Foreign competition is extending in this branch, with the result that prices are cut very fine. The significance of this could not be made plainer than the above average and total values, from which it will be seen that over 16,000 cwt. more were supplied in quantity in 1888 than in 1887, for 2,100l. less value.

PAINTERS' COLOURS.

In colours and materials for painters the following foreign trade was done:—

BRITISH PAINTERS' COLOURS AND MATERIALS EXPORTED.

—	1886.	1887.	1888.
Value £	1,266,103	1,317,684	1,447,750

TANNING SUBSTANCES IMPORTED AND RE-EXPORTED.

—	1886.	1887.	1888.
Imported:			
Bark, cwt.	390,793	346,583	339,985
Value £	173,066	147,101	135,018
Average value per cwt.	s. 8.85	s. 8.19	s. 7.95
Cutch and gambier, cwt.	567,380	545,160	562,700
Value £	654,438	658,364	701,731
Average value per cwt.	£1.15	£1.20	£1.25
Madder, &c., cwt.	21,325	19,397	15,034
Value £	26,710	24,267	19,292
Average value per cwt.	£1.25	£1.24	£1.28
Valonia, cwt.	679,900	591,660	690,310
Value £	480,742	324,194	457,634
Average value per cwt.	s. 11.14	s. 11.28	s. 13.24
Total £	1,331,956	1,253,869	1,316,675
Re-exported:			
Cutch and gambier, cwt.	263,840	192,400	187,380
Value £	255,145	251,818	249,860
Average value per cwt.	£1.25	£1.30	£1.33

CAOUTCHOUC.

The rubber trade, which is also to an extent dependent on the electrical industries prospering, is shown below to have taken a decreased import in 1888 of both caoutchouc and gutta-percha, there being a rise in values of both, and in the latter by itself of about 50 per cent. :—

CAOUTCHOUC AND GUTTA-PERCHA IMPORTED AND RE-EXPORTED.

—	1886.	1887.	1888.
Imported:			
Caoutchouc, cwt.	192,518	235,539	218,171
Value £	2,202,746	2,682,515	2,529,436
Average value per cwt.	£11.44	£11.38	£11.59
Re-exported:			
Caoutchouc, cwt.	109,416	116,570	127,814
Value £	1,281,499	1,311,613	1,335,835
Average value per cwt.	£11.71	£11.51	£10.45
Net imports £	921,247	1,370,902	1,193,601
Imported:			
Gutta-percha, cwt.	10,697	24,145	22,483
Value £	269,808	156,563	181,660
Average value per cwt.	£6.63	£6.48	£8.43
Re-exported:			
Gutta-percha, cwt.	11,525	8,821	8,372
Value £	75,159	61,716	62,372
Average value per cwt.	£6.54	£6.99	£7.45
Net imports £	194,349	144,847	119,288

The crop of Para rubber was an exceptionally heavy one, and its total may not be reached in 1889, when a rise in prices may again be expected if the United States, which principally cleared off the largely-augmented supplies in 1888, maintains its consuming power at the same level. We are unable to gauge the value of the rubber boot and

shoe trade here, but a large amount is used up by Americans in this way alone. They too are far more advanced than Britishers in the use they make of electricity for all purposes. British rubber manufacturers for exports did fair business, having an increased value to their account in the returns:—

BRITISH CAOUTCHOUC MANUFACTURES EXPORTED.

—	1886.	1887.	1888.
Exported:			
Value £	971,108	1,070,311	1,143,104

PAPER.

Taking the imports of raw materials as a basis on the one hand and exports of British goods on the other, the indications for the British paper, stationery, and printing trades in 1888 are as distinctly encouraging as those of any other trade in the whole returns. In only a single instance, that of British rags exported, has a decrease to be noted. The foreign raw materials imported for paper-making are here covered for three years, the increased use of wood pulp demanding attention.

PAPER-MAKING, FOREIGN RAW MATERIALS IMPORTED.

—	1886.	1887.	1888.
Imported:			
Rags, tons	36,852	38,223	41,404
Value £	458,409	465,932	470,833
Esparto and other fibres, tons.	194,646	199,750	247,936
Value £	996,723	966,380	1,265,515
Pulp of wood, tons.....	..*	79,543	110,040
Value £ .....	..*	511,450	677,968
Total tons	231,498	317,516	399,380
„ Value £	1,455,222	1,937,762	2,414,516
Average value per ton.....	£6.28	£6.10	£6.05

* Not separately stated.

Demand must have been very active to have encouraged the large imports, too, of the manufactured articles, as the net value retained was in excess of 1886 by 271,714*l*.

FOREIGN PAPER IMPORTED AND RE-EXPORTED.

—	1886.	1887.	1888.
Imported:			
Quantity, cwt.	1,515,197	1,701,254	1,922,283
Value £	1,491,903	1,587,876	1,767,145
Average value per cwt.....	£0.98	£0.93	£0.91
Re-exported:			
Quantity, cwt.	71,771	66,135	87,248
Value £	89,848	77,780	93,376
Average value per cwt.....	£1.25	£1.16	£1.07
Net imports	1,402,955	1,510,696	1,673,769

The good features are not limited to the foreign articles of which the imports are low-valued. Whereas there was a decrease in the average value of foreign rags imported as raw materials, those of British origin exported experienced a rise in price sufficient to make the gross value exceed that of 1887 by over 2,000*l*., whereas the aggregate quantity was less by 862 tons.

PAPER-MAKING, BRITISH RAGS FOR, EXPORTED.

—	1886.	1887.	1888.
Exported:			
Quantity, tons	49,255	59,199	58,337
Value £	388,406	458,267	460,335
Average value per ton.....	£7.78	£7.74	£7.89

GLASS.

In the glass trade we continue to be under the sway of foreign producers, a state of things probably due to the inclusive system of syndicates which govern the industry, and some of which work in conjunction with producers in the United Kingdom. The extension of building operations caused a further demand, and the imports increased in quantity and in prices compared with 1887 and 1886.

FOREIGN GLASS IMPORTED AND RE-EXPORTED.

—	1886.	1887.	1888.
Imported:			
Quantity, cwt.....	1,473,275	1,662,336	1,786,202
Value £	1,546,267	1,678,906	1,906,325
Average value per cwt.	£1.05	£1.01	£1.06
Re-exported:			
Quantity, cwt.	175,355	195,674	200,208
Value £	152,686	166,131	174,789
Average value per cwt.....	£0.87	£0.85	£0.87

Although our imports are nearing two millions sterling per annum, our exports are also augmenting, and last year passed 1,100,000*l*. in value. Bottles contribute more than one-half the quantity and nearly one-half the value comprised in the appended figures under "other kinds," having been in 1886, 750,515 cwt. (114,537*l*.); in 1887, 826,409 cwt. (390,585*l*.); and in 1888, 864,888 cwt. (406,088*l*.).

BRITISH GLASS EXPORTED.

—	1886.	1887.	1888.
Exported:			
Plate glass, square feet.....	4,402,132	4,697,143	4,348,716
Value £	240,367	262,680	261,013
Average value per 100 square feet	£5.46	£5.59	£6.00
Other kinds:			
Quantity, cwt.....	1,005,424	1,003,694	1,198,145
Value £	730,010	758,349	848,646
Average value per cwt.....	£0.72	£0.69	£0.71

CEMENT.

Cement exports were more for the whole year by 105,000 tons than in 1887, and by 138,000 tons compared with 1886, but prices realised declined. The chief foreign customers for this article are the South American and United States, where the public works in progress of execution maintain a good demand. Under the rise in freights, the business was somewhat checked at the close of the year, but the prospect was one of increased demand. Australasia, of British possessions, takes the largest quantity of this article.

BRITISH CEMENT EXPORTED.

—	1886.	1887.	1888.
Exported:			
Quantity, tons.....	425,880	506,090	611,328
Value £	802,052	982,776	1,160,419
Average value per ton.....	£2.02	£1.94	£1.89

More than half the value is contributed by the under-mentioned countries:—

—	1886.	1887.	1888.
	£	£	£
United States	204,716	392,543	354,121
Australasia	174,002	149,759	212,718
Argentine Republic.....	64,515	51,568	110,261

BUSINESS WITH FOREIGN COUNTRIES.

The gross value of the divisions of our business with foreign countries is shown below, taking the monthly trade returns as the basis:—

—	1886.	1887.	1888.
	£	£	£
Imports	349,381,086	361,935,006	386,582,626
Exports.....	212,432,754	221,414,186	233,733,937
Re-exports.....	56,234,263	59,348,975	64,613,447
Total, including re-exports	618,048,103	642,698,167	684,929,110
Total, excluding re-exports	561,813,840	583,349,192	620,315,663

The complaints of small margins, which from an exhaustive examination of trade reports we know to be general, are warranted by these tables, summary as they may be. "The Economist" index number betrayed a falling off for the end of 1888 contrasted with the beginning, and the same authority asserts, from calculations effected on usual bases, that the volume of business also did not progress at the same rate in 1888 over 1887 as did 1887 over 1886. The

figures supplied by this source for the last five years show the following to have been the fluctuations in volume of our foreign trade in the last five years:—

FOREIGN TRADE.—VOLUME.			
—	Net Imports.	Exports.	Imports and Exports.
	Per Cent.	Per Cent.	Per Cent.
1888	+ 3'42	+ 4'64	+ 3'91
1887	+ 5'07	+ 4'80	+ 4'93
1886	— 0'37	+ 5'33	+ 1'94
1885	+ 3'28	— 3'84	— 0'26
1884	— 2'81	— 1'14	— 1'23

At the same time "the Economist" statistics incline to the support of rising prices, and there are adduced the appended figures showing the average rise or fall in prices of imports and exports over five years in justification of this cheerier view of things:—

FOREIGN TRADE.—PRICES.			
—	Net Imports.	Exports.	Imports and Exports.
	Per Cent.	Per Cent.	Per Cent.
1888	+ 2'89	+ 0'20	+ 2'04
1887	— 1'72	— 0'52	— 1'22
1886	— 5'67	— 5'35	— 5'53
1885	— 5'63	— 4'89	— 5'44
1884	— 6'44	— 3'96	— 5'42

BRITISH TRADE WITH EUROPEAN STATES.

TRADE OF THE UNITED KINGDOM WITH THE UNDER-MENTIONED EUROPEAN STATES DURING THE YEARS 1888 AND 1887, SHOWING ALSO THE INCREASE OR DECREASE PER CENT. BETWEEN THE YEARS 1888 AND 1887, 1887 AND 1886, 1886 AND 1885, AND 1885 AND 1884.

—	Total Trade.		Difference †			
	1888.	1887.	Between 1888 and 1887.	Between 1887 and 1886.	Between 1886 and 1885.	Between 1885 and 1884.
	£	£	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Austrian territories	3,532,000	2,815,000	+ 25'4	— 5'0	— 9'5	+ 0'8
Belgium.....	28,600,000	27,874,000	+ 2'2	+ 12'7	— 8'5	— 3'3
Bulgaria.....	216,000	128,000	+ 68'7	— 21'4	— 46'8	+ 7'8
Denmark*	9,491,000	7,430,000	+ 27'7	+ 5'3	— 0'5	— 9'8
France	62,985,000	57,617,000	+ 9'3	+ 1'2	— 3'1	— 7'9
Germany	54,040,000	51,659,000	+ 4'6	+ 8'2	— 4'8	— 7'9
Greece	2,912,000	2,973,000	— 2'0	+ 13'1	— 8'9	— 14'1
Holland.....	40,999,000	40,365,000	+ 1'5	+ 0'1	— 1'3	— 7'4
Italy	9,997,000	11,065,000	— 1'4	+ 19'6	— 6'9	— 6'7
Norway	4,802,000	4,299,000	+ 13'8	— 0'2	— 4'8	— 6'9
Portugal.....	5,712,000	5,312,000	+ 7'5	+ 11'6	— 0'3	— 12'1
Roumania	4,622,000	4,509,000	+ 2'5	+ 23'4	+ 1'2	— 13'3
Russia	33,902,000	22,847,000	+ 48'7	+ 14'3	— 16'6	+ 0'2
Spain.....	15,212,000	14,151,000	+ 7'4	+ 9'7	— 3'3	— 10'3
Sweden.....	11,736,000	10,450,000	+ 12'3	+ 6'3	— 9'6	+ 5'0
Turkey (European).....	4,332,000	4,211,000	+ 2'8	— 16'8	— 1'5	— 12'3
Total (trade with all Foreign Countries) and British Possessions.....	685,521,000	642,991,000	+ 6'6	+ 3'9	— 3'7	— 6'3

* Including Iceland.

† Increase (+), Decrease (—).

REVIEW OF THE PETROLEUM INDUSTRY.

1. Statistics of the Petroleum Trade of the United Kingdom for the year 1888, from the Annual Petroleum Circular of Messrs. Mordant Bros., and a return compiled by Messrs. Henry Funck & Co.

The prominent features of the trade have been the large increase in the importation of Russian petroleum, and the development of the tank system of ocean transport.

The shipments of petroleum oil from the United States and Russia to the United Kingdom for the past six years have been as under:—

—	American.	Russian.	Total.
	Barrels.	Barrels.	Barrels.
1883	1,329,004	502	1,329,505
1884	927,919	17,078	944,997
1885	1,367,729	79,149	1,446,879
1886	1,363,801	16,814	1,410,615
1887	1,444,350	188,461	1,632,811
1888	1,286,118	549,126*	1,835,244

* Of this quantity, 528,793 barrels were shipped in bulk in tank steamers, the amount being stated in barrels in accordance with the practice of the trade.

The destinations of the shipments in 1888 were as follows:—

Ports.	American.	Russian.	Total.
	Barrels.	Barrels.	Barrels.
Belfast	21,990	2,500	24,490
Barrow-in-Furness	..	14,492	14,492
Bristol	132,980	7,058	140,038
Cork	2,750	..	2,750
Cardiff	12,014	..	12,014
Dublin	38,014	7,100	45,114
Exeter and Exmouth	31,029	..	31,029

The monthly deliveries of petroleum oil from the London public wharves were:—

—	January.	February.	March.	April.	May.	June.	July.
	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.
1886	74,005	62,399	65,802	35,672	31,922	21,818	20,111
1887	96,503	56,026	55,280	38,514	38,792	22,616	23,415
1888	78,408	69,964	59,703	52,622	29,082	25,114	37,758

—	August.	September.	October.	November.	December.	Total.
	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.
1886	50,885	59,666	60,316	81,095	68,735	636,936
1887	43,922	60,035	89,400	78,630	87,956	691,659
1888	39,110	52,391	98,215	82,493	111,522	731,392

The average price has been:—

—	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
1886	6 $\frac{1}{2}$	6 $\frac{1}{4}$	6 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	6 $\frac{1}{4}$	6 $\frac{1}{2}$
1887	6 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	6 $\frac{1}{2}$
1888	(Amer., 7 $\frac{1}{2}$)	6 $\frac{1}{2}$	6 $\frac{1}{2}$	6 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$	6	7 $\frac{1}{2}$	7 $\frac{1}{2}$	6 $\frac{1}{2}$	6 $\frac{1}{2}$	6 $\frac{1}{2}$
	(Russ., 7)	6 $\frac{1}{4}$	6 $\frac{1}{4}$	5 $\frac{1}{4}$	5 $\frac{1}{4}$	5 $\frac{1}{4}$	5 $\frac{1}{4}$	6 $\frac{1}{4}$	6 $\frac{1}{4}$	6 $\frac{1}{4}$	6 $\frac{1}{4}$	6 $\frac{1}{4}$

Destinations of Shipments in 1888—*cont.*

Ports.	American.	Russian.	Total.
	Barrels.	Barrels.	Barrels.
Falmouth	955	..	955
Gloucester	3,133	..	3,133
Great Yarmouth	9,477	..	9,477
Galway	2,295	..	2,295
Hull	73,832	..	73,832
Ipswich	2,714	..	2,714
King's Lynn	8,176	..	8,176
London	536,563	352,550	889,113
Liverpool	280,349	152,636	432,985
Limerick	22,572	..	22,572
Newcastle	16,293	..	16,293
Plymouth	31,048	..	31,048
Portsmouth	5,033	..	5,033
Sligo	9,414	..	9,414
Sharpness	30,545	..	30,545
Shields	3,172	12,790	15,962
Waterford	11,800	..	11,800
	1,286,118	549,126	1,835,244

The aggregate importation of American and Russian petroleum oil into London for the past six years has been:—

	Barrels.
1883	714,753
1884	325,101
1885	688,616
1886	700,184
1887	708,554
1888	849,587

The stock in London on the 1st January was as follows:—

	Barrels.
1886.....	98,483
1887.....	98,124
1888.....	70,519
1889.....	92,148

II.—STATISTICS OF THE PETROLEUM TRADE OF THE UNITED STATES, 1888.

	Barrels (of 42 American gals.).
Production of crude petroleum	16,259,975
Shipments of crude petroleum from the oil regions	26,470,654
Stocks of crude petroleum, Dec. 31st, 1887	28,354,299
Stocks of crude petroleum, Dec. 31st, 1888	18,595,471
Approximate consumption of crude petroleum for home trade	10,000,000
Approximate consumption of crude petroleum for export trade	16,000,000

Shipments of crude petroleum and its products from the United States (New York, Philadelphia, Baltimore, and Boston) during 1888, from the annual report of Messrs. Ibeling, Niemeyer, and Wessels.

Crude petroleum	{ 1,233,778 barrels. 1,138,428 cases.
Petroleum oil	{ 5,639,170 barrels. 13,432,867 cases.
Petroleum spirit	{ 264,262 barrels. 25,722 cases.
Petroleum residuum	15,062 barrels.

Of the crude petroleum and petroleum oil a considerable proportion was shipped in bulk.

III.—STATISTICS OF THE PETROLEUM TRADE OF RUSSIA.

Approximate Unofficial Estimates for the Year 1888.

Crude petroleum produced in the Balak-hany and Bibi-Eibat oil fields	Pounds. 175,000,000
Kerosene manufactured	52,000,000
Of the kerosene there were transported:—	
By rail from Baku to Batoum	31,000,000
By sea from Baku to the Volga	21,000,000
Of the kerosene transported by rail to Batoum, there were shipped:—	
To Odessa, about	3,000,000
Abroad, about	28,000,000
Of the kerosene shipped from Baku to the Volga, there were consumed in Russia about	16,000,000
And there were exported via the Austrian and German frontiers, or Baltic ports, about	5,000,000
Of lubricating oils the export exceeded	2,000,000
Of petroleum residuum the consumption in Russia as fuel probably amounted to	50,000,000

The United States and Russia continue to be the only countries exporting petroleum, though Canada and Galicia produce a large amount for home consumption, and in Scotland about half a million barrels of mineral oil are annually manufactured from shale. Several promising petroleum fields exist in India in addition to the well-known deposits in Burmah, and in many other countries petroleum occurs in considerable quantities, but as yet these sources have either been neglected or have not been so far developed as to become of commercial importance.

THE JUTE TRADE.

Although samples of jute were exhibited in this country in the beginning of the century, it was only about the year 1823 that sufficient quantity was received here to enable it to be tested as a fibre suitable for spinning purposes. For some years importers of jute met with little encouragement, as spinners, manufacturers, and consumers were all prejudiced against it, and it was only about the year 1835 that any progress was made in establishing the fibre as one suitable to be made into cloth. After that date, however, it began to be more freely used in Dundee, and year by year the consumption of that material there has steadily and rapidly increased. About 15 years ago the manufacture of jute was commenced on the Continent, and now in every country in Europe there are jute-spinning and weaving factories. Most of the jute is sent from London to these countries, but the direct shipments from Calcutta are getting larger every year.

For many years jute was used in combination with other fibres, principally hemp and flax, but now it is almost entirely used alone, the principal products of the fibre being Hessians, a light material used for packing and many other purposes, and the heavier fabrics, sackings and bagging. There is also a considerable quantity manufactured into carpets, rugs, table-cloths, and curtains, the jute being easily dyed, and made to produce very bright colours.

Most of the manufacturers in this country and on the Continent have machinery for finishing and packing their own goods, but in addition there are eight calendering works in Dundee, that finish, mangle, make up, and pack jute goods. They also cut up the cloth and make it into sacks or bags when required. Many of the manufacturers of carpets dye their own yarns, but there are four works in Dundee that only dye yarns. There are also 12 bleach works in the county of Forfar, many of which bleach or semi-bleach jute yarn and cloth, but the bulk of their business is bleaching flax yarns.

A considerable portion of the machinery used in the process of jute manufacture is made in Dundee and its neighbourhood, but it is also made in Leeds, Belfast, and other places.

METALS AND MINERALS OF THE UNITED KINGDOM.

STATEMENT SHOWING THE QUANTITIES OF METALS OBTAINABLE FROM ORES PRODUCED IN THE UNITED KINGDOM IN 1886 AND 1887, WITH THE TOTAL OFFICIAL VALUE AND THE AVERAGE VALUE PER TON.

Metal.	1886.			1887.		
	Quantity.	Value.	Average per Ton.	Quantity.	Value.	Average per Ton.
Copper	Tons. 1,472	£ 65,507	£ s. d. 44 10 0	Tons. 889	£ 42,850	£ s. d. 47 2 2
Gold .....	..	..	..	oz. 58	210	per oz. 3 12 4
Pig iron*	4,967,574	11,259,834	2 5 4	4,708,994	11,000,000	2 6 8
Lead	39,482	522,650	13 5 3	37,890	486,886	13 2 8
Magnesium	lbs. 250	1,200	4 16 0	..	1 0 0	..
Silver	oz. 325,427	63,051	0 3 10	oz. 320,315	59,564	0 3 8
Tin	9,312	944,470	101 8 6	9,282	1,048,633	112 18 0
Zinc	8,989	141,135	15 14 0	13,012	209,506	16 1 5

* The total quantities of pig iron made from home-raised and imported ores was 7,009,754 tons in 1886, and 7,559,518 tons in 1887.

STATEMENT SHOWING THE QUANTITIES OF MINERALS PRODUCED IN 1886 AND 1887, WITH THE TOTAL OFFICIAL VALUE AND THE AVERAGE VALUE AT THE MINES IN EACH YEAR, EXPRESSED IN SHILLINGS AND DECIMALS THEREOF.

Mineral.	1886.			1887.		
	Quantity.	Value.	Average per Ton.	Quantity.	Value.	Average per Ton.
	Tons.	£	£ s.	Tons.	£	£ s.
Alum clay (bauxite)	8,262	2,478	0 6'00	4,169	1,040	0 4'98
Alum shale	2,962	374	0 2'5	2,586	323	0 2'49
Arsenic	5,027	32,862	6 10'5	4,618	32,458	7 0'02
Arsenical pyrites	4,918	7,749	1 11'5	4,364	3,205	0 14'63
Barytes	25,142	25,818	1 0'53	24,813	26,619	1 1'05
Bog iron ore	6,780	2,712	0 7'98	9,273	4,630	0 9'09
Clays (excepting ordinary clay)	2,390,440	583,210	0 4'87	2,413,693	590,412	0 4'88
Coal	157,518,930	38,143,930	0 4'84	162,119,812	39,092,830	0 4'69
Cobalt and nickel ore	100	526	5 5'2	154	900	4 18'8
Copper ore	18,205	88,567	2 2'36	9,079	20,982	2 6'22
„ precipitate	412	2,831	6 17'42	280	3,075	10 19'64
Fluorspar	279	412	1 9'52	288	885	1 7'20
Gold ore .....	..	..	..	cwts. 17½	209	12 1'61
Gypsum	118,848	44,462	0 7'45	120,783	48,293	0 7'60
Iron ore	14,110,013	3,513,515	0 4'97	13,098,041	3,235,355	0 4'94
„ pyrites	27,829	16,575	0 11'85	22,079	12,682	0 11'48
Lead ore	53,429	471,295	8 17'73	51,563	429,137	8 6'06
Lignite .....	..	..	..	1,764	793	0 8'09
Manganese ore	12,763	10,893	0 16'66	13,777	11,110	0 16'12
Ochre, umber, &c.	12,392	22,185	1 16'66	8,293	15,789	1 18'07
Oil shale	1,728,503	435,962	0 5'61	1,411,378	355,085	0 5'03
Petroleum	43	129	0 3'00	66	99	1 10'00
Phosphate of lime	20,000	31,500	0 1'55	9,894	15,830	1 12'30
Salt	2,142,220	712,178	6 9'29	2,193,951	732,320	0 6'67
Slates and slabs	456,208	1,107,169	2 8'53	464,334	1,118,818	2 8'19
Stone, &c. ....	..	8,917,705	..	..	8,609,600	..
Sulphate of strontia	13,602	5,750	0 8'45	15,169	7,584	0 9'09
Tin ore	14,232	780,362	54 16'5	14,189	878,831	61 18'70
Tungstate of soda	11	213	24 16'66	1	24	24 00'00
Wolfram	140	2,236	15 19'43	54	1,269	23 10'00
Zinc ore	23,156	63,759	2 15'06	25,445	76,182	2 19'80

TRADE OF THE UNITED KINGDOM WITH FOREIGN COUNTRIES AND BRITISH POSSESSIONS.

VALUE OF THE TOTAL IMPORTS AND EXPORTS OF MERCHANDISE INTO AND FROM THE UNITED KINGDOM DURING EACH OF THE YEARS FROM 1860 TO 1888, DISTINGUISHING THE TRADE WITH FOREIGN COUNTRIES AND BRITISH POSSESSIONS, AND ALSO THE EXPORTS OF DOMESTIC PRODUCE AND FOREIGN AND COLONIAL PRODUCE. (000's OMITTED.)

Years.	Imports.			Exports.								
	From Foreign Countries.	From British Possessions.	Total Imports.	Domestic Produce.			Foreign and Colonial Produce.			Total Exports.		
				To Foreign Countries.	To British Possessions.	Total.	To Foreign Countries.	To British Possessions.	Total.	To Foreign Countries.	To British Possessions.	Total.
	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000
1860	167,571	42,960	210,531	92,226	43,665	135,891	25,762	2,868	28,630	117,988	46,533	164,521
1861	164,809	52,676	217,585	82,857	42,216	125,103	31,636	2,894	34,530	114,194	45,139	159,633
1862	160,434	65,283	225,717	82,097	41,895	123,992	38,617	3,529	42,176	120,744	45,424	166,168
1863	161,235	81,984	243,219	95,723	50,879	146,602	46,209	4,091	50,300	114,932	54,970	169,902
1864	181,208	93,744	274,952	108,735	51,714	160,449	48,173	3,998	52,171	156,908	55,712	212,620
1865	198,231	72,841	271,072	117,629	48,207	165,836	49,656	3,349	52,996	167,285	51,547	218,832
1866	223,084	72,206	295,290	135,198	53,720	188,918	46,549	3,448	49,988	181,738	57,168	238,906
1867	214,449	60,734	275,183	131,162	49,800	180,962	41,278	3,563	44,841	172,441	53,362	225,803
1868	227,700	66,094	293,794	129,813	49,865	179,678	44,248	3,853	48,101	174,061	53,718	227,779
1869	225,004	70,416	295,460	141,881	48,073	189,954	43,242	3,819	47,061	185,123	57,893	237,015
1870	238,425	64,832	303,257	147,773	51,814	199,587	49,917	3,577	44,494	188,689	55,392	244,081
1871	258,071	72,914	331,015	171,816	51,250	223,066	56,198	4,311	60,509	228,014	55,561	283,575
1872	275,321	79,373	354,694	195,702	60,566	256,258	53,278	5,053	58,331	248,980	65,609	314,589
1873	290,277	81,010	371,287	188,836	66,329	255,165	51,021	4,819	55,840	239,857	71,118	311,005
1874	287,920	82,163	370,083	167,278	72,280	239,558	52,462	5,630	58,092	219,740	77,910	297,650
1875	289,516	84,424	373,940	152,374	71,092	223,466	52,583	5,563	58,146	204,957	76,655	281,612
1876	290,822	84,323	375,155	135,780	64,859	200,639	50,847	5,291	56,138	186,627	70,150	256,777
1877	304,866	89,554	394,420	128,970	69,923	198,893	47,624	5,829	53,453	176,594	75,752	252,346
1878	296,835	77,936	374,771	126,612	65,237	191,849	46,880	5,755	52,635	173,491	71,963	245,484
1879	284,949	78,943	363,892	130,539	61,002	191,532	51,745	5,597	57,252	182,275	66,590	248,784
1880	318,711	92,519	411,230	147,807	75,254	223,061	57,081	6,273	63,354	204,887	81,528	286,415
1881	305,483	91,540	397,023	151,658	79,365	231,023	55,744	7,316	63,060	210,402	86,681	297,083
1882	313,589	99,431	413,020	156,641	84,826	241,467	57,683	7,511	65,194	214,323	92,338	306,661
1883	328,216	98,682	426,892	156,322	83,478	239,800	58,714	6,923	65,637	215,036	90,401	305,437
1884	294,206	95,813	390,019	152,119	80,876	233,025	55,515	7,428	62,943	207,664	88,304	295,968
1885	286,566	84,402	370,968	155,115	77,930	213,045	59,865	7,494	58,359	185,980	85,324	271,404
1886	267,979	81,884	349,863	136,026	75,597	211,623	49,673	6,561	56,234	186,599	82,068	268,667
1887	278,429	83,799	362,228	146,278	75,136	221,414	52,448	6,900	59,348	198,727	82,036	280,763
1888	300,720	86,916	387,636	149,944	83,038	233,842	56,556	7,486	64,042	206,460	91,125	297,885

IMPORTS AND EXPORTS OF THE UNITED KINGDOM.

VALUE OF THE TOTAL IMPORTS AND EXPORTS OF MERCHANDISE INTO AND FROM THE UNITED KINGDOM DURING EACH OF THE YEARS FROM 1860 TO 1888, WITH THE PROPORTION THEREOF PER HEAD OF THE POPULATION.

Years.	Imports.		Exports.				Total of Imports and Exports.	
	Total Value.	Proportion per Head of Population of United Kingdom.	British Produce.		Foreign and Colonial Produce.	Total Value of British and Foreign and Colonial Produce.	Total Value.	Proportion per Head of Population of United Kingdom.
			Total Value.	Proportion per Head of Population of United Kingdom.				
	£	£	£	£	£	£	£	£
1860	210,530,873	7·35	135,801,227	4·73	28,630,124	164,521,351	375,052,224	13·03
1861	217,485,024	7·51	125,102,814	4·32	34,529,684	159,332,498	377,117,522	13·02
1862	223,716,976	7·73	123,902,264	4·28	42,175,870	166,168,134	391,885,110	13·41
1863	248,919,020	8·47	146,602,342	5·00	50,300,067	196,902,409	445,821,429	15·17
1864	274,952,172	9·28	160,449,053	5·41	52,170,561	212,619,614	487,571,786	16·44
1865	271,072,285	9·08	165,835,725	5·55	52,993,851	218,831,576	489,903,861	16·41
1866	293,290,274	9·81	188,917,536	6·28	49,988,146	238,905,682	534,195,956	17·75
1867	275,183,137	9·07	180,961,923	5·96	44,840,606	225,802,529	500,985,666	16·06
1868	294,693,608	9·64	179,677,812	5·86	48,106,642	227,778,454	522,472,062	17·06
1869	295,430,214	9·55	189,953,967	6·13	47,061,095	237,015,052	532,475,266	17·22
1870	303,257,493	9·72	199,586,322	6·39	44,493,755	244,080,077	547,338,970	17·54
1871	331,015,180	10·50	223,066,162	7·09	60,598,538	283,574,700	614,590,180	19·50
1872	354,693,624	11·12	256,257,347	8·05	58,331,487	314,588,834	669,282,458	21·02
1873	371,287,372	11·53	255,164,603	7·93	55,840,162	311,004,765	682,292,137	21·20
1874	370,082,701	11·39	239,558,121	7·37	58,092,343	297,650,464	667,733,165	20·54
1875	373,639,577	11·39	223,465,963	6·80	58,146,360	281,612,323	655,551,900	19·96
1876	375,154,703	11·30	209,639,204	6·04	56,137,398	256,776,602	631,931,305	19·63
1877	394,419,682	11·74	198,893,065	5·92	53,452,655	252,346,020	646,765,702	19·26
1878	368,770,742	10·86	192,848,914	5·68	52,634,944	245,483,858	614,254,600	18·09
1879	362,991,875	10·58	191,531,758	5·58	57,251,606	248,783,364	611,775,239	17·83
1880	411,229,565	11·88	223,060,446	6·44	63,354,020	286,414,466	397,644,031	20·15
1881	397,022,489	11·36	234,022,678	6·69	63,060,067	297,082,775	694,105,264	19·85
1882	413,019,608	11·70	241,467,162	6·84	65,193,552	306,660,714	719,680,322	20·38
1883	428,891,579	11·99	239,799,473	6·73	65,637,597	305,437,070	732,328,649	20·56
1884	399,018,569	10·84	233,025,242	6·48	62,942,341	295,967,583	685,986,152	19·07
1885	379,967,955	10·21	213,644,500	5·86	58,359,194	271,403,694	642,371,649	17·68
1886	349,863,472	9·53	212,432,754	5·77	56,234,263	268,667,017	618,530,489	16·85
1887	362,227,564	9·77	221,414,156	5·97	59,348,975	280,763,161	642,990,725	17·34
1888	387,635,743	10·35	233,842,067	6·24	64,042,629	297,885,236	685,520,979	18·30

—Year Book of Commerce.

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

14,736. G. F. Redfern.—From W. P. Abell, British Guiana. Centrifugal machines. September 18.

14,786. E. de Pass.—From G. Lelièvre. Means for raising, conveying, and projecting liquids by compressed air. September 19.

14,865. C. W. Guy. Improvements in and relating to evaporating apparatus, also applicable to steam generators. September 20.

14,891. T. Parker. See Class XI.

14,951. E. Ackroyd.—From E. Ackroyd, New Zealand. Improvements in filters. September 23.

14,958. J. Hodgkinson. Mechanical stokers, and apparatus connected therewith. September 23.

15,124. R. C. A. Bantfield.—From C. Liude, Germany. Method and means for refrigerating and drying air. September 25.

15,229. P. Colligan. Apparatus for gauging liquors whilst boiling. September 27.

15,432. R. Marsden and J. Pickard. Improvements in condensers. October 1.

15,599. C. Thompson. Improvements in gas furnaces. October 4.

15,867. C. Thompson. Improvements in gas furnaces. October 9.

16,010. J. Fitton. An anti-corrosion composition for retorts used for evaporating acids and other similar purposes. October 11.

16,037. H. H. Lake.—From C. A. Catlin, C. S. Sweetland, and R. Cox, United States. An improved method of charging liquids with gas. Complete Specification. October 11.

16,063. G. Rose. Apparatus for pumping, raising, or forcing liquids, air, or gases. October 12.

16,099. P. Nézeraux. Centrifugal pumps, compressors, and blowers. October 12.

COMPLETE SPECIFICATIONS ACCEPTED.*

1888.

11,613. I. S. McDougall and J. T. McDougall. See Class XIX.

15,229. J. Newton and D. A. Quiggin. Coiled tubular heating or cooling surfaces for apparatus for condensing steam, heating or cooling fluids, and evaporating. September 25.

15,495. J. Hilton, E. Jackson, and G. C. Hilton. Furnaces for economising fuel and consuming smoke. October 9.

16,372. H. Paplett and J. L. Rigg. Apparatus for distillation and liquefaction of condensable gases. October 16.

16,443. L. Johnson and J. Powell. Apparatus for charging furnaces or for analogous purposes. September 25.

16,535. T. Gaunt and E. H. Clapp. Apparatus for evaporating, distilling, refining, or concentrating liquids. October 2.

16,726. J. Cooper. Blast or air supply pipes for gas producers and other furnaces. October 16.

17,425. J. Buchanan. Fluid pressure and vacuum gauges. September 25.

17,564. Sir L. Bell, Bart. Evaporating brine and other solutions. October 9.

18,085. A. E. Tavernier and E. Casper. An improved pressure gauge. October 16.

18,177. H. R. Gregory and G. MacDonald. Manufacture of filtering material applicable to the filtration and purification of water, sewage effluents, saccharine juices, alcoholic liquors, and other liquids and fluids. October 9.

1889.

10,991. P. H. Adams, jun., and O. T. X. Adams. See Class X.

11,020. P. H. Adams, jun., and O. T. X. Adams. See Class X.

12,514. J. Y. Johnson.—From La Compagnie Industrielle des Procédés Raoul Pietet, France. A mixture for use in apparatus for producing cold. October 2.

13,212. R. Reichling. Apparatus for evaporating, cooling, or heating liquids, and for charging gases with vapours. October 2.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

14,644. W. P. Thompson.—From F. P. Dewey, United States. Improvements in or appertaining to the separating and collecting of the solid materials from fume, smoke, or the like. Complete Specification. September 17.

14,686. H. Howell and L. Smith. A new or improved automatic carburettor or apparatus for enriching or generating illuminating gas from volatile liquid hydrocarbons. September 18.

14,715. E. Mansfield. Improvements in oil-gas apparatus. September 18.

14,717. G. W. Macalpine. An improvement in coke-oven valves. September 18.

14,881. A. Kitt. Improvements in gas-making apparatus. Complete Specification. September 20.

14,922. A. Kitson. Apparatus for manufacturing heating gas. Complete Specification. September 21.

14,990. J. R. Wigham. Improving the illuminating power of lighthouses and other places. September 23.

15,106. C. McKenzie Dowie and A. L. Briggs. Improvements in apparatus for carburetted illuminating and other gas. September 25.

15,269. J. Dunn and J. K. Thompson. Improvements in an appliance for economising the consumption of fuel and obtaining greater heat. September 28.

15,409. J. Somerville and S. Cutter. Improvements in apparatus for charging and drawing gas retorts. October 1.

15,421. H. G. F. de Beaumont. Improvements in the manufacture of water-gas. October 1.

15,426. M. A. Morse. Improvements relating to the manufacture of gas and to apparatus therefor. Complete Specification. October 1.

15,500. P. G. Lambert. A device for increasing the illuminating power of gas. October 3.

15,797. J. R. Paisley. Improvements in or connected with apparatus for the manufacture of water-gas applicable for gas engines and other purposes. October 8.

15,906. C. Bernard. Improvements in or relating to coke furnaces. October 9.

15,947. J. H. Fergusson. Improvements in and connected with the manufacture of illuminating gas from coal and analogous material. October 10.

15,988. J. Haworth. Improvements in apparatus for manufacturing illuminating and heating gas. October 11.

16,009. J. Lawson. Improvements in oil-gas producing apparatus. October 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

15,655. W. T. Walker. Desulphurising the lime used in gas purifiers, and recovering the sulphur therefrom. October 9.

15,983. B. Loomis. Process and apparatus for manufacturing fuel gas. October 9.

16,118. C. Brotherhood. Apparatus for automatically controlling the generation of gas from oil or other liquid fuel. September 25.

16,194. J. H. R. Dinsmore. Manufacture of illuminating gas. September 25.

16,927. R. R. Hutchinson. Generating gas from hydrocarbon oils, and apparatus therefor. October 9.

16,958. J. E. Dowson and A. Dowson. Apparatus for use in the treatment of gas. October 2.

17,738. J. A. Yeaton and R. Middleton. Machinery for manufacturing blocks or briquettes of fuel or materials for smelting, &c. October 16.

1889.

1326. J. Greenfield.—From C. A. d'Assumpção and E. S. Dias. Treatment of coal and small coke or breeze in the manufacture of gas and coke. September 25.

13,129. C. B. Harris. Making incandescing elements for gas burners. October 2.

13,763. E. Tatham. An improved gas, usable as an explosive, and, in admixture with other gases, as an illuminating and heating gas. October 16.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

15,175. O. Imray.—From The Farbwerke vorm. Meister, Lucius, and Brüning, Germany. Improvements in the production of amido-oxy-naphthalin-disulphonic acid and of amido-dioxy-naphthalin-monosulphonic acid. September 26.

15,176. O. Imray.—From The Farbwerke vorm. Meister, Lucius, and Brüning, Germany. Improvements in the production of amido-naphthol-monosulphonic acids. September 26.

15,296. A. G. Green. The production of new azo-colouring matters. September 28.

15,360. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran. Manufacture of new derivatives of tannin and catechin and of colouring matters obtained therefrom. Complete Specification. September 30.

15,558. F. Rhodes. Improvements in dye-extracting apparatus. Complete Specification. October 3.

15,678. W. R. Lake.—From Messrs. Kern and Sandoz, Switzerland. Improvements in the manufacture of colouring matter. October 5.

15,706. M. Lange. A process for the production of thioxydiphenylamine. October 7.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

14,822. O. Imray.—From The Farbwerke vorm. Meister, Lucius, and Brüning, Germany. Production of green and bluish-green colouring matters. October 9.

17,094. C. F. X. Noroy. A new dyeing material, and method of employing the same. October 2.

18,425. S. Pitt.—From L. Casella. Bluish-black colouring matters. October 16.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

14,751. I. Smith. Improvements in the treatment of woollen, worsted, back-worsted, unions, and other woven fabrics. September 19.

15,135. J. E. Richardson. Improvements in the preparation or treatment of esparto grass for use in the manufacture of carpets, matting, twine, and other materials. September 25.

15,333. K. T. Sutherland and G. Esdaile. Improvements in the treatment of fibres and fibrous materials made of China grass, flax, hemp, &c., by which means such can be more easily cleansed or bleached. September 30.

15,916. I. Leviustein. See Class XIX.

COMPLETE SPECIFICATIONS ACCEPTED.

1889.

13,173. J. Holden and J. R. Jepson. Manufacture of felt. September 25.

14,316. J. Grunhut, E. Gonty, and F. B. Gonty. Process for waterproofing materials or fabrics. October 16.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

14,610. R. Nickels. Improvements in the method of and apparatus for dyeing and otherwise treating cotton and other vegetable fibres in sliver, roving, yarn, or other state of preparation. September 17.

14,710. A. S. Bowden.—From A. Vendôme, France. Improvements in machines for printing designs on paper or other material, applicable to decorating earthenware, china, and other similar articles. September 18.

15,094. R. Locfler. A new mordant for dyeing vegetable fibres. September 25.

15,671. L. Schreiner. Improvements in bleaching. October 5.

15,881. J. C. Mewburn.—From La Société Grandsire et fils, France. Improvements in apparatus for dyeing skeins. October 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

15,955. J. W. Hepworth. Method and apparatus for dyeing woollen cloths, &c. September 25.

18,780. H. Recker. Process and apparatus for dyeing cotton yarn. October 16.

18,987. J. Pollard. Apparatus for washing, bleaching, dyeing, &c. textile fabrics. September 25.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

15,322. C. T. Casebourne. Improvements in or relating to the conversion of brine into salt. September 30.

15,531. W. L. Wise.—From Messrs. Solvay and Co., Belgium. Improvements in and connected with apparatus for producing gaseous hydrochloric acid. October 3.

15,649. F. Bale. Improvements in obtaining ammonia, chlorine, and hydrochloric acid from ammonium chloride, and in the apparatus employed therein. October 5.

15,652. J. Grossmann. The purification of alkali waste. October 5.

15,655. J. Grossmann. Improvements in the manufacture of nitrite of soda. October 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

15,097. J. R. Wyld, M. J. Hammill, and H. Auer. Separating chlorate of potash (and, if desirable the chloride of calcium or magnesium or other similar salt in the mother-liquor) from solutions thereof. October 2.

15,256. A. C. Ponton, B. L. Mosely, and C. Chambers. Crystallisation of silica in a compacted mass. October 16.

15,367. H. W. Wallis. Production of carbonate of soda. September 25.

17,367. T. Parker and A. E. Robinson. Manufacture of chlorine. October 16.

17,447. T. Parker and A. E. Robinson. Manufacture of cyanogen compounds from sulpho-cyanides. October 9.

17,564. Sir L. Bell, Bart. See Class I.

17,569. F. Foster. Apparatus for generating carbonic acid gas. October 16.

1889.

382. M. Williams. Manufacture of barytes. October 16.

8883. C. A. Doremus. Process for removing salts of calcium, magnesium, and other metals from aqueous solutions. September 25.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

14,653. A. J. Clay. Improvements in the manufacture of glazed bricks and tiles. September 17.

14,710. A. S. Bowden.—From A. Vendôme. See Class VI.

14,723. F. Fehse. Improvements in the manufacture of decorative tiles and ornaments. September 18.

15,801. Sir H. Doulton and J. Slater. Improvements in decorating china and the like. October 8.

15,831. F. P. Meyenberg. Improvements in brick and pottery kilns. October 8.

15,959. T. C. Brown-Westhead, Moore, and Co. Improved process of printing in clays, applied to gold, silver, and colour decorations on china and earthenware and pottery generally. October 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1889.

8597. J. Stiel. A weather- and acid-proof enamel for building materials, and method of producing same. October 9.

9148. F. E. Grosse. Process for manufacturing iridescent, blown, rolled, or pressed window glass. October 9.

9960. D. Lucas. Printing upon and decorating china, earthenware, or glass. September 25.

13,128. A. G. Neville. Glass melting pots. September 25.

13,880. M. W. Griswold and W. B. Atterbury. Manufacture of sheet or window glass. October 9.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

14,600. J. Cockburn. Improvements in the manufacture of pavement, floor coverings, and the like, of rubber or rubber compounds. September 17.

14,643. W. Torrance, jun. Improvements in or relating to the manufacture of Portland cement. September 17.

14,733. D. Nicoll. Improvements in waterproof slabs and blocks for structural purposes. September 18.

14,778. J. A. Macmickan. Improvements in coping bricks. September 19.

14,963. H. Stanton. Improvements in fire-resisting floors for buildings. September 23.

14,997. A. Bishop. Improvements in the method of burning lime, and in kilns therefor. September 23.

15,115. W. Joy. Improvements in apparatus for separating imperfectly disintegrated chalk and other matters from slurry prepared in wash mills and other apparatus used for mixing and preparing slurry for the manufacture of cement, and improvements in cement kilns, and in the method of loading or charging such kilns, and improvements in mills for grinding cement, clinker, and other like matters, and in apparatus for separating the finer from the coarser particles of ground cement, clinker, and other like matters; and the treatment of cement, and apparatus for use in connexion with the said treatment. September 25.

15,405. J. C. W. Stanley. Improvements in or relating to the burning of bricks or the like. October 1.

15,406. W. J. Oswald, J. R. Ashwell, and J. A. Cooke. Improvements in the manufacture of plaster of Paris, and in the utilisation of waste or cheap materials therefor. October 1.

15,669. J. Ersley. Improvements in the manufacture of artificial asphalt. Complete Specification. October 5.

15,737. W. T. Timewell. Improvements in the manufacture of Portland cement made from hard limestone. October 8.

15,831. F. P. Meyenberg. See Class VIII.

16,015. E. Johnson. Perforated paving. October 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

16,770. C. O. Weber and F. W. Follows. Artificial stones or blocks, applicable for grinding, crushing, granulating, polishing, &c. September 25.

17,257. W. Cussans. Colouring and ornamenting Portland cement for the manufacture of imitation grained or figured marble mosaics, slabs, tiles, &c. September 25.

17,563. W. Lindsay. Fireproof floors. October 9.

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

14,770. E. J. Railton. Improvements in gold screening apparatus. September 19.

14,880. W. R. Lake.—From E. Thomson, United States. Improved methods of and apparatus for welding, shaping, and otherwise working metals. September 20.

15,027. T. Millward. Improvements in furnaces for heating iron or for other purposes. September 24.

15,066. R. Hannan.—From J. J. C. Smith, New Jersey. Casting in aluminium bronze dies to be used for the purpose of stamping metals or other substances for which dies are used. Complete Specification. September 24.

15,144. T. Lambert. The extraction of gold and silver from pulverised ores or other matrix in which these metals are found. September 26.

15,156. B. Moran. Improvements in crucible pots. September 26.

15,226. A. J. Campion. Improvements in the extraction of tin and other oxides from the refuse slags and debris of tin smelting furnaces. September 27.

15,245. E. Grutzner and O. Koehler. Apparatus and process for condensing the metallic vapours produced in zinc furnaces, and furnace applicable in combination with the said condensing apparatus. September 27.

15,301. W. H. Akester, W. T. Glover, and H. Edmunds. Improvements in the treatment or manufacture of metals or metallic alloys. September 28.

15,302. W. H. Akester, W. T. Glover, and H. Edmunds. Improvements in the treatment of metallic castings or forgings for remedying or repairing imperfections thereof.

15,413. T. Twynam. Improvements in the direct reduction of oxides of iron. October 1.

15,428. T. F. Rowland. Improvements in apparatus for welding metals. Complete Specification. October 1.

15,465. D. Rennie. Improvements in furnaces for melting crucible steel and other metals. October 2.

15,552. T. H. Roberts and T. Underhill. Improvements in puddling furnaces and in appliances connected therewith. October 3.

15,563. J. H. Watkins. A resinous fluid or flux, for soldering, brazing, and the like. October 3.

15,729. N. Lébédéff. Improvements in extracting copper and nickel from combinations of these metals with other substances. October 7.

15,792. L. Grabau. An improved apparatus for obtaining metals of the alkalis from molten chloride. October 8.

15,824. G. Archbold. Improvements in the manufacture of iron and steel. Complete Specification. October 8.

15,887. P. P. Craven. A new fluxing or protecting material for use in the welding and brazing of metals. Complete Specification. October 9.

15,970. W. C. Taylor and T. N. Kirkham. Improvements in the treatment of gold-bearing quartz and other minerals for facilitating their reduction to powder. October 10.

16,101. I. Beardmore. Improvements in the distributing of the gases in open-hearth furnaces for steel melting and analogous purposes, and in the means or apparatus employed therefor. October 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

13,884. L. Q. Brin. Production of alloys of copper with iron or steel. September 25.

14,287. L. Q. Brin. Process for alloying iron and steel with aluminium in the blast furnace. October 2.

14,332. H. W. Wallis. Hardening and tempering steel. October 9.

15,506. L. Q. Brin and A. Brin. Method of plating metals with aluminium, platinum, silver, gold, &c. October 2.

15,507. L. Q. Brin and A. Brin. Alloying metallic aluminium with any other metal. October 2.

16,671. W. C. Roberts-Austen, E. J. Ball, and A. Wingham. Manufacture of iron and steel. September 25.

16,821. A. Arche. Separation of lead from silver, &c. September 25.

16,854. G. M. Edwards and W. J. Griffiths. Machinery for dressing or concentrating tin and other mineral ores. September 25.

17,324. L. H. Cahaigne. Apparatus for the treatment of zinc. October 2.

17,373. R. Middleton. Preparing materials for smelting, &c. October 9.

17,614. B. J. Mills.—From T. A. Edison. Methods and apparatus for effecting the separation of metals from their ores. October 9.

17,614A. B. J. Mills.—From T. A. Edison. Methods and apparatus for effecting the separation of metals from their ores. October 16.

17,614B. B. J. Mills.—From T. A. Edison. Methods and apparatus for effecting the separation of metals from their ores. October 9.

17,738. J. A. Yeadon and R. Middleton. See Class II.

18,020. P. R. Shill. Machinery for crushing or reducing and amalgamating auriferous quartz or ores, &c. October 16.

1889.

560. G. Gatheral. Treatment of copper precipitates. October 2.

10,991. P. H. Adams, jun., and O. T. X. Adams. Apparatus for use in decomposing chemical compounds, metallic salts, and desulphurising ores. October 9.

11,020. P. H. Adams, jun., and O. T. X. Adams. Apparatus for use in decomposing chemical compounds, metallic salts, and desulphurising ores. October 9.

13,013. N. M. de la E. Tenison-Woods. Extracting metals from alkaline solutions, scrap, or waste materials. September 25.

13,138. H. H. Lake.—From G. W. Cummins and J. H. Colman. Treating iron, steel, and other metals to prevent oxidation thereof while in a heated state. September 25.

13,839. H. J. Allison.—From the Great Western Aluminium Smelting and Refining Company, United States of America. Process for obtaining aluminium. October 9.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

14,551. H. A. Henderson. A primary battery solution. September 16.

14,552. H. A. Henderson. Improvements in or relating to primary batteries. September 16.

14,601. G. Macaulay-Cruikshank.—From S. H. Barrett, Massachusetts. An improved connector for the elements of electric batteries. Complete Specification. September 17.

14,677. R. R. Moffatt. Improvements relating to the application and utilisation of electro-magnetism for the separation of metals, and to apparatus therefor. September 17.

14,871. E. Hopkinson and D. Appleton. Improvements connected with or applicable to baths or vessels containing liquids used in electro-plating or dyeing, or the electrolyte of storage batteries and the like. September 20.

14,894. T. Parker. Improved furnace and apparatus for electro-chemical and chemical manufactures. September 21.

14,971. P. J. R. Dujardin. Improvements in secondary batteries. September 23.

15,230. Sir W. Vavasour. Improvements in electric batteries. September 27.

15,235. F. V. Anderson. Improvements in dynamo-electric machinery. September 27.

15,299. J. H. Pratt. Improvements in the electrical reduction and recovery of metals from metallic ores and from compounds and mixtures containing metals. September 28.

15,383. G. E. Heyl. The manufacture of electrodes for accumulators from chromates and wolframates, and particularly from amalgams of chrom, and from amalgams of wolfram with other metals respectively. October 1.

15,446. S. C. C. Currie. Improvements in the method of and apparatus for "forming" or charging plates for electrical accumulators. Complete Specification. October 1.

15,700. W. B. Sayers. Improvements in dynamo machines for electro-plating. October 7.

15,775. C. F. Winkler. Improvements in electro-dynamic and dynamo-electric machines. Complete Specification. October 8.

15,821. S. C. C. Currie. Improvements in the method of electrolytically reducing plates of metallic salts to a metal state to "form" the electrodes of secondary or storage batteries. Complete Specification. October 8.

15,963. P. Schoop. Improvements in the manufacture of electrodes or plates for electrical purposes. October 10.

16,036. W. E. Irish. Improvements in galvanic batteries. Complete Specification. October 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

13,687. R. E. B. Crompton. Electrical furnaces. October 2.

14,322. S. Miller. An improved galvanic cell or battery. October 9.

14,323. S. Miller. Electrolyte or depolarising solution for galvanic batteries. October 9.

15,508. L. Q. Brin and A. Brin. Producing aluminium and its alloys by means of electricity. October 9.

16,479. H. H. Lake.—From H. Walter. Secondary batteries. October 16.

17,537. M. Bailey and J. Warner. Cells for secondary batteries. October 2.

17,694. H. J. Harris and J. Garford. Voltaic batteries. October 9.

18,589. J. L. Huber. Secondary batteries. October 16.

1889.

3222. A. J. Boulton.—From A. K. Reinhold. Treating plates, &c. for facilitating the removal of galvanic plastic deposits therefrom. October 9.

11,471. E. N. Reynier. Electric accumulators. October 2.

11,780. C. E. Buell. Dynamo-electric generators. October 9.

12,145. P. M. Justice.—From E. G. Acheson. Generating electricity or magnetism by the application of heat. October 2.

12,752. H. G. Morris and P. G. Salom. Machines for filling secondary battery plates. September 25.

13,480. W. P. Kookogey. Switching apparatus for charging storage batteries. October 9.

13,636. F. Hughes.—From E. J. McDonald. Manufacture of indigo by the application of electricity. October 9.

13,864. S. C. C. Currie. Apparatus for automatically charging secondary batteries. October 9.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

14,914. W. G. Little. Improvement in soap. September 21.

15,835. J. G. S. Fawns.—From J. S. Burns, United States. Improved manufacture or preparation of lubricating oils or compounds, and a mixture to be used in the said manufacture or preparation. October 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

14,692. H. Ritter von Dahmen. Manufacture of oleaginous material from hydrocarbons, applicable for saponification, &c. September 25.

17,628. W. Michell and S. Picard. Process and composition for extracting oil from, and cleaning cotton waste. October 16.

19,015. G. T. Bishop. Apparatus employed in the manufacture of soap. October 16.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

14,569. F. Eekstein. Improvements in translucent plastic compositions. September 16.

14,797. R. Barton. Improvements in paints or compositions for covering surfaces. September 19.

14,828. E. G. Stidder. A blacklead varnish for grates, stoves, and other objects usually polished after the application of blacklead. September 20.

14,889. A. French and J. Gordon. Improvements in making white pigments of lead. September 21.

15,255. W. C. Edwards and J. H. W. Smeed. A new or improved ink powder. September 27.

15,805. W. L. Wise.—From J. P. Perkins. A new pigment or paint base and processes of producing the same. October 8.

15,826. A. J. Boulton.—From W. Kiel, United States. Improvements in or relating to the manufacture of vulcanised plastic compounds. October 8.

15,949. H. Thame. Improvements in plastic compositions and the moulding or manufacture thereof into various forms. October 10.

16,039. J. H. Noad. A process and apparatus for the manufacture of carbonate of lead or white pigment. October 11.

COMPLETE SPECIFICATION ACCEPTED.

1889.

13,345. W. P. Thompson.—From P. Leonard and P. Zen. Anticorrosive composition for protecting iron vessels. October 2.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

14,595. A. Hull. An improved method of preparing hides for tanning. Complete Specification. September 17.

14,774. C. Hough. An improved means or mode to be employed in the liming and tanning of skins. September 19.

15,450. B. Nicholson and T. Palmer. The treatment of tanning extracts and other vegetable extracts for decolourising and preserving the same. October 1.

15,777. G. Hand-Smith and P. Warnford-Davis. Improvements in rendering ivory, bone, horn, wood, and similar materials non-absorbent. October 8.

16,081. A. Kraft. Process and composition for producing a new or improved gilding size. October 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1889.

13,126. P. Jensen.—From D. Pierson, jun. Process of chrome-tanning leather, and the article produced thereby. October 16.

13,542. R. C. Waut.—From G. Mitchell and R. W. Rutherford. Means and process for preparing skins and hides for tanning. October 9.

XV.—AGRICULTURE AND MANURES.

APPLICATIONS.

14,633. N. B. Powder. A compound of animal substances and earths containing phosphate of iron and alumina for fertilising purposes. Complete Specification. September 17.

14,719. A. Manbré, sen. See Class XVII.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATION.

14,940. W. T. Crooke. Improvements in pockets or bags employed in the manufacture of sugar and like substances, together with an improved process for cleansing the same. September 23.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

17,339. A. Baumgarth. Refining sugar, and apparatus therefor. September 25.

1889.

12,393. W. Fairweather.—From The Babcock and Wilcox Co. Bagasse furnaces. October 2.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

14,584. H. M. King. Purification of beer bottles, wine barrels, vats, and utensils used by brewers, distillers, and wine merchants. September 16.

14,642. L. Frisch. Improvements in or relating to the manufacture of beer, ale, porter, and the like. Complete Specification. September 17.

14,719. A. Manbré, sen. Improvements relating to the manufacture of spirit from grain and cereals, and to the treatment of the by-products derived therefrom for producing cattle-food, charcoal, and manure. September 18.

14,928. A. Manbré, sen. Improvements relating to the manufacture of refined malt and extract from barley malt and from barley malt and amylaceous substances, and the treatment of the spent grains for the production of cattle-food. September 21.

15,064. A. Manbré, sen. Improvements relating to the production and manufacture of methylated spirit, and the treatment of the by-products derived therefrom. September 24.

15,401. A. J. Boulton.—From Otto and Schwerdtfeger, Saxony. Improvements in or relating to the preservation of beer and the like. October 1.

15,568. J. F. Gallogly. A process for maturing and mellowing of new whiskies, brandies, and all other liquors containing alcohol, producing in a few months a similar result to that obtained by many years' storage. October 4.

15,624. W. R. Lake.—From F. A. Reihlen, Germany. Improvements relating to ferments and to the fermentation of liquids. October 4.

15,772. J. Bruce. Improvements in the manufacture of yeast. October 8.

16,079. C. Huelser.—From N. Reif, Germany. An improved cooling apparatus for brewing purposes. October 12.

16,093. W. P. Thompson.—From La Société Générale de Maltose, Belgium. Improvements in or relating to a process for the saccharification and fermentation of amylaceous matter. October 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

17,972. I. Traube. Separation of mixtures of ethyl alcohol and water from fusel oil and other impurities, and apparatus therefor. October 9.

1889.

13,451. D. R. J. J. G. Morel. Apparatus for mixing water with malt for supply to mash tuns. October 2.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

14,670. A. A. Freeman. Improvements relating to the preservation of shell-fish. Complete Specification. September 17.

15,205. W. Peacock. Improvements in apparatus for effecting the preservation of fruit. September 27.

15,526. B. Graf and F. Piekenbroek. An improved process for producing ozone water, in which the ozone is retained for a considerable period without alteration. Complete Specification. October 3.

B.—Sanitary Chemistry.

14,734. F. P. Candy. Improvements in the deodorisation and purification of sewage and other polluted water. September 18.

15,190. H. Rohrbeck. Improvements in method and apparatus for disinfecting by means of saturated steam of a high temperature. September 26.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1889.

14,23. F. McIntyre. Process and means for the preservation of milk. 9 October.

B.—Sanitary Chemistry.

1888.

14,108. W. Clark and W. A. Clark. Treatment of sewage and apparatus therefor. October 2.

15,810. E. Knowles. Combination of mechanical applications for the purification of sewage. October 9.

1889.

4411. J. B. Paddon. Method and apparatus for destroying town and other refuse material. October 9.

C.—Disinfectants.

1888.

15,925. T. Rowan, L. Hakeman, and The Coal Tar Disinfectants Co. Apparatus for distributing disinfectants. October 2.

15,993. C. T. Kingzett. Preparation and preservation of peroxide of hydrogen. October 16.

15,994. C. T. Kingzett. Preparation of antiseptics, disinfectants, and sanitary reagents. September 25.

17,042. G. R. Tweedie. Compositions for disinfecting, deodorising, or antiseptic purposes. October 9.

1889.

2858. W. H. Daniels. Antiseptic compounds for preserving perishable articles. October 2.

9256. J. Shaw. "Purifying sewer gas, and ventilating sewers, drains, &c.—a deodoriser." September 25.

14,032. J. G. Flower and D. W. Macdonald. Disinfecting, deodorising, and preserving compound. October 16.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

14,793. J. M. Baines. Improvements in the manufacture of paper or cardboard and other similar boxes. September 17.

15,122. J. Luke, jun. Improvements in and relating to the manufacture of paper for mill wrappers, lappings, boxes, and such like, and in machinery connected therewith. September 25.

15,499. H. Brocklehurst. Producing a coloured transparent material made from papier-mâché, &c., called "Glacialite." October 3.

15,916. I. Levinstein. A new or improved material or compound to be used in finishing paper and textile fabrics. October 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

14,643. I. S. McDougall and J. T. McDougall. Boilers or digesters lined with lead or other acid resisting metal or alloy, especially suited for use in preparing paper making materials or for analogous purposes. October 9.

15,956. J. H. Shorroek. Machine for preparing or finishing wood pulp and other fibres for making paper. September 25.

16,943. J. Mactear. Treatment of esparto grass. October 2.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

14,443. H. Baum. Production of aromatic ditbio-oxy-carbon acids. October 16.

17,075. J. Y. Johnson.—From F. von Heyden. Production of paraoxybenzoic acid. September 25.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

14,557. A. M. Browne. The manufacture of "dry plates" for photography. September 16.

14,701. J. Malloch. A glass plate or other transparent substance coated with a nonactinic film, and used as a negative for photographic and other purposes. September 18.

15,263. W. Brierley.—From R. Schorr, Germany. Improvements in method of and process for producing coloured impressions, lithographs, or zincographs by aid of photography. September 28.

16,106. J. S. Fairfax.—From F. Crane, United States. Improvements in films for photographic purposes. October 12.

XXII.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

14,614. S. Stocks. Improvements in matches. September 17.

14,678. A. V. Newton.—From A. Nobel, France. Improvements in cartridges, and in guns to be used therewith. September 17.

14,804. H. Stephenson. Improvements in the manufacture of certain fireworks for display purposes. September 19.

15,883. H. J. Haddan.—From L. Azémar, France. A new or improved explosive. October 9.

16,028. P. Molyneux. Improvements in or connected with wax matches. October 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

14,229. C. J. F. M. Lilliehöök. Percussion fuses for shells. September 25.

14,962. J. B. Readman. Producing phosphorus. September 25.

15,159. J. C. Thompson. Mechanical fuse for exploding shells and indicating number of revolutions performed and distances traversed by projectiles. October 2.

15,934. A. Nobel. Fuses for armour-piercing shells. October 2.

16,213. H. S. Maxim. Manufacture of explosives, and apparatus therefor. October 2.

16,594. T. A. Bayliss. Percussion fuses for quick-firing cartridges, &c. October 9.

16,693. T. Nordenfelt. Torpedoes. October 16.

16,997. H. M. Chapman. Percussion caps or fuses. October 2.

17,212. J. Sayers. Explosive compounds. October 9.

17,719. T. Parker and A. E. Robinson. Manufacture of phosphorus. October 15.

17,772. W. S. Simpson. Explosive shells. October 16.

18,181. T. Nordenfelt. Base fuses for projectiles. October 16.

18,241. G. Trench. Explosives. October 16.

1889.

12,089. P. Giffard. Mining or blasting cartridges, and shells or explosive projectiles. September 25.

12,427. W. E. Liardet. Explosive compounds. October 16.

XXIII.—ANALYTICAL CHEMISTRY.

APPLICATION.

15,800. H. Cortland. Improvements in thermostats. Complete Specification. October 8.

THE JOURNAL OF THE Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 11.—VOL. VIII.]

NOVEMBER 30, 1889.

[Non-Members 30/- per annum; Members 21/- per Set of extra or back numbers; Single Copies (Members only) 2/6.]

The Society of Chemical Industry.

Past Presidents:

Sir H. E. Roscoe, M.P., LL.D., V.P.R.S.	1881—1882.
Sir Frederick Abel, C.B., D.C.L., F.R.S.	1882—1883.
Walter Weldon, F.R.S.	1883—1884.
W. H. Perkin, Ph.D., F.R.S.	1884—1885.
E. K. Muspratt	1885—1886.
David Howard	1886—1887.
Prof. James Dewar, F.R.S.	1887—1888.
Ludwig Mond	1888—1889.

COUNCIL FOR YEAR ENDING JULY, 1890.

President: Sir Lowthian Bell, Bart., F.R.S.

Vice-Presidents:

R. Forbes Carpenter.	S. H. Johnson.
Prof. F. Clowes, D.Sc.	Ludwig Mond.
Sir J. Neilson Cuthbertson.	Dr. Hugo Muller, F.R.S.
Prof. James Dewar, F.R.S.	Dr. W. H. Perkin, F.R.S.
Jas. Duncan.	Dr. Edw. Schunck, F.R.S.
Dr. John Evans, F.R.S.	Prof. W. A. Tilden, F.R.S.

Ordinary Members of Council:

L. Archbutt.	B. E. R. Newlands.
S. B. Benilton.	Jno. Pattinson.
Jno. Brock.	Jno. Spiller.
Jno. Calderwood.	E. C. C. Stanford.
Alexander M. Chance.	J. C. Stevenson, M.P.
A. E. Fletcher.	A. Norman Tate.

With the Chairmen and Secretaries of Sections.

Honorary Treasurer:

E. Rider Cook, East London Soapworks, Bow, E.

Honorary Foreign Secretary:

Dr. Ferdinand Hurter.

General Secretary: Charles G. Cresswell.

Offices:

Palace Chambers, 9, Bridge Street, Westminster, S.W.

THE JOURNAL.

Publication Committee:

The President.

Sir F. A. Abel, F.R.S.	Prof. A. K. Huntington.
A. H. Allen.	F. Hurter, Ph.D.
G. H. Bailey, D.Sc., Ph.D.	Ivan Levinstein.
Joseph Bernays, M.J.C.E.	Prof. R. Meldola, F.R.S.
H. Brunner.	Ludwig Mond.
W. Lant Carpenter.	E. K. Muspratt.
Prof. Frank Clowes, D.Sc.	B. E. R. Newlands.
W. Y. Dent.	C. O'Sullivan, F.R.S.
Prof. Jas. Dewar, F.R.S.	John Pattinson.
John Heron.	W. H. Perkin, Ph.D., F.R.S.
D. B. Hewitt, M.D.	Sir H. E. Roscoe, M.P., F.R.S.
David Howard.	John Spiller.
Prof. J. J. Hummel.	A. Norman Tate.
	Thomas Tyrer.

Editor:

Watson Smith, University College, London, W.C.

ASSISTED BY THE FOLLOWING STAFF OF

Abstractors:

T. L. Bailey, Ph.D.	Chas. A. Kohn, Ph.D.
G. H. Beckett.	F. W. T. Krohn.
D. Bendix.	T. A. Lawson, Ph.D.
E. Bentz.	J. Walter Leather, Ph.D.
Jos. Bernays, M. Inst., C.E.	A. Liebmann, Ph.D.
E. E. Berry.	D. A. Louis.
E. J. Bevan.	W. Macnab.
Bertram Blount.	N. H. J. Miller, Ph.D.
Arthur G. Bloxam.	J. M. H. Munro, D.Sc.
C. H. Bothamley.	H. S. Pattinson, Ph.D.
W. Lant Carpenter.	H. T. Pontermann.
E. G. Clayton.	S. G. Rawson, D.Sc.
Julius B. Cohen, Ph.D.	A. Réé, Ph.D.
C. F. Cross.	F. W. Renault.
A. R. Davis.	Frank Seudder.
W. W. Haldane Gee, B.Sc.	Edward Simpson.
C. Napier Hake.	A. J. Smith, B.Sc.
Oswald Hamilton.	Oscar J. Steinhart, Ph.D.
Bertram Hunt.	A. L. Stern, B.Sc.
C. C. Hutchinson.	D. A. Sutherland.
D. E. Jones, B.Sc.	Bertram Thomas.
W. E. Kay.	Enstace Thomas.
A. J. King, B.Sc.	V. H. Veley, M.A.
F. S. Kipping, D.Sc.	A. Wingham.

NOTICES.

Members are hereby advised that the subscription of 25s. for 1890 falls due on January 1st next. Only those members who have paid their subscriptions will be entitled to receive the Journal.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE AND SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January 1883, and January, February, and April 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once, stating price required, with Mr. Cresswell. The stock of all other numbers is at present sufficient for the Council's requirements.

Post Office Orders in payment of subscriptions should in all instances be made payable at the General Post Office, London.

LIST OF MEMBERS ELECTED, 22nd NOVEMBER, 1889.

Anderson, Robt. T. R., 618, Gallowgate Street, Glasgow, technical chemist.

Burton, Wm., 18, Victoria Street, Basford, Stoke-on-Trent, potter's chemist.

Feodossieff, Capt. G., 11, Great Masterskaia, St. Petersburg, Imperial Russian Navy.

Grant, Arthur L., 35, Gould Street, Toronto, Canada, analytical chemist.

Lea, Horatio H., 39, Aldermanbury, E.C., manufacturing chemist.

Macintosh Jas. B., 21st Street and Avenue A., New York, U.S.A., chemist to Consolidated Gas Co.

Peace, Frank K., General Post Office, Sydney, New South Wales, assayer.

Schlichter, H., 2, Linden Cottages, Wimbledon, doctor of natural science.

Vautin, Claude, T. J., Johannesburg, via Cape Town, South Africa, metallurgist.

Wadman, Walter E., 15, Perry Street, New York, U.S.A., manufacturing chemist.

Watts, Sidney E., Tyne Brewery, Newcastle-on-Tyne, brewer's chemist.

White, Henry, 8, Brown Street, Mashboro', Rotherham, manufacturing chemist.

Williams, Rupert Greville, P.O. Box 35, Albany, N.Y., U.S.A., dye manufacturer.

CHANGES OF ADDRESS.

Boam, F., 10 Leicesters; Coombe Arsenic Works, Callington, Cornwall.

Bradburn, J. A., 10 West Genessee Street; The Crouse, Warren Street, Syracuse, N.Y., U.S.A.

Butler, Wm.; Journals to Elmdon, Selly Park, near Birmingham.

Claudet, A. C.; Journals to 9, Dulcham Gardens, Hampstead, N.W.

Ewens, Paul, 10 Maida Vale; Grima, Wimbledon, Surrey.
Galbraith, Wm., 10 Stoke; e/o Wingerworth Iron Co., Chesterfield.

Glover, Jno., 10 Jesmond Dene; 20, Holly Avenue, Newcastle-on-Tyne.

Green, German, 10 Croft Terrace; Bergholt House, Park Road, Jarrold-on-Tyne.

Green, Jno. E.; 52 (not 32), Claypath, Durham.

Greenhough, D. W., 10 Mincing Lane; 5, Rood Lane, London, E.C.

Hamilton, Geo., 10 Kensington Crescent; Gowerton, near Swansea.

Hunter, T. G., 10 Wayne; 540, Drexel Building, 54th Street, Philadelphia, Pa., U.S.A.

Kingdon, J. C., 10 Belgium; e/o Bart, Boulton, and Haywood, Latresne près Bordeaux, France.

Morley, Dr. H. Forster, 10 Gordon Square; 29, Kylemore Road, West Hampstead, N.W.

Parker, Thos., 10 Crawford Street; Newbridge, Wolverhampton.

Powell, A. E., 10 Dryden Street; 478, Stockport Road, Longsight, Manchester.

Reynolds, H. C., 10 Bristol; Thorncliff, Lansdown Road, Cheltenham.

Smith, Thos., 10 Craigmores; Heriot Hill House, Edinburgh.

Thomson, Dr. Andrew, 10 Dundee; 10, Comly Bank, Bridge End, Perth.

Tyrer, Thos.; Journals and communications to 179, Bridge Road, Battersea, S.W.

CHANGE OF ADDRESS REQUIRED.

Wilson, A., 10 Stafford.

Death.

Goold, J. R. P., 68—70, Hop Exchange, London, S.E.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.
H. E. Armstrong.
W. Lant Carpenter.
W. Crowder.
W. J. Dibdin.
C. Graham.
S. Hall.
C. C. Hutchison.

R. Messel.
B. E. R. Newlands.
B. Redwood.
T. Royle.
John Spiller.
Wm. Thorp.
C. R. Alder Wright.

Hon. Local Sec. and Treasurer: Thos. Tyrer.

SESSION 1889-90.

Dec. 2nd:—

Mr. Watson Smith. "Some Notes on Variations in the Products of the Destructive Distillation of different Gas Coals, heated separately in the same retort and under similar conditions."

Mr. J. Hauff. "Cresotinic Acid and its Applications."
Mr. G. E. R. Ellis. "A New Hydrocarbon Assay Furnace."

1890.

Jan. 6th:—

Mr. C. T. Kingzett. "Peroxide Hydrogen. Its Preservation and Commercial Uses."

Mr. J. W. Lovibond. "An Analytical Tintometer."

Feb. 3rd.—Messrs. A. H. Allen and W. W. Staveley. "On the Properties and Applications of Metallic Compounds of the Phenols."

Notices will be found in the Journal and other Scientific Papers.

Meeting held Monday, November 4th, 1889.

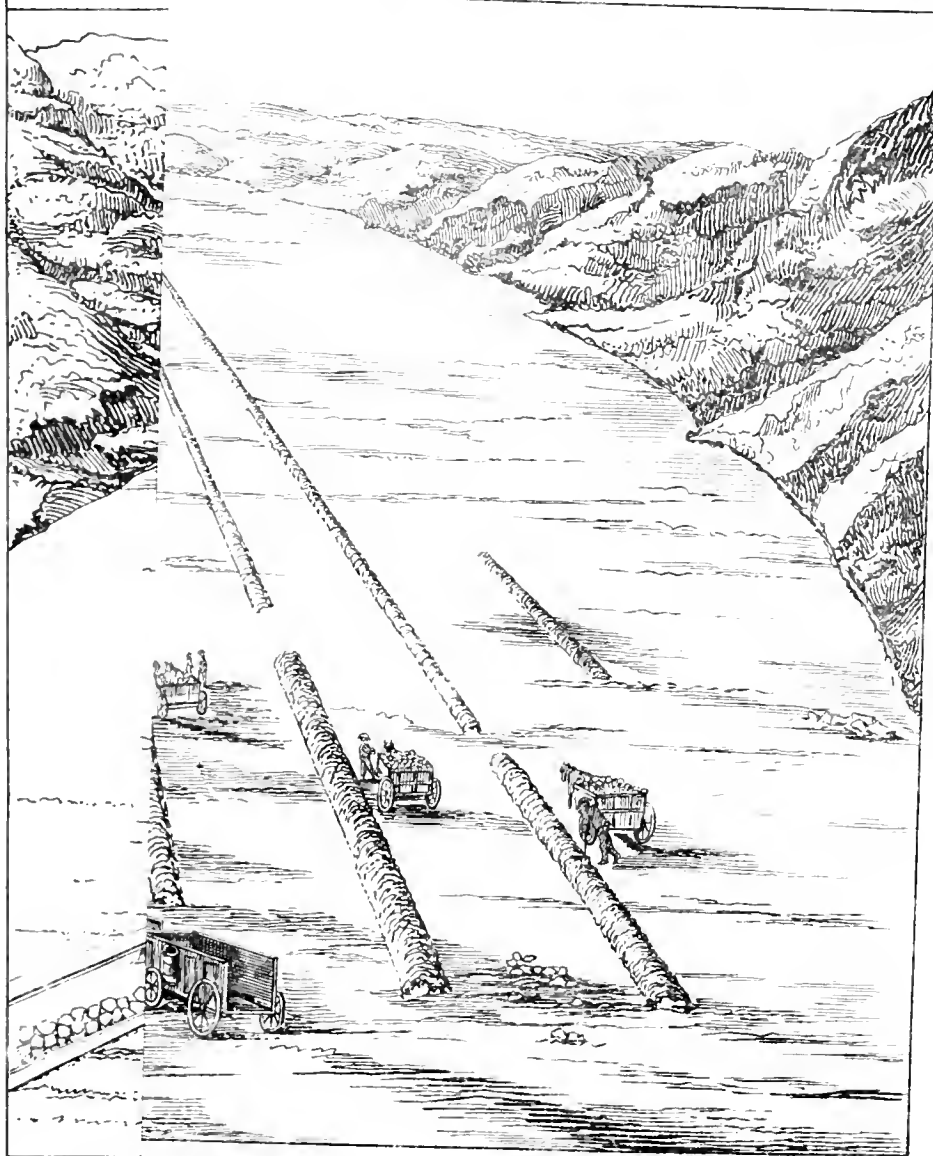
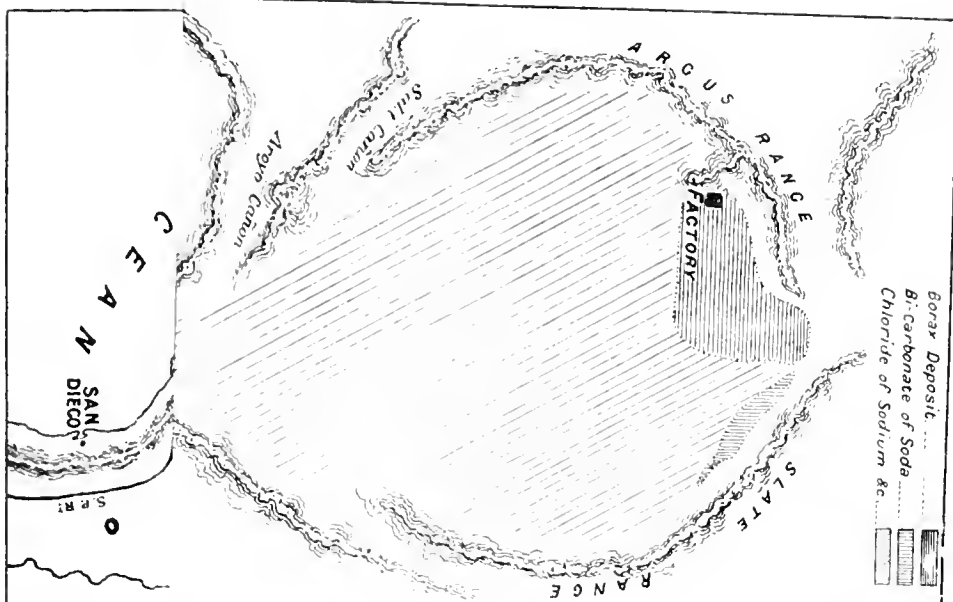
MR. DAVID HOWARD IN THE CHAIR.

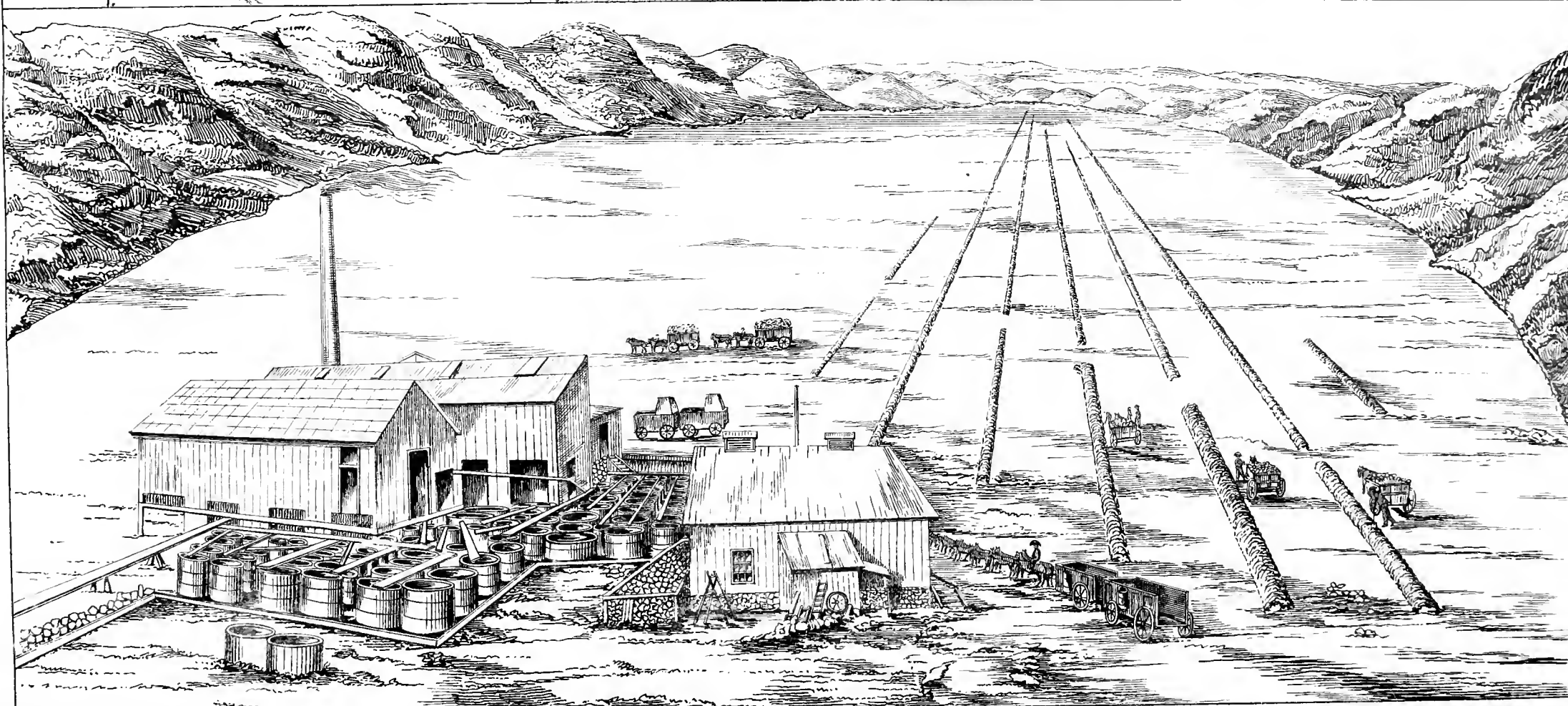
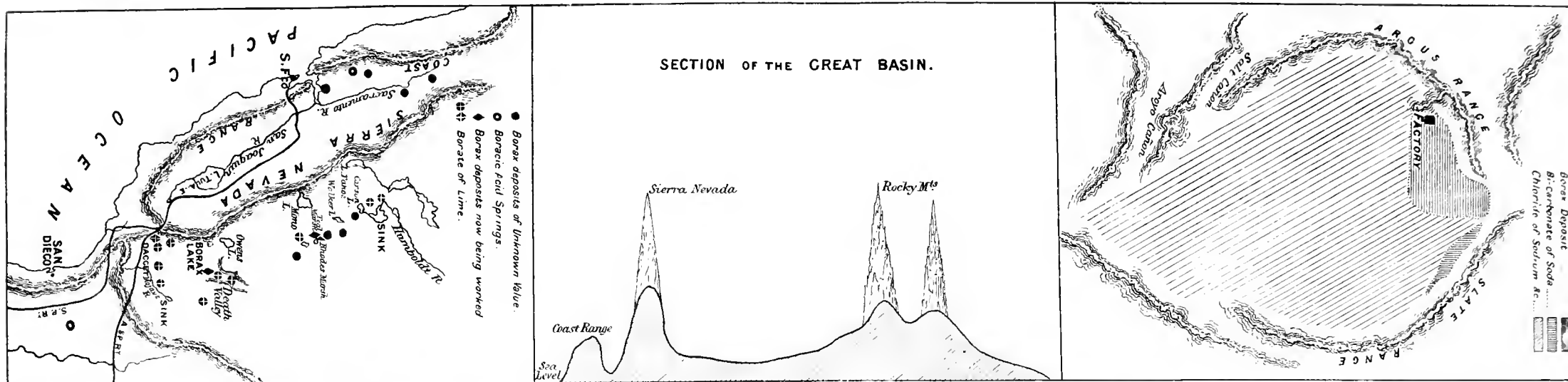
AN ACCOUNT OF A BORAX LAKE IN CALIFORNIA.

BY C. NAPIER HAKE.

Features of the Region.—Before entering upon a detailed description of the dry Salt Lake, the subject of this paper, I propose to put before you briefly some of the more striking geographical and geological features of the remarkable region in which this lake is situated.

Between the Sierra Nevada, on the west, and the Rocky Mountains, on the east, and from the 35° N. Lat. to the Columbia, may be found a succession of interior depressions of a particular character, inasmuch as the rivers and watersheds do not empty themselves into the sea, but are absorbed by the sands of the great desert or lost in the salt lakes. The most remarkable of these depressions, which is known as the Great Basin, is situated from 4,000 to 5,000 feet above the sea-level and occupies an area of 202,500 square miles. Its form is almost a square and its diameter





GENERAL VIEW OF THE BORAX LAKE & WORKS.

from east to west about 500 miles. Surrounded on all sides by lofty mountains, its lakes and rivers have no visible communication with the ocean. Partly arid and scarcely inhabited, the feature of this vast country is that of a wilderness.

The interior of the Great Basin is dotted with mountains of a uniform aspect, each rising abruptly from a base of from 2 to 20 miles in circumference, to a height varying from 2,000 to 5,000 feet above the plain; their slopes are covered with trees and verdure, and their summits are capped with snow during the greater portion of the year. This on melting causes innumerable torrents, which are afterwards lost in the lakes, or sucked up by the sand.

Another grand characteristic of these deserts is the phenomenon caused by the rivers rolling with a crashing noise through the enormous ravines which the Mexicans call *cañons*. These ravines, which are often impenetrable, are hollowed out by the action of the waters to a depth of 300, and even in some places 900 feet, their faces being usually quite perpendicular and so close that you could easily cross from one bank to the other by means of a bridge a few yards in length.

Amongst the rivers irrigating the Great Basin the finest is the Humboldt. This river has two branches which take their sources in a group of mountains situated to the west of the Great Salt Lake. After a course of 55 miles the two branches unite in one bed. For upwards of 300 miles no obstacle whatever impedes its course and no tributaries run into it. As it advances towards the west it gradually loses part of its volume, owing to the absorption and evaporation of its waters, and finally is lost near the Sierra Nevada in a muddy lake or "sink," the borders of which are flat and whitened by saline incrustations.

The other rivers of the Great Basin on the west are the Salmon River, which flows into Lake Pyramid, the Carson, the Walker, and the Owen, which descend with a terrific noise from the Sierra Nevada, and then disappear in lakes to which these rivers give their name.

Such is the general aspect of these deserts. Except in certain valleys where fertility and beauty afford a most striking contrast to their bleak surroundings, the soil is to all intents and purposes sterile. It is chiefly composed of the debris of volcanic rocks. Beds of lava rich in soda felspar cover the country to an extent of many miles; the rain in its season falling on these causes their superficial decomposition and gathers up the soluble salts in its passage. Owing to the general dryness of the atmosphere which prevails, however, for the greater part of the year, evaporation follows solution, and whatever is dissolved tends to rise to the surface, there to crystallise and form what are called efflorescent crusts. These crusts, which at times measure from one foot to 18 inches in thickness, the rain again dissolves away, and if the region contains natural depressions or basins these are transformed into saline lakes. The saline deposits or incrustations so largely distributed over this great plain include common salt, carbonate of soda, sulphate of soda, sulphate of alumina, sulphate of magnesia, borax and borate of lime, sulphate of lime, and carbonate of soda and lime, &c.

Borax Deposits in Northern California.—The first deposits of borax discovered in California are situated in Lake County, about 100 miles north of San Francisco. Some of these deposits were worked successfully between 1864 and 1874, but they now lie idle.

Discovery of Borax in Nevada.—The history of the discovery of borax and borates in Nevada may be briefly summed up as follows:—

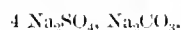
In 1864 some borate of lime in the form of cotton balls (ulexite) was found in Columbus Marsh, but no particular notice was taken of this discovery beyond sending specimens to Washington, where they found a place in the cabinet of the State Museum. Between 1869 and 1871 a systematic search was made which resulted in the rediscovery of the deposits in Columbus Marsh and other deposits of ulexite near Salt Wells. These deposits were worked for a short time only. In 1873 the deposits known as Borax Lake and Teel's Marsh were discovered. The former lies in the Mojave Desert, the latter in Nevada. Both deposits are very extensive. A little later a third deposit was discovered near Dagget consisting of borate of lime (colemanite).

Situation of Borax Lake.—The Borax Lake, which specially interests us this evening, is situated in the extreme north-west corner of San Bernardino county, and is 450 miles distant from San Francisco in a south-easterly direction.

Mojave station, on the Atlantic and Pacific Railway, the nearest point of shipment, is connected with the lake by a good waggon road, 72 miles in length.

The lake lies in the valley of the Slate Range and Argus Mountains at an elevation of 1,700 feet above the sea. It is oval in shape and its greatest length and breadth is 12 miles by 8 miles. The greater part of it is covered with a hard saline incrustation varying in thickness from a few inches to several feet. The surface is covered with white efflorescent matter largely mixed with sand. Under the hard crust the lake consists of one vast bed of black mud containing a large proportion of iron sulphide saturated with saline matter and strongly impregnated with sulphuretted hydrogen gas. The thickness of this mud-bed has not been determined.

In the lake is contained common salt, carbonate of soda, hydrated and anhydrous bicarbonate of soda, baborate of soda, sulphate of soda, hydrated and anhydrous sulphate of magnesia, salts of ammonia, and traces of bromine and potash. Although I made a diligent search during the four weeks I remained on the lake I was unable to detect a trace of iodine. A new and highly interesting mineral has been discovered in the mud of this lake in small hexagonal crystals, to which the name of "Hanksite" has been given after Professor Hanks, of San Francisco, whose name is so honourably connected with the mineral development of California. Its composition is expressed in the formula—



The lake may be for all practical purposes divided into three sections, each section representing well defined deposits of—

- (1) Biborate of soda.
- (2) Bicarbonate of soda, and
- (3) Common salt.

The borax occupies the northern portion of the lake. A very pure deposit of bicarbonate of soda lies on the N.E. shore. The remaining surface deposits consist chiefly of common salt, which becomes purer towards the southern extremity of the lake.

The common salt and bicarbonate of soda deposits have at present no commercial value. The latter is, however, of considerable interest as an example of the ammonia-soda process being carried on by nature. All the ingredients necessary for this process are contained in the waters underlying the deposit, viz., ammonia, carbonic acid, and common salt. The deposit is from 6 in. to 18 in. thick, and in many places almost chemically pure.

Crystal Beds.—Near the centre of the borax section, which is the lowest level of the lake, there exists a patch covering an area of about 300 acres, which is nearly always covered with water to a depth of from one inch to a foot. This patch is called "the crystal bed," from the fact that the mud underlying the water is full of large crystals. These crystals are not deposited regularly, but form nests several feet in thickness, and penetrating 3 or 4 ft. downwards.

The spaces intervening between these nests are filled up with mud, and are comparatively free from crystalline deposit. By damming off the water I was enabled to make an examination of some of these nests. The crystals thrown out consisted of carbonate of soda and common salt, with a large proportion of borax, some of the crystals of which measured as much as 7 in. During one exceptionally dry season, when the water was low, about 700 tons of borax were refined from this source.

The underlying water, at a depth of 15 ft., contains—

- Carbonate of soda,
- Chloride of sodium,
- Sulphate of soda,
- Borax, and
- Salts of ammonia.

The ground around this crystal bed consists of a dry hard crust about 1 ft. thick. This crust contains carbonate and sulphate of soda and about 1 per cent. of borax. On this hard crust there is, again, another deposit of efflorescent matter, containing about—

	Per Cent.
Sand	50
Sulphate of soda	16
Common salt	12
Carbonate of soda	10
Borax	12

This surface deposit represents the chief source of raw material for the manufacture of refined borax.

The deposit is worked in the following manner:—

Method of Working Deposit.—When the crude efflorescent surface has accumulated to a depth of about 1 in. in thickness it is loosened by means of a shovel and swept into wind-rows, space being left between each wind-row to allow of the passage of a cart.

The surface thus cleared of its salts begins to renew its coating. The moisture as it creeps upwards is evaporated by the heat of the sun, leaving the solid matter, which is held in solution on the surface. This action is allowed to go on for three or four years before the surface is again disturbed. In order to get some idea as to the proportionate growth of the different salts contained in this efflorescent matter, I took samples representing 6 months' growth, 2 years' growth, 3 years' growth, and 4 years' growth. From all the sections from which these samples were taken, the surface has been removed three or four times during the last 12 years, and in most places marks of the old wind-rows were visible.

ANALYSES OF CRUDE BORAX MATERIAL FROM DRY LAKE.

—	Six Months' Growth.	Two Years' Growth.	Three Years' Growth.	Four Years' Growth.
Sand	58.0	55.4	52.4	53.3
Carbonate of soda	5.2	5.0	8.1	8.0
Sulphate of soda	11.7	6.7	16.6	16.0
Chloride of soda	10.9	20.0	11.1	11.8
Borax	14.2	12.9	11.8	10.9
	100.0	100.0	100.0	100.0

The analyses show that the first six months' growth is richest in borax and that the proportion of carbonate of soda to borax appears to increase regularly. The presence of sand in such large quantities is due to the high westerly winds which blow periodically, and drive it from the mountain slopes across the lake. This sand no doubt facilitates the formation of the surface deposit by keeping the ground in a porous condition.

That only this section of the lake produces borax to any extent is due, no doubt, to its low level. The hard crust above mentioned dips in the water which rises by capillary attraction. This contact appears to be a favourable if not a necessary condition, for during very dry seasons, when the level of the water is low, surface reevaporation goes on very slowly, or even ceases entirely.

Process of Manufacture.—The factory, which is situated on the north-west corner of the lake, consists of a dissolving house raised about 20 ft. above the level of the ground, concentration house, a refining house, and boiler house. The process by which the borax is extracted from the crude material is very simple and comprises two operations, viz., dissolving and allowing the solution to crystallise.

The crude material is transported by means of carts from the lake to the works, and is passed through a mill previous to its being thrown into the dissolving pan, in which is contained a boiling saline solution, preferably mother-liquor, from the second crystallisation. The solution is kept boiling by high pressure open steam as the crude

material is being shovelled into it, during which operation free ammonia is copiously given off. The salts dissolve entirely, leaving the insoluble residue, chiefly sand, at the bottom of the pan. The hot solution, after standing for some time in order to clarify, is run off into crystallising pans and allowed to cool for from five to nine days according to the season of the year.

The product of this first crystallisation is a mixture of octohedral and prismatic borax, slightly impure and somewhat coloured by organic matter. This product is either sold as "concentrations" or redissolved in boiling mother-liquor and the resulting solution allowed to cool to 120° F. From this solution refined borax of excellent quality is obtained. The works are capable of turning out over 100 tons per month, about 50 men and 65 animals being employed. The factory is exceedingly well arranged, and substantially built, and under careful and intelligent management.

During the time of my visit at the lake the fuel used on the works was the sage brush, the only wood growth in this desert. The difficulties of collecting this material were enormous. Carts were sent out scouring the country for 10 miles round in search of fuel, and remained away often for a week at a time. This difficulty has been partially met by substituting crude petroleum, which has to be carted 72 miles across the desert. The results, however, I am told, show a saving of nearly 40 per cent. as against the sage brush, besides other advantages, such as greater regularity of working.

Water Supply.—The question of water supply is an extremely interesting one. The water is obtained from two sources. The one which is used for drinking purposes and for feeding the boilers is brought in iron pipes from a cañon lying in the Argus range, 7½ miles distant from the work, at an elevation of nearly 300 ft. This cañon, which forms an oasis in the desert, contains several springs, and where cultivated yields an abundance of fruit and vegetables.

The other supply is derived from artesian wells which are sunk to a depth of 55 ft. on the shores of the lake. The water rises from 3 to 10 ft. above the surface, and the flow is constant and regular.

This water is strongly alkaline, containing about 1 per cent. of carbonate of soda, strong traces of borax, and salts of ammonia equal to about 18 grains per gallon.

Labour.—The question of labour presents no difficulties; all common operations are carried on by Chinamen, and this class of labour can be procured in California at a comparatively moderate rate.

Transport.—The refined borax is packed in casks and transported to Mojave in the so-called "Desert Schooner," a strongly built wagon drawn by 20 mules. The average load is 10 tons, and the trip to Mojave and back takes eight days. The road through the light sandy soil of the desert rises gradually 1,000 feet during the first 25 miles.

This road is controlled by the owners of the lake, who possess the right to the water, which is supplied to the four roadside stations through iron pipes from a range of mountains 10 miles distant. These stations afford sleeping accommodation for the teamsters and stabling for the animals.

During my visit to California I took every opportunity of making myself acquainted with the extent and value of the borax deposits in the Pacific States, and I gathered that, though widely distributed, there are only three deposits of any great importance which are actually being worked at the present time. These deposits yield from 1,500 to 2,000 tons of borax annually, nearly the whole of which is consumed in the United States.

The lake which I have described has been regularly worked for the last 15 years under the direction of Mr. J. Searle, the chief owner, who is known all over California as the keenest bear hunter in the State; but he is not less known for his hospitality, high integrity, and intelligence. During this period it has supplied about one-third of the total amount derived from similar sources and with considerable profit to the owners. The supply of borax on this lake appears to be practically inexhaustible, and it only requires improved means of transport for its full development.

In conclusion, it may be of interest to briefly allude to Death Valley, which lies 100 ft. below the level of the sea. Borax and borate of lime deposits have been discovered and worked in this valley, which is probably the most desolate and least explored of any portion of the United States. The climate, owing to the intense heat and dryness of the atmosphere, is almost unbearable. It is absolutely devoid of either animal or vegetable life. During several months in the year work has to be suspended, one reason being that the solution would not cool down to a temperature at which crystallisation takes place.

The communication which I have made to you this evening will, I trust, prove of interest to the Society, if only as an instance of what can be accomplished in manufacturing chemistry under stupendous difficulties, when the enterprise is directed by intelligent perseverance.

DISCUSSION.

The CHAIRMAN said that the hearty thanks of the meeting were due to Mr. Hake for his able paper on a subject of very wide interest and practical importance. When one remembered that, at a comparatively recent date, borax was selling at 90*l.* a ton, and was a costly material used chiefly for producing the most valuable glazes on pottery, whereas now it was not only extremely cheap, but was found to be available for a vast variety of purposes—even running a good second to some of the most widely-advertised soaps—it was evident that the subject before them had an important practical bearing. The matter also possessed considerable interest in a geological aspect, as an example of the wide distribution of what was once considered a rare element. In the early part of the present century the only sources of borax were the tincal lakes in the North of India and Thibet, where it was obtained in a crystalline state from beds of semi-gelatinous mud. Then followed that triumph of technical engineering, the working of the *lagoons* of Tuscany, where the *solfioni* containing a small quantity of boracic acid were condensed by blowing through water, and the solution thus obtained evaporated down by the same volcanic steam. Italy thus became practically the sole source of the world's supply of borax, its product running the tincal deposits completely out of the market. Next came that singular deposit obtained from Peru, which in appearance closely resembled a very white potato; and lastly came this wonderful American deposit described by Mr. Hake, and Rhodrate—the borate of lime of Turkey. Boron, therefore, instead of being an element of rare occurrence, as was once supposed, was found to be widely spread over different parts of the world. And its applications were likely to be equally wide. It was already known to be the finest of all glazes, a most useful detergent, and one of the most valuable of disinfectants; and its uses were not yet exhausted, seeing that this once chemical luxury was now cheaper than carbonate of soda was a few years ago. He was glad to see that Mr. Robottom was present. He could speak on this subject with more authority than anyone else in Europe or America; and the meeting would, he was sure, be glad to have the benefit of hearing his views.

Mr. ARTHUR ROBOTOM then gave the meeting a vivid and interesting account of his pioneer work in the exploitation of Californian borax; of his journey on foot at the rate of 12 to 14 miles a day, and, disguised as a "busted" miner, across the 240 miles of sterile country lying between Los Angeles and the Mono Lake; his stay at "Jim Bridger's shanty"; his meeting with the pioneers John and Dennis Searle, and the shipment of the first cargo of natural borax to England; his high hopes of future profit from the trade; and his subsequent disappointment and trials on finding himself saddled with an immense quantity of borax, the selling price of which had suddenly declined from 90*l.* to 26*l.* per ton (a figure very little above the bare cost of transport), and which could not be readily disposed of even at that price, owing to the general ignorance of its many good qualities. Mr. Robottom concluded by expressing his conviction that the efforts which he had then made had given such a stimulus to the use of borax as could not fail to result in mutual benefit to traders and consumers. He could not agree, however, with Mr. Hake's statement that there

were only three deposits of natural borax in the region under notice. The supply was inexhaustible, and there were several sources not mentioned by the author.

Mr. Moss desired to inquire of the author of the paper—in view of his statement, confirmed by Mr. Robottom, that the supply of Californian natural borax was inexhaustible—whether he had been able to trace the borax to its origin, and could say in what form the boron was presented to the bodies with which it combined to produce borax. He would also like to know whether Mr. Hake had made any examination of the mud-bed in which the borax crystals were found with the purpose of ascertaining whether it contained any low forms of organisation, which might be the cause or the result of decomposition. The fact that ammonia had been found in the stratum under the crystal-bed suggested that organic matter in some form or other was not far away.

Mr. HAKE, in reply, said that he had listened with great pleasure to Mr. Robottom's remarks, and was glad to find that they generally confirmed his own observations. With regard to the only point of difference between them, he ought to have said that the three deposits which he had described were not the only but the chief sources of supply. There were many smaller deposits in the vicinity, but he had not mentioned them because they were not worked continuously or regularly, and therefore had but little influence on the supply. He had not been able to form any theory as to the source of the Californian borax; it was a question which had puzzled people far better able to judge than himself. He believed that the origin of the boracic acid obtained from the Tuscan lakes had not yet been satisfactorily accounted for, and there was great similarity between the deposits of Italy and those of California—especially those of South California. The whole of the six weeks he had spent in the region was taken up by the practical examination of the great lake, 12 miles by 8 miles, which he had described. He had found that there was one vast bed of mud of apparently uniform character. The presence of ammonia and carbonic acid of course indicated the existence of organic matter; but where it came from no one, he believed, had been able to determine. Very little was yet known of the geology of the region, and perhaps an examination in that direction might throw some light on the subject.

The CHAIRMAN said that he would venture, contrary to Newton's law, to make an hypothesis on the subject. He could not help connecting these natural deposits with that singular mineral known as Colmanite. That was a borate of lime in appearance curiously like borax. He could not say how it was formed, but seeing that there was borate of lime present, and that the natural ammonia-soda process mentioned by Mr. Hake supplied bicarbonate of soda, he could not see any difficulty in Nature doing what art can do—*i.e.*, make borax. Where the Colmanite came from, however, he could not venture to say.

Mr. A. H. ALLEN said that it had been suggested that the boracic acid of the Tuscan lakes owed its origin to the pre-existence of nitride of boron—which would also account for the presence of ammonia. Nitride of boron was decomposed under the influence of water at high temperatures, with formation of ammonia and boracic acid, and in presence of carbonate of soda the latter would easily react to form borax. On this hypothesis they were not bound to associate organic matter with the production of ammonia in the case under notice. He would like to ask the author by what method he had found it most convenient to estimate the borax in presence of sodium carbonate and other sodium salts.

Mr. HAKE replied that his examination having been made some three years ago he was not quite clear upon that point, but if he remembered rightly, he had employed the titration method, using a special indicator. Most of the analyses were made in a laboratory in San Francisco from samples taken at the lake.

THE CONDITIONS OF THE REACTION BETWEEN COPPER AND NITRIC ACID.

BY V. H. VELEY, M.A.

IN the course of some experiments, it was observed that when a sphere of pure electrolytic copper was revolved in dilute nitric acid (of 27.5 per cent. concentration, and heated to 27° C.) no gas bubbles were evolved from the surface of the copper for a few minutes. But if the same sphere were introduced into the same acid containing in small quantities the products of the reaction between the metal and the acid, the evolution of gas commenced immediately. Further, other conditions remaining the same, the amount of copper dissolved per unit surface in a given interval of time was less in the former than in the latter case. In another paper, tables of figures have been given in illustration of these results. In these earlier experiments, however, no especial precautions were taken to purify the nitric acid used from a small quantity of nitrous acid with which it was contaminated. This impurity was subsequently removed by passing a rapid stream of air into nitric acid of sp. gr. 1.41, sheltered from direct sunlight, and heated to a temperature not exceeding 35° C. until a small test portion of the acid gave no immediate blue colouration to a solution of potassium iodide and starch, nor any appreciable tint to a solution of metaphenylenediamine hydrochloride. The acid was then diluted with water to the required concentration; thus prepared, it contained a proportion of nitrous acid less than one part in three but more than one part in five millions of nitric acid. On repetition of the experiments described above, the same results were obtained, and it was shown that when the metal has commenced to dissolve, then the acid contained nitrous acid. But if some substance, such as urea, be added to destroy the small proportion of nitrous acid not removed by the process of purification, and which should also react with any nitrous acid produced in the immediate vicinity of the metal, then copper is not dissolved by dilute nitric acid of 28 per cent. concentration, heated to 27° C., provided that the metal is rapidly rotated, and the acid kept in agitation by blowing in a rapid stream of an inert gas as carbonic anhydride. Substances other than urea are even more effectual in preventing the chemical change. But if these conditions of movement were not fulfilled, then, owing to some local action, the solution of the copper commenced, and when once started could not subsequently be prevented. Thus it would appear that *pure copper does not dissolve in pure nitric acid*, but that the presence of nitrous acid is the necessary condition.

In this respect copper is analogous to silver, which, according to the experiments of Russell (J. Chem. Soc. 1874, 3), dissolves only in nitric acid containing nitrous acid. If the conditions are such that these metals dissolve, then they yield primarily their own solvent nitrous acid. In the case of copper, the chemical changes which take place are probably as follows:—1st. The copper dissolves in nitrous acid to form copper nitrite, which is decomposed by the nitric acid to produce copper nitrate, liberating again nitrous acid. 2nd. The nitrous acid is subsequently decomposed to form nitric oxide, which, in its turn, reduces a further quantity of nitric to nitrous acid. Then the chemical change becomes more rapid until a limit is reached, when the production of nitrous acid on the one hand, and its decomposition on the other, counterbalance one another. The production of nitrous oxide and nitrogen gases is due to subsequent changes effected by the highly-reducible substance cupric nitrate, as pointed out by Armstrong and Acworth (J. Chem. Soc. 1877, 54).

In the course of further investigation, it has been shown that mercury does not dissolve in nitric acid even of 35.5 per cent. concentration and without the addition of substances reacting with nitrous acid, provided that both the metal and acid are kept in motion. In illustration of the experiments described above, G. J. Burch and the author have found that the E.M.F. of copper, platinum, dilute nitric acid is at first about .55 of a volt, but that this increases with the greatest regularity until it reaches a

maximum of about .75 of a volt; but if a trace of nitrous acid is introduced into the pure nitric acid, the maximum is reached *at once*. It is proposed to continue these investigations, reserving their details for a future memoir.

DISCUSSION.

THE CHAIRMAN said he had no doubt that many members had, like himself, been greatly puzzled by this curious perversity of metals in dissolving in nitric acid. Mr. Veley's valuable contribution was an additional proof that many of those beautifully simple formulae which were taught to beginners were, to say the least of them, defective expressions of truth which might be good for the young but were not very good for the old.

MR. C. F. CROSS said that about two years ago he had dealt with a similar reaction. In the article "Cellulose" for Watts' Dictionary (ed. 1888) it was recorded that the action of dilute nitric acid upon lignified tissues (which is to resolve them into cellulose (insoluble) and nitroso-derivatives of the non-cellulose (soluble)), is, in presence of urea, suspended, or rather converted into a simple hydrolysis similar to that of dilute hydrochloric acid or sulphuric acid. By using varying proportions of urea in a 5 per cent. solution of nitric acid, and digesting this mixture at 60°—80° with any fibres of the lignified class, he had obtained results giving every gradation between the two extremes. Of course the case in point was a special example of what was now regarded as generally true, that without the *tertium quid* no reaction took place.* He might also mention another case bearing on the general question, but in which nitric acid became the determining reagent. It was that of combustion of nitrogenous bodies with chromic acid in presence of sulphuric acid. While most bodies containing carbon, hydrogen and oxygen only, burnt without difficulty and yielded the whole of their carbon in the gaseous form, in the case of nitrogen compounds there were complications and incomplete combustion. It was found, however, that in many cases, notably that of urea, the presence of nitric acid determined the evolution of the whole of the nitrogen as such. Now, it was known that urea had the power of assuming the isomeric form of cyanic acid; and he had found in fact that urea in presence of this oxidising mixture was not burnt, but took the form of cyanic acid, thus accounting for incomplete combustion also of bodies forming urea as a product of severe oxidation. It was evident that the nitric acid determined complete combustion by upsetting the equilibrium of cyanic acid.†

NOTE ON APPLIED TECHNICAL INSTRUCTION IN GERMANY.

BY THOS. CHRISTY, F.L.S.

IT may be useful to place before the London Section of the Society of Chemical Industry some facts which came under my notice during a visit, in September last, in Brunswick. The Government Druggist College was founded in 1880, with the approval of the Druggists' Society of Brunswick. It is the only establishment on the Continent with which I am acquainted which teaches the whole *minutiae* of the druggist's trade. The object being to prepare druggists with a scientific knowledge of their business, the whole organisation is arranged to treat of practical details—an organisation, which while teaching everything worth knowing in connexion with this particular business, omits matters of a secondary and unimportant character.

The students who seek the diploma of the academy vary in age from 16 to 25, and it is generally found that they

* See Chem. News, vol. lx., p. 13.

† Compare J. Chem. Soc., vol. xxxv., p. 12, H. J. H. Fenton. On the Combustion of Urea by Hypochlorites.

have had experience in drug stores or warehouses previously to studying at the academy, their object being, by further study, to obtain a thoroughly theoretical knowledge of the trade. The course of education is distributed over one year, the holidays in which amount to 60 days. Students have to learn the names of all drugs, gums, woods, herbs, spices, &c., and also the way to treat them with ordinary apparatus in practical use, not only relying upon first-class and the latest improved machinery. Further, students are made acquainted with different methods of arriving at a successful result. In the laboratory the work is based on the natural wants of commerce, and in order to help the understanding of those students who may not fully comprehend the lectures, a number of questions are asked after each lecture by which repetition of specific points is ensured and a clearer knowledge of the lectures is gained.

An enumeration of the facilities for acquiring knowledge placed at the disposal of students will convey a very clear idea of the practical nature of the academy.

Amongst means of teaching in the laboratory—which accommodates 34 students—are a collection of 240 scientific instruments, an herbarium, illustrations and diagrams of plants, fruits, &c., photographs of chemical and technical factories, plants and drugs, a sample collection of drugs, essences, perfumes, and chemical preparations, a technological collection of industrial products, and a library of selected works and newspapers.

The subjects of education include inorganic chemistry, in which six hours' instruction is given weekly; organic chemistry, five hours; theoretical chemistry, two hours; technical chemistry, three hours weekly, and analytical chemistry with lectures on working in the laboratory. Two hours per week are devoted to acquiring a theoretical knowledge of drugs, two hours to a practical knowledge of the same, two hours weekly (in winter) to the study of chemicals, and two hours weekly (in summer) to colours, paints, &c., whilst botany has two hours weekly allotted to it in the summer, when it is taught in the agreeable form of country excursions. The programme is completed by taking two hours' weekly instruction (in winter) in chosen subjects in physics, three hours weekly are given to book-keeping by single and double entry, two hours to commercial arithmetic, two hours to correspondence, and 12 hours weekly are spent in the laboratory.

For Germans this course of education lasts one year, and for non-German-speaking students 18 months, Germans being admitted in April and October on production of school certificates, a regulation dispensed with in the case of foreigners.

The school fees amount to 20*l.* a year, payable in two parts; a moiety on entrance, and the other half at the beginning of the second term. The admission fees amount to 6*s.*, the fee for the laboratory servant is 4*s.* per term, for gas in the laboratory 4*s.* 6*d.* per term, for reading in the library and the use of papers 3*s.* per term. All students on entry bind themselves for a whole course.

As a further instance of the practical management of the institution, visits are made to factories where the technical chemistry lectures may be elucidated by practical illustrations on a commercial scale. Soap, candle, alkaloid, and oil works, also to sugar factories, tar and spirit distilleries, the Neuhausen paper mills, the Schöningen chemical works, soda manufacturing, sulphuric acid, hydrochloric acid, chloride of lime, and manure works were visited.

The progress obtained at different stages of the tuition is registered by means of examinations in which each student has to take part. At the close of each month examinations are held, in writing, on all the subjects taught. At the end of each term a theoretical as well as practical examination takes place, the marks for which are added to those obtained at the monthly examinations. From these marks is made up the average stated on the certificates awarded at the end of each term, and from the whole documents for the period of studentship may be ascertained the position of a student on leaving. When specially requested extra examinations are held for diligent but slow scholars.

In the laboratory the work consists of qualitative and quantitative analysis, making chemical preparations, and examining drugs described in the two German Pharmacopœia. The "home" work of a student is judged, firstly, by his written record of the lectures; and, secondly, by the way in which he prepares and describes an herbarium consisting of at least 100 specimens of plants. This latter item is based on a thorough method which includes the collecting, drying, and mounting of specimens on separate sheets, which must bear also a full botanical and medicinal description. A collection of medicinal drugs is made and placed in boxes, the drugs being fully described. Sections are also cut and sketched from microscopical observations, thus enabling a student when in practical business life to detect the true character of any particular article. The drugs are also treated for the extraction of alkaloids or salts, these being shown in bottles. The full history of the drugs is recorded, with their appearances—bark, fruit, foliage, &c.

Although I had seen the programme of this institution, I had not gathered that full idea of its scope and value which has been impressed upon me by becoming personally cognisant with the details as they exist.

What I have endeavoured to make clear is that the students who earnestly avail themselves of the facilities offered by such a course of instruction may, after a year or 18 months' instruction, claim to have good general knowledge. The student, in addition to the attraction offered by the prizes awarded for proficiency, is also encouraged in a more practical way by the knowledge that he can command a lucrative situation if he obtains a good certificate on leaving. There is a great demand from all parts for the holders of such certificates, and when in Brunswick, just after the examinations, I was introduced to some of the students, one of whom was going to Riga, another to Odessa, and the first prize man had taken a situation in Brunswick. Many of them could converse in English and French, and some hoped to obtain appointments abroad and in the English colonies.

The books and examination papers, and collection of specimens of various products made by the student who obtained the first prize, were on the table for inspection.

DISCUSSION.

The CHAIRMAN said that he had been deeply interested by Mr. Christy's account of pharmaceutical training as carried out in Germany. He thought, however, that English pharmacists could boast that they had been before the rest of the world in applying chemistry to their instruction. He could hardly say how the general curriculum would compare with the German; but he heartily wished that such practical work as Mr. Christy had described were the rule rather than that tendency to too much theory which was characteristic of English ideas of technical instruction—at any rate as exhibited in the recent Government Bill on the subject. When the discussion was over he would invite the members' attention to the valuable and beautiful collection of specimens of drugs, &c. provided by the author.

MR. WATSON SMITH, referring to the author's remarks on the opportunities afforded to students by German manufacturers, said that during the seven or eight years in which he had been engaged in teaching applied chemistry in the north of England he had never experienced any difficulty in obtaining permission for his students to inspect chemical works. In fact he had found that manufacturers were not only willing to throw open their works to the inspection of students, but they frequently added to their kindness by putting the party under the personal guidance of one of the directors or managers of the works; and he had found it easy to satisfy manufacturers that none but *bona fide* students were present, by offering his class roll-call, that it might be called over before the inspection commenced. It would, of course, be foolish and unreasonable to expect manufacturers to show any secret or even special processes, but all that students required was to witness the carrying out of the general principles of scientific and industrial chemistry on a manufacturing scale, and that end could be easily attained under ordinary circumstances without prejudice to the interests of the manufacturer.

Dr. C. R. ALDER WRIGHT desired to add to what the Editor had just said, his own testimony as to the liberality of British manufacturers in permitting visitors not engaged in their own particular trade to inspect their works. Neither as a student some 20 years ago, nor subsequently as a member of the British Association and kindred societies, had he found any difficulty in gaining admission to, and much information concerning, works of various descriptions in different parts of the country. There was one sentence in the Chairman's remarks to which he would like to draw further attention. That was regarding the tendency of technical education as at present carried out in this country, towards the theoretical rather than the practical side of the subject.

The CHAIRMAN said he had spoken of the Government Bill—or of technical education as it was to be conducted under that Bill.

Dr. WRIGHT, continuing, said that he hoped he was in accord with the Chairman in saying that one great fault in the present system of teaching applied chemistry was the fact that the teachers themselves, as a rule, did not possess that practical acquaintance with the subject which was necessary in order to fit them to explain it thoroughly. There was a great difference between the chemistry of a scientific laboratory and that of an actual work, and unless a man had been through a course of training in chemical engineering, only to be obtained in the factory itself, he could hardly appreciate the difference. Unless a teacher had been through such a course he could not hope to make it clear to students what chemical technology really was. He felt strongly, therefore, that the technical education of the future would be much more profitably directed from the practical than from the purely theoretical side.

Mr. PETER McEWAN wished to point out with regard to this paper that he understood Mr. Christy to speak of the *druggists* of Germany, who were different from the *pharmacists* of that country. In Germany, druggists held a position similar to that which herbalists held in England, and so far as these two classes were concerned he admitted that the German education of druggists was far ahead of that of British herbalists. But as a matter of fact the whole course of education described by Mr. Christy had been carried out in this country for the last 40 years, so far as pharmacists were concerned. The beautiful and interesting specimens exhibited by Mr. Christy on the present occasion as the work of a German student served to recall to his mind similar collections made 35 or 40 years ago by noted English pharmacists now living. With regard to the practice of visiting chemical works, from the pharmacist's point of view he would like to say that it was not quite necessary, the modern tendency of pharmacopœias being to omit processes. All that the pharmacist had to do in practice was to accurately carry out physicians' prescriptions, to test his chemicals rather than to make them. On that ground there was little use in teaching him the practical methods of manufacturing such chemicals as were generally made only on one large scale, because he would always be able to buy them much purer and cheaper than he could make them himself.

Mr. J. Moss believed that this was the first paper presented to the Society specially referring to druggists as a class. They were an important and influential body, many of them being large manufacturers, and probably the only reason that they did not receive wider recognition from the Society he was addressing, was the fact that they had a powerful Society of their own which was able to attract and absorb all matters pharmaceutical. In bringing forward this subject, Mr. Christy had, he thought, done good service to a cause which was receiving much attention just now—that of technical education. He would like to point out that in Mr. Christy's account of the institution he had described there was nothing to indicate that it was a corporate body. It was rather to be regarded as a private school; and in that respect it had a great advantage over most corporate bodies existing for similar purposes, inasmuch as the men at the head of it were able to make their own arrangements from time to time, and decide what should be the course of study and what the

rules to which every student coming to them should be subject. Another great advantage was the permission to see works. He could hardly imagine the kind of factory which would be useful to a druggist being thrown open to inspection by a school or by individual students. Whatever might be the practice in chemical works in the North of England, he did not think it would be applicable to the works of manufacturing pharmacists in London. The routine described by Mr. Christy included book-keeping and arithmetic. In England, a youth was supposed to be educated in commercial and literary matters before beginning the technical studies of a chemist and druggist. He could confirm much that Mr. McEwan had said with regard to the Pharmaceutical Society of London. When that Society was first installed its laboratory was the finest in the country for practical instruction. It now possessed a museum of *materia medica* which was second to none, and the specimens were open to every student under the guidance of the curator, who was always willing to give his services. It had, too, a library of he could not say how many thousand volumes—a library unequalled in Europe from the pharmaceutical point of view. So that with regard to the materials needed for teaching, England was as well supplied as any country need be; but no doubt in some respects Germany had the advantage, and it was well for us to know that and learn from our rival. For example, the obligation laid on students to produce their note-books from time to time and make up specimens under the guidance of their teacher were points which English teachers of pharmacy might copy with great advantage. He hoped that this paper would be the means of impressing them with the necessity of doing so, and that the students who worked under such conditions would turn out even better than formerly.

Mr. T. TYRER said that he felt a deep personal interest in this matter, and would like again to assert his conviction that English professors were not behind their foreign rivals. He did not know whether the custom was first introduced by Hofmann, but he gratefully remembered that that great teacher made it his regular practice, firstly, to become personally acquainted with every student under him, secondly to call upon every such student to produce his note-book periodically; almost daily indeed. If the student failed to do so, he speedily got the "cold shoulder," which in Hofmann's case was a thing to be remembered. Whether Hofmann set the example or not, he believed it was a fact that the system was followed now by every teacher worthy of the name.

Nottingham Section.

UNIVERSITY COLLEGE, NOTTINGHAM.

Chairman: Sir John Turney.

Vice-Chairman: L. Archbutt.

Committee:

Jno. R. Ashwell.
F. Clowes.
J. B. Coleman.
W. A. Curry.
H. Forth.
E. Francis.

J. M. C. Paton.
S. J. Pentecost.
C. Spackman.
H. J. Staples.
J. T. Wood.

Treasurer: S. V. Holgate.

Hon. Local Secretary:

R. L. Whiteley, University College, Nottingham.

SESSION 1889-90.

Dec. 11th.—Mr. J. T. Wood, "Methods of Bacteriological Research, with some Account of Bran Fermentation."

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Liverpool Section.

UNIVERSITY COLLEGE, BROWNLOW STREET.

Chairman: F. Hurter.

Vice-Chairman: A. Norman Tate.

Committee:

J. Campbell Brown.	F. Gossage.
H. Brunner.	S. H. Hamburger.
E. Carey.	W. D. Herman.
H. Deacon.	D. McKechnie.
T. Fletcher.	G. Shack-Sommer.
H. Gaskell, jun.	Henry Tate.

Hon. Treasurer: W. P. Thompson.

Hon. Local Secretary:

Dr. C. A. Kohn, University College, Liverpool.

SESSION 1889-90.

December 14th:—

H. T. Carr. "The Dinsmore Process for the Manufacture of Coal Gas."

Dr. Chas. A. Kohn. "Note on the First Synthetically Prepared Base Isomeric with Quinine."

Mr. C. J. McEwan. "A Photographie Jet Photometer," 1890.

Jan. 15th:—

Discussion on Dr. Hurter's paper on "The Condensation of Hydrochloric Acid."

Miscellaneous Communications.

Feb. 5th:—

Dr. G. Shack-Sommer. "The Manufacture of Sugar from Beetroot grown in Lancashire and Ireland."

Dr. S. G. Rawson. "A New Form of Sprengel Pump and Apparatus connected therewith."

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Wednesday, November 6th, 1889.

DR. F. HURTER IN THE CHAIR.

THE CONDENSATION OF HYDROCHLORIC ACID GAS.

BY F. HURTER, F.I.D.

In an old syllabus of the City Guilds I found, many years ago, a statement that students should be acquainted with the theory and practice of the condensation of hydrochloric acid. I felt at the time that I was tolerably well acquainted with the practice of the condensation of hydrochloric acid, but I had to confess that of the theory I was ignorant; and I often wondered what the authorities of those days meant by the term.

Clearly, a complete theory of the condensation of hydrochloric acid must enable us to answer questions such as this: What is the highest strength of liquid hydrochloric acid which can be obtained from a gas of known composition, and what conditions must be satisfied to obtain acid of that strength?

Such a theory of the condensation of hydrochloric acid does not exist, and many problems which have presented themselves to me in my practice have urged me to collect the materials for such a theory, and to devise one which should allow us, with great approximation to truth, to answer such questions as the one proposed.

A really complete theory of the condensation of hydrochloric acid would, however, require a great deal more experimental data than are at present at our disposal. I do not, therefore, wish the following to be considered anything more than an empirical method of solving various problems connected with the condensation of hydrochloric acid, such method being based upon the best experimental researches at present available.

There are three researches of great importance to this subject.

The first research is one by Hammerl, on the specific heat of aqueous hydrochloric acid. The amount of heat needed to heat aqueous hydrochloric acid is less than that which would be needed to heat the pure water contained in the liquid acid. For all acids between 10° and 32° on Twaddel's

hydrometer, the amount of heat necessary to heat such an acid one degree is almost exactly 7 per cent. less than that needed to heat, in the pure state, the water contained in the acid. Thus, all such acids require 0.93 units of heat for raising by one degree the temperature of a quantity of acid containing 1 grm. of water. Hammerl makes use of a complicated formula for calculating the specific heat, but that formula is useless for practical applications, and the above statement expresses the facts found by Hammerl with sufficient accuracy for technical purposes.

The second research I have to mention is one by Berthelot, on the heat developed by the solution of hydrochloric acid gas in water.

Berthelot finds that when 36.5 grms. of hydrochloric acid dissolve in 3,600 grms. of water (200 molecules to one molecule HCl) 17,430 grm. units of heat are evolved. An acid containing 36.5 HCl in 3,600 grms. H₂O is of about 1 per cent. or 1 Tw. If 36.5 grms. of hydrochloric acid gas are dissolved in less water less heat is evolved, and Berthelot gives the following formula, for the heat generated when a concentrated acid containing *n* molecules of water is diluted until it contains 200 molecules of water on one molecule of HCl, viz.:—

$$\text{heat liberated} = \frac{11,620}{n}.$$

But this formula again is, though extremely simple, not well adapted for our purposes, and I have changed it into another one which gives the amount of heat liberated when *x* grms. of hydrochloric acid are dissolved in 1 grm. of water. This formula is:—

$$\text{Grm. units heat liberated} = 477.5 \times x - 157 x^2.$$

And combining this result with the last one we find the rise of temperature if *x* grms. of hydrochloric acid are absorbed in 1 grm. of water to be—

$$\text{Rise of temperature} = 513 x - 169 x^2 \text{ in degrees C.}$$

The following table I have computed in order to facilitate calculations. The usual mode of expressing the strength of hydrochloric acid in this country is by indicating its specific gravity on the Twaddel scale. It so happens that the number of degrees on Twaddel's hydrometer almost exactly represents the percentage of hydrochloric acid. But for my purpose it is more convenient to express the strength of acid by saying that 1 grm. of water contains *x* grms. of hydrochloric acid. The table shows for any percentage of acid: 1st, the grms. of HCl on 1 grm. of water; 2nd, the units of heat evolved; 3rd, the rise of temperature during its formation.

TABLE I.

HCl.	Grm. HCl pro 1 Grm. H ₂ O.	Units of Heat Generated per Grm. of H ₂ O.	Rise of Temperature.
Per Cent.			°
5	.053	24.8	26.6
6	.064	29.9	32.1
7	.075	34.9	37.5
8	.087	40.4	43.4
9	.099	45.7	49.1
10	0.111	51.0	54.8
11	0.124	56.8	61.0
12	0.136	62.0	66.6
13	0.149	67.7	72.8
14	0.163	73.7	79.2
15	0.176	79.2	85.1
16	0.190	85.0	91.4
17	0.205	91.3	98.1
18	0.219	97.0	104.3
19	0.234	103.1	110.8
20	0.250	109.6	117.7

TABLE I.—*continued.*

HCl.	Grm. HCl pro 1 Grm. H ₂ O.	Units of Heat Generated per Grm. of H ₂ O.	Rise of Temperature.
Per Cent.			°
21	0.266	115.9	..
22	0.282	122.2	..
23	0.299	128.7	..
24	0.318	136.0	..
25	0.333	141.6	..
26	0.351	148.3	..
27	0.370	155.2	..
28	0.388	161.6	..
29	0.408	168.7	..
30	0.428	175.6	..
31	0.449	182.8	..
32	0.470	189.8	..
33	0.493	197.2	..
34	0.515	204.3	..
35	0.538	211.5	..
36	0.562	218.8	..

On glancing over this table, we are struck at once by the enormous amount of heat generated by the condensation of the hydrochloric acid. Supposing we had to convert 1 lb. of water into liquid acid of 28° Tw., which acid would contain 28 per cent. of HCl, the table shows that 0.388 lb. of HCl gas would be required, and that so much heat would be liberated as would heat 161.6 lb. of water by 1° C.

If we brought into contact water of 15° C. with pure hydrochloric acid gas of 15° C., the temperature of the liquid would rapidly rise, and would reach the boiling point 110° when 0.20 lb. of HCl has been absorbed for every 1 lb. of water. Such an acid would be of about 15° to 16° Tw. at ordinary temperature. According to this table then, the boiling point would be reached when the acid contains from 15 to 16 per cent. of HCl. The condensation of hydrochloric acid would not, however, cease; it would continue until the acid contains more than 20 per cent. of acid, the heat liberated by the condensation would no longer raise the temperature, but would simply cause the evaporation of some water.

Thus the result of bringing into contact cold water and cold hydrochloric acid gas under circumstances when no heat can escape would result in an acid of about 20° Tw.

It is very interesting to compare with this result another one, viz., that of bringing into contact cold water with hot hydrochloric acid gas. Let us assume the temperature of the hydrochloric acid very high, higher than any usual in practice, say 500° C. In that case each gram. of HCl gas brings with it $0.18 \times 500 = 90$ units of heat, which will help to heat the solution of the acid, and the total heat evolved will be increased to: $H = 477.5x - 157x^2 + 90x$, or: $H = 567.5x - 157x^2$.

Whilst cold hydrochloric acid evolves per 1 gram. HCl 477 units of heat, red-hot hydrochloric acid gas evolves 567 units or only 18 per cent. more heat. In other words to condense red-hot hydrochloric acid requires the removal of only 18 per cent. more heat than the condensation of hydrochloric acid of low temperature.

I have purposely chosen this high temperature in order to show how under certain circumstances previous cooling of the gas is of very little practical importance. *The great amount of heat to be removed is only generated when and where the gas comes into contact with water.*

The next research I have to mention, is that of Messrs. Roscoe and Dittmar. This is the most important research of all, because it furnishes us with the leading data for a theory of the condensation of hydrochloric acid. Though Messrs. Roscoe and Dittmar's research has been published a

quarter of a century, and ought to be well known, I will shortly recapitulate its essential points.

Messrs. Roscoe and Dittmar determined first the amount of hydrochloric acid which 1 gram. of water would absorb at 0° C., and under pressures varying from $\frac{1}{25}$ to 2 metres of mercury, and thus furnished us with a series of experiments from which we learn the influence of variations in pressure.

2nd. They also determined the amount of hydrochloric acid which 1 gram. of water would absorb under ordinary atmospheric pressure, but at various temperatures. From this series it is possible to find how the absorption varies with temperature, when the pressure remains constant, after applying a certain correction, which Messrs. Roscoe and Dittmar omitted, viz., a correction of the pressure for the partial pressure of water vapour at these various temperatures.

Messrs. Roscoe and Dittmar could not apply such a correction, because there did not exist at the time a table of the tension of aqueous vapour in presence of hydrochloric acid gas, nor has there been one supplied since to my knowledge. But it is possible to obtain such a table from the further determinations which Roscoe and Dittmar published in the same paper.

They determined the pressures, the boiling points, and the composition of hydrochloric acid, which distilled unaltered in composition, i.e., of which the vapour tensions can be calculated from the known composition of the residual acid. The experimental data supplied by Roscoe and Dittmar give us directly the highest possible tension of aqueous vapour in presence of hydrochloric acid gas at temperatures from 60° upwards. For temperatures below 60° we have also from Roscoe and Dittmar's researches, at least the ratios of the partial pressures of steam and hydrochloric acid into air, and by means of an ordinary table of the tension of aqueous vapour and the data furnished by Roscoe and Dittmar, it is possible to construct a table of the tension of aqueous vapour in presence of hydrochloric acid gas, which, if it is not perfectly accurate, is quite sufficient for technical applications. Roscoe and Dittmar gave the composition of acids which had been treated with large volumes of air at different temperatures, until the further application of air produced no alteration in the composition. It was found that at one and the same temperature an acid treated by air had the same composition as the acid boiling under diminished pressure at that temperature, a fact which proves that the partial pressures of steam and hydrochloric acid are independent of the presence or absence of atmospheric air. In consequence of this fact a table for the tension of aqueous vapours in presence of hydrochloric acid gas as deduced from Roscoe and Dittmar's researches is applicable also for gases containing atmospheric air.

I subjoin here a table thus constructed with considerable care from Roscoe and Dittmar's experimental results, supplemented by a few experiments of my own.

TABLE II.—MAXIMUM TENSION OF AQUEOUS VAPOUR (IN PRESENCE OF HYDROCHLORIC ACID) IN MILLIMETRES MERCURY.

t °	Maximum Tension of Aqueous Vapour.	Minimum Tension of Hydrochloric Acid.	t °	Maximum Tension of Aqueous Vapour.	Minimum Tension of Hydrochloric Acid.
0	3.2	0.52	60	79.0	11.8
5	5.0	0.81	65	103	15.0
10	7.2	1.16	70	130	18.6
15	9.8	1.65	75	164	23.0
20	12.8	2.0	80	205	28.4
25	16.6	2.6	85	254	4.6
30	21.0	3.3	90	313	42.0
35	26.5	4.1	95	386	50.7
40	32.8	5.0	100	472	60.8
45	40.0	6.0	105	574	72.5
50	50.0	7.5	110	676	84.0
55	63.0	9.3			

The figures in this table have the following meaning. Any gas saturated with aqueous vapour, but containing hydrochloric acid gas, the partial pressure of which is at least that given in the table, cannot hold more aqueous vapour than that corresponding to the partial pressure given in the table under the heading "maximum tension of aqueous vapour."

The first fact that strikes us on comparing this table with an ordinary table of the tension of aqueous vapour, is that much less steam can exist in hydrochloric acid gas than in other gases at the same temperature. Thus, for instance, at 100° C. the ordinary vapour tension is 760 mm., whilst in this table it is only 172 mm.

This explains the behaviour of hydrochloric acid gas escaping into damp air. Almost half the moisture of the air is at once precipitated as fog when hydrochloric acid gas is mixed with the air.

That the tension of aqueous vapour in hydrochloric acid is much less than given by ordinary tables I have frequently had opportunity to observe. I have often analysed mixtures of air, hydrochloric acid and steam, and seldom have I found even as much water as corresponds to the table given above. The amounts given there are maximum amounts.

I must also add that the mere fact that drops of liquid acid deposit from a gaseous mixture is no proof that the gas is fully saturated with moisture.

Temperature alone never can be used with certainty as an indicator of the amount of moisture in hydrochloric acid gas.

The following examples will show this:—

(1.) Ordinary pot-gas cooled to 62° C. contained:—

Air	57.2
HCl	31.2
H ₂ O	11.6
	<u>100.0</u>

Mm.

Partial tension of water vapour by analysis .. 88

" " " " by table... 91

(2.) Ordinary pot-gas cooled to 44° C. contained:—

Air	51.7
HCl	43.3
H ₂ O	5.0
	<u>100.0</u>

Mm.

Tension of aqueous vapour by analysis ... 38.0

" " " " by table 38.6

(3.) Hydrochloric acid gas dried by sulphuric acid, temperature 50° C.:—

Air	77.1
HCl	20.5
H ₂ O	2.4

Mm.

Tension of aqueous vapour by analysis 18

" " " " by table 50

This gas deposited acid of 32° Tw., though not saturated.

(4.) Gas evolved at 22° C.

This gas deposited acid of 36° Tw.:—

Air	83.66
HCl	14.73
H ₂ O	1.71

Mm.

Tension of aqueous vapour per analysis... 13.4

" " " " per table 14.2

The gas, dried by means of sulphuric acid, containing only one-third the amount of water corresponding to the table, still deposited liquid acid. It will also be seen that the other examples of gases saturated with moisture fairly agree with this table.

The use of this table in practice is chiefly confined to calculating the alterations which a given mixture of gas will undergo on cooling, and, if we combine the results with the information given in Table I., we can calculate the

amount of work which is done by a set of cooling pipes, as compared with the work which the condenser has to do. We can also by means of this table show the influence which the admixture of air has on the condensation.

When steam and hydrochloric acid condense together, a great amount of heat is evolved, which serves to keep the temperature of the gas up for a long time. It requires, therefore, a considerable length of cooling pipes to lower, by any considerable amount, the temperature of a hydrochloric acid gas containing steam.

The heat given out by the condensation of water vapour and hydrochloric acid to liquid acid of 25° Tw. is, per gram. of water, at least $536 + 141.6 = 678.2$ units, or 678.2 units pro 0.333 gram. HCl thus condensed. Thus the heat given out by 1 litre of HCl gas condensed will serve to heat nearly 10,000 litres of gas by 1° and prevent its cooling.

In his report of 1866, Dr. Angus Smith says (page 37):—"The cooling of the gas before entering the condenser is an extremely important point, so important that it may be said to be the key to all good condensation. It demands the most careful attention of the alkali makers."

He then gives a number of tables showing the temperatures of hydrochloric acid gas at various distances from the pan in which the gases had been evolved. As one striking example of the slow cooling of hydrochloric acid gas, I give the following series from Dr. Angus Smith's reports:—

Gas at pot.....	° F.
" 8 ft. from pot.....	324
" 16 "	295
" 24 "	288
" 32 "	230
" 40 "	188
" 48 "	187
" 56 "	185
" 64 "	182
" 72 "	176
" 80 "	172
" 88 "	171
" 96 "	160
" 104 "	168

If this had been a case of ordinary cooling the temperatures would have decreased much faster, but it was evidently a case of condensation and evolution of heat, and the decrease of temperature does not directly give any idea of the work actually done by such pipes.

At Messrs. Gaskell, Deacon, and Co.'s works, we have frequently measured with great care the amount of condensation taking place in such pipes.

From a charge of 16 cwt. of salt containing 10 per cent. of water, with the necessary amount of sulphuric acid of 132° Tw., there were evolved—

702.7 lb. HCl } in the pan and { 359 lb. HCl } in the furnace.
509.0 lb. water } 160 lb. water }

The gas from the pan passed through a length of 360 feet of earthenware pipes and was cooled down to 50° C. before entering the condenser. The acid condensed in the pipe was collected, weighed, and analysed, and amounted to 633 lb., containing 201.6 lb. of HCl = 28° Tw. Thus the cooling of the gas involved the dissipation of the following amount of heat:—

For condensation of 431.4 lb. water: $431.5 \times 536 = 231,616$	
" " " " to 28° Tw. acid .. 69,822	
Total units.....	<u>300,838*</u>

The amount of work left to be done by the condenser amounted therefore to the condensation of 501.1 lb. HCl and 78 lb. of steam, or in units of heat—

For condensation of 78 lb. steam	41,808
" " " 501 lb. HCl	192,884
	<u>234,192</u>

* Or approximately 2 units per square foot per hour per degree difference of temperature inside and outside

From these figures we see the great importance of previous cooling of the gas, the cooling pipes in that case having done 56 per cent. of the total condensation, as measured by the heat dissipated. We have made a great many such measurements, they are all very similar and they clearly demonstrate that previous cooling in the case of a gas containing steam is of great assistance.

Almost identically similar results as those found by direct measurement can be calculated by means of the table of tensions I have given, if we know the composition of the gas at any particular stage.

For if the volume V_0 of a gaseous mixture of hydrochloric acid, air, and steam containing x volumes of steam be cooled down to a certain temperature, then steam and hydrochloric acid will condense together in such proportion that for every 6 volumes of steam which condense, approximately 1 volume of hydrochloric acid condenses with that steam, and the remaining volume V_1 is saturated with moisture, and will contain x_1 volumes of steam such that $\frac{x_1}{V_1} = \frac{t}{760}$, where t = tension as given in the table. The amount of steam condensed would therefore be $V_0 x_0 - V_1 x_1$, and the amount of hydrochloric acid gas condensed would be $\frac{1}{6}$ of that or $\frac{V_0 x_0 - V_1 x_1}{6}$, and these two amounts account for the whole diminution of the volume, so that—

$$\frac{1}{6} (V_0 x_0 - V_1 x_1) = V_0 - V_1$$

from which equation we find—

$$V_1 = V \left(\frac{6-7x_0}{6-7x_1} \right).$$

The fraction of steam which was not condensed would be represented by—

$$\frac{V_1 x_1}{V_0 x_0},$$

or by—

$$\frac{x_1}{x_0} \cdot \left(\frac{6-7x_0}{6-7x_1} \right),$$

and the fraction of steam condensed would be represented by—

$$\frac{x_0 - x_1}{[1 - 1.166 x_1] x_0},$$

and x_1 is always = $\frac{t}{760}$, i.e., the tension given in the table divided by the barometric pressure at the time.

An example will make the application of the formula clearer. At Messrs. Gaskell, Deacon, and Co.'s works a charge of 16 cwt. of salt containing 8 per cent. of moisture, or 143 lb. of water, was treated with 1,858 lb. of sulphuric acid containing 423 lb. of water. The total amount of water is therefore 566 lb. Of this amount 500 lb. were evolved in the pan together with 700 lb. of HCl. If no air were present, and the gas were cooled down to 50° C., the amount of steam condensed during cooling would be found thus. The relative volumes of equal weights of hydrochloric acid gas and steam are nearly as 1:2 ($\frac{1}{36.5} : \frac{1}{18}$), or by bulk on 700 HCl there would be 2×500 of steam. The total bulk would be represented by 1,700, and the steam by 1,000, consequently $x_0 = \frac{1,000}{1,700} = 0.588$.

Then the table gives the tension at 50° C. as 50 mm., consequently $x_1 = \frac{50}{760} = 0.066$, and the fraction of steam condensed would be—

$$\frac{0.588 - 0.066}{[1 - 1.166 \times 0.066] 0.588} = \frac{0.522}{0.923 \times 0.588} = \frac{0.522}{0.543} = 0.961$$

so that 96.1 per cent. of the steam would condense in cooling down to 50° C.

But we can never entirely exclude air from these gases, and the more air there is present, the less effective previous cooling becomes as an aid to condensation. If, for instance, the gas evolved from the pan had been mixed with the gas from the furnace, and so much air had been present that only 150 grs. of HCl would be found on 1 cubic foot of air, or in round numbers 5 of air to 1 vol. of HCl, the gaseous

mixture would have had the following composition when leaving the furnace:—

HCl	14.1
H ₂ O	15.1
Air	70.8
	<hr/> 100.0

and x_0 of our formula would be = 0.206. We should therefore have when cooled to 50° C.

Percentage of steam condensed—

$$\frac{0.151 - 0.066}{[1 - 1.166 \times 0.066] 0.151} = 61 \text{ per cent.}$$

very much less than in the previous example.

In the first practical example I gave of an actual measurement, the amount of the steam condensed on cooling to 50° C. was 84.5 per cent., a result standing in between the two examples I have just calculated. In that case the composition of the gas was actually—

HCl	18.3
H ₂ O	27.0
Air	54.7
	<hr/> 100.0

From which composition the formula above calculates a condensation of 418 lb. of water, whilst 431 were actually condensed.

Considering the examples I have brought to your notice so far, I must modify the words of Dr. Angus Smith, and say that in the case of a hydrochloric acid gas containing much steam and little air, previous cooling is the key to good condensation, but with a gas containing little or no steam, previous cooling has not the importance which Dr. Smith ascribed to this operation generally.

Thus far I have dealt with the effects of previous cooling, and have shown how, by means of the table of tensions given, these effects can be ascertained by calculation.

There has been controversy as to whether previous cooling was really an advantage. I have already quoted Dr. Angus Smith. Opposed to his views are those of M. Schlösing, who thinks that the condensation of gases is more perfect when they are brought into contact with the condensing liquids while still hot. Professor Lunge, on the other hand, strongly opposed Schlösing, and supported the views of Dr. Smith. I think that if each of the authorities had stated exactly the conditions of the gas they proposed to cool, their opinions would not be found to differ materially.

I now pass on to a question which is of great interest to the manufacturer. It is the question, what is the highest strength of acid which can be produced from a gas of a given composition, under given circumstances as regards temperature, &c.

It has not been possible to answer that question hitherto with any degree of certainty. In a general way manufacturers knew what they had to do if they wanted strong hydrochloric acid. In a conversation I had with a friend on this subject, he said: It is surprising how much less water you have to put on the condenser to bring acid of 28° Tw. up to 30° Tw., this is also an important question.

To be able to answer such questions by calculations, we must know exactly how the amount of hydrochloric acid which 1 grm. or 1 lb. of water can absorb varies with the temperature and with the partial pressure of the gas. Such experiments have indeed been made by Messrs. Roscoe and Dittmar, but only under circumstances which do not occur on the large scale.

They made a series of experiments at freezing point with pure hydrochloric acid in order to ascertain how the absorption differed when the pressure was altered, but they did not repeat these experiments at any other temperature. They also determined the difference in the amount of HCl which 1 grm. of water could absorb at ordinary barometric pressures, the temperatures varying from 0° to 60° C. In these experiments the pressures of the hydrochloric acid were not, however, corrected for the tension of aqueous vapour, as is erroneously stated in some books, and this important series of experiments represents therefore not the results of variation of temperature only, but the result

both of variation of temperature and considerable variation of partial pressure of the hydrochloric acid gas.

That series of experiments which I have alluded to in the first part of my paper, concerning the composition of acids of constant boiling points, may also be considered as special cases of absorption, at varying temperatures and varying partial pressures of hydrochloric acid gas.

But all these experiments, so to say, represent extreme conditions, such as do not occur usually in the works. The conditions obtaining on the large scale lie between, and sometimes outside, the various conditions under which Messrs. Roscoe and Dittmar made their observations and performed their valuable experiments. The chief reason why no experiments have been made under conditions similar to those existing in works, I think, is this: those conditions are so difficult to imitate on a small scale as to entirely place such experiments out of question.

Under these circumstances, the only course open to us is to attempt to find a simple empirical formula which expresses the amount of HCl absorbed by 1 gm. of water as depending upon temperature and partial pressure of the hydrochloric acid, such a formula as would, with some degree of accuracy, reproduce the various series of experimental results ascertained by Roscoe and Dittmar.

Such a formula, which would calculate approximately all the results of Roscoe and Dittmar, would, with a high degree of probability, also calculate the amounts of hydrochloric acid absorbed under conditions intermediate, and such a formula, if simple enough, might prove very useful in practice.

I have, after many attempts, decided on the following simple formula as best adapted for practical purposes:—

$$C = [0.3040 - 0.0016 t] P^{0.150}$$

In this formula C represents the grms. or lb. of hydrochloric acid which 1 gm. or 1 lb. of water will absorb when the absorbing liquid has the temperature t , and is in presence of hydrochloric acid gas of partial pressure, P expressed in millimetres of mercury.

For convenience of calculations, I have constructed the following Table III. of the values of $[0.3040 - 0.0016 t]$.

TABLE III.—VALUES OF $0.3040 - 0.0016 t = C$ FOR DIFFERENT TEMPERATURES.

t .	C.	t .	C.	t .	C.
0	0.304	40	0.240	80	0.176
5	0.296	45	0.232	85	0.168
10	0.288	50	0.224	90	0.160
15	0.280	55	0.216	95	0.152
20	0.272	60	0.208	100	0.144
25	0.264	65	0.200	105	0.136
30	0.256	70	0.192	110	0.128
35	0.248	75	0.184		

I also append Table IV., giving the values of $P^{0.150}$ for gases under atmospheric pressure, and containing various amounts of hydrochloric acid.

TABLE IV.—VALUES OF $P^{0.15}$ IF THE BAROMETER STANDS AT 760 MM. AND THE GAS CONTAINS PER CENT OF HCl.

Per Cent.	$P^{0.15}$	Per Cent.	$P^{0.15}$	Per Cent.	$P^{0.15}$
5	1.725	40	2.357	75	2.530
10	1.915	45	2.400	80	2.615
15	2.035	50	2.438	85	2.639
20	2.124	55	2.473	90	2.662
25	2.197	60	2.505	95	2.684
30	2.257	65	2.535	100	2.705
35	2.311	70	2.564		

By means of these two tables it is easy to calculate, for any condition as to temperature and pressure, the amount of hydrochloric acid which 1 gm. of water will absorb, and when that is known, we find by Table I. the corresponding strength of the acid in per cent. or degrees Tw.

An example will make the use of these tables clearer.

(1.) Given pure hydrochloric acid gas at freezing point, how much hydrochloric acid will water absorb at ordinary barometric pressure?

From Table III. we find C for 0° to be 0.304, this we multiply by the value of $P^{0.15}$ for hydrochloric acid of 100 per cent. in Table IV. = 2.705, the result is 0.822 gm. of HCl absorbed by 1 gm. of water, or 0.822 lb. of HCl absorbed by 1 lb. of water.

(2.) A gas containing 25 per cent. HCl is in contact with a liquid hydrochloric acid at a temperature of 50° C., and ordinary barometric pressure, what strength will that liquid acid ultimately become, the temperature being kept constant?

We find in Table III. the value for temperature $50^\circ = 0.224$, and in Table IV. the value for 25 per cent. HCl = 2.197; multiply these two, and the result, 0.492, gives the amount of HCl absorbed by unit weight of water. Consulting Table I., we find that 0.492 corresponds to nearly 33 per cent. HCl or to 33° Tw.

In this way, a simple multiplication will give the desired result. For intermediate pressures and temperatures, the formula itself must be employed; it is readily applicable with the use of logarithms. It may be useful to give one example more.

(3.) What will be the strength of acid depositing from a gas of the following composition:—

HCl.....	43.3
H ₂ O.....	5.0
Air.....	51.7
Temperature.....	43° C.
Barometer.....	735 mm.

In order to find the value of the partial pressure of the hydrochloric acid, we multiply 735 by 43.3 and divide by 100, the result, 318.25, is the partial pressure in millimetres of mercury of the hydrochloric acid gas. We must now find the value of $318.25^{0.15}$. In an ordinary logarithm table we find $\log. 318.2 = 2.50270$, and multiplying by 0.15 we obtain 0.37540. The number to this latter logarithm is 2.373.

We now find the value of $0.3040 - 0.0016 \times 43^\circ$ to be $0.3040 - 0.0688 = 0.2352$.

Multiplying 0.2352 by 2.373 = 0.558 is the desired amount of HCl which will be condensed with unit weight of water. Consulting Table I. we find the corresponding strength to be between 35° and 36° Tw.

I have chosen this example to show the mode of applying the formula. I will not go into further calculations, but simply state that a gas containing 20.5 per cent. HCl gave at a temperature of 122° F. actually a liquid acid of 32° Tw., while the calculation would demand 32.9° Tw. (other examples follow below).

I have, in most cases to which I have applied the formula, found it to answer within one degree on Twadell's hydrometer. The greatest error I have found was in calculating an extreme case, viz., one of Roscoe and Dittmar's experiments at 0° and 0.05 m. mercurial pressure, where the error is 2° Tw.

So far then we are enabled, by means of the four tables I have supplied, to calculate the alterations which may happen during the cooling of the gas, the evolution of heat, the amount of condensation, and the strength of the acid formed at any temperature, and it only remains now to show the application of the formula to the condensing apparatus in ordinary use in this country, viz., the coke tower. These towers are usually built of stone, and the first difficulty we have to meet is the question how much heat does stone-work dissipate, for clearly the work which a condenser can do depends upon that, since the condensation means simply abstraction of heat.

In Box's treatise on heat we find that for 1 difference of temperature a stone wall 6 inches thick, 40 feet high, will dissipate per square foot 0.261 units of heat (British) per

hour. From Ferrini's technology of heat I calculate for similar conditions a very similar figure. But these figures are of no use, and in order to realise the work done by a stone condenser we must in the first case appeal to experiment.

A condenser 40 feet high, 8 feet \times 8 feet, has a vertical surface of 1,280 square feet. Into such a condenser there passed at Messrs. G. D. and Co.'s works in two hours 840 lb. HCl and 216 lb. of steam. The gas was mixed with air, the air leaving the condenser being 3 cubic feet per second = 1,720 lb.

The gas entered at a temperature of 73° C. and left at 60° C.

The condenser was fed with 2,520 lb. water in two hours, flowing in at a temperature of 15° C., and leaving as acid of 25° Tw. (measured cold) at a temperature of 80° C.

From these data we have—

(1) Units of heat entering condenser:—

Air 1,720 lb. at 73° C., specific heat 0.23.....	28,878
HCl 840 lb. " " 0.18.....	11,037
Steam 216 lb. " " 0.48.....	7,560
Total.....	47,475

(2) Units of heat carried away by gas leaving condenser:—

1,720 lb. air at 60° specific 0.23.....	21,958
Saturated with steam = 260 lb. at 60° \times 0.48....	7,388
+ latent heat of 44 lb. steam.....	23,584
Total.....	53,020

(3) Units of heat generated within condenser by condensation of HCl to 25° Tw. pro 1 lb. water 11.6 units, or for—

$$2,520 - 44 = 2,476 \text{ lb. water} \dots\dots 350,601$$

(4) Units of heat carried away by hot acid flowing out at 80° C. the water entering at 15°—

$$2,476 \times 65 \times .93 = 149,674$$

If from the amount of heat generated we subtract that carried away by the hot acid, and that which the gas takes away more than it brings, we find that the condenser walls must have dissipated the remainder, viz., 195,282, or, per hour, 97,641, per square foot per hour = 76.3 units.

Taking the internal temperature of the condenser as that of the liquid within, and the outside temperature as 15°, we have as a result that one square foot of stone work dissipates 1.15 units per degree per hour. This result is nearly four times as large as that given by Box.

What we learn from this example taken from actual practice is, that for successful condensation it is necessary to provide ample cooling surface in that part of the apparatus in which the gas comes in contact with the condensing liquid, since it is the act of absorption which generates the great amount of heat.

The condenser in question only yielded acid of 25° Tw. If it were required to make under the same conditions acid of 30° Tw., we should have to use considerably less water.

In order to find how much water would have to be used, we must know at what temperature the acid may flow out at the bottom in order to come out at least as 30° Tw. acid. This calculation is not difficult by means of the tables I have given.

From Table I. we find that pro lb. of water 0.428 lb. of HCl are condensed to form 30° Tw. acid.

The gas entering the condenser contained in round numbers 20 per cent. by volume of hydrochloric acid, and Table IV. gives for this amount the value of the pressure coefficient as 2.124.

Dividing 0.428 by 2.124 we obtain 0.201 as the value of the temperature coefficient to which corresponds in Table III. a temperature of 65 degrees. Consequently, with gas of this description 30° Tw. acid can only be obtained if the temperature of the liquid acid does not exceed 65° C., or the temperature of the condenser itself must not exceed 65°. Disregarding the small difference of heat owing to alterations

in the temperature of the gas, we can say that the heat dispersed by the condenser, and that carried away by the liquid acid, must be equal to that generated by the condensation.

By Table I. the heat generated per lb. of water used for 30° Tw. acid is 175.6 units. That carried away is $65 \times 0.93 = 45.4$, consequently the condenser has to dissipate for every lb. of water $175.6 - 45.4 = 130$ units.

Taking the figure 1.15 per degree per hour per square foot, and the temperature difference as $65 - 15 = 40$, the condenser will dissipate 117,760 units in two hours. Thus we find that we may use $\frac{117,760}{130} = 906$ lb. of water.

These will condense 387.7 lb. of HCl, and the rest of 453 lb. would escape, and would require a post condenser to deal with it.

That brings me to the last example I wish to cite. Two condensers, such as described, readily give acid of 30° Tw. from the gas of two saltcake furnaces.

The amount of HCl entering in two hours is 520 lb. The gas contains on an average only from 10 to 15 per cent. HCl. It is conveyed through the two towers in succession, the weak acid of the second condenser being pumped on the first condenser.

The gas passes into the first condenser at 77° C., leaves at 38° C., and leaves the second condenser at 32° C.

The second tower is fed with 1,215 lb. water at 15° C., which flows out at 48° as 10°—12° Tw. acid, but cools to 26° C. before entering the first condenser, from which it flows as 30° Tw. acid at 49° C.

These figures are from actual observations. It is easily calculated that two such condensers are capable of doing that work. As already explained we find for a gas of 10 per cent. HCl the temperature at which 30° Tw. acid can be formed. We divide 0.428, the amount of HCl to be condensed with 1 lb. of water by the pressure coefficient corresponding to 10 per cent. gas, which is 1.915, the result, 0.223, gives the temperature coefficient to which corresponds in Table III. a temperature of 50° C., which closely corresponds with the observed temperature.

The temperature of the first condenser being 50° C., the outer temperature being 12°, it will dissipate 111,872 units of heat in two hours. The acid carries away $22 \times 0.93 \times 1,215 = 24,860$, so that we may generate within the condenser $111,872 + 24,860 = 136,732$ units. If we divide this figure by the amount of water, 1,215, we obtain 112.5 units of heat as possible to be generated in the first condenser per lb. of water flowing through it. Consulting Table I. we find that 30° Tw. acid would generate 175.6, deducting the 112.5 possible to be generated in this condenser, we obtain 63.1 units, which must be generated in the second condenser, and this corresponds by Table I. to 12° Tw. acid.

We see, therefore, that calculations made by these tables closely agree with actual work.

It must, however, be understood that the figure 1.15 cannot be considered applicable to all condensers as expressing the units of heat dispersed per square foot per hour per degree difference of temperature. I have reason to believe that condensers free on all sides will disperse a great deal more heat; the condensers here spoken of are not free on all sides.

It must also not be forgotten that with a very dilute gas, the sensible heat of the gas may be greater in amount than that evolved during the act of condensation. It will, therefore, be impossible to lay down any rule as to the desirability of previous cooling, the usefulness of which depends entirely on the constitution of the gas.

It is also a commercial question, viz., whether it is cheaper to disperse the heat by means of glass or clay pipes, or by means of large and well constructed coke condensers. The continental system of great numbers of Woulf's bottles offers the advantage of large and effective cooling surface for the absorbing liquid. On the other hand the coke tower is comparatively free from nuisance.

I will now shortly refer to another part of the subject, viz., the amount of HCl which an inert gas will carry away if it passes through liquid acid of a given strength. This is important sometimes. The maximum amount of HCl which

a gas will carry away from an acid of given strength can be ascertained by means of the formula—

$$C = [0.3040 - 0.0016 t] P^{0.15}$$

If the equation is solved with respect to P, we obtain—

$$P = \sqrt[0.15]{\frac{C}{0.3040 - 0.0016 t}}$$

The equation can easily be solved by logarithmic calculation. P is then the partial pressure of the hydrochloric acid into the inert gas, and $\frac{P}{760}$ will give the volume per cent. of HCl carried away by the inert gas. This problem is at present more interesting to Her Majesty's inspectors of alkali works than to the manufacturer. I will only say that if air were passed in fine bubbles through a deep column of liquid hydrochloric acid of 12° Tw., it would just carry away 0.20 grains of hydrochloric acid gas per cubic foot of air.

I have now shown how by means of Roscoe and Dittmar's, Hammer's and Berthelot's researches many problems connected with the cooling and condensation of gases containing hydrochloric acid can be solved arithmetically.

The key to good condensation is not only to be found in the previous cooling of the gas, but also in the cooling of the absorbing liquid.

DISCUSSION.

After a vote of thanks on the motion of Mr. A. Norman Tate, seconded by Dr. J. Campbell Brown, the discussion was adjourned until the January meeting.

Dr. HURTER, in replying to the vote of thanks, said that the subject was a very difficult one, and one which nobody had attempted to deal with. He could not find in literature any attempt to make such a calculation, yet it was a subject which frequently occurred in works. Hydrochloric acid was no longer the valueless substance it was considered 40 years ago, and they had to be more careful with it every day; and it was important to obtain it of as high concentration as possible. It was therefore necessary that they should thoroughly understand the working of the apparatus which dealt with that gas.

It was considered that time and surface of coke were the great factors in the condensation of hydrochloric acid; the examples and calculations would show them that a most important factor was the heat which was generated by the absorption of the gas in water. The paper attempted to show the part which previous cooling in pipes, and the part which the walls of the condenser played in dispersing the heat of condensation.

If the tables and calculations were not quite perfect, they were the best substitute he could give them for a really accurate scientific theory. The tables were constructed so as to save all labour and all mathematical understanding. Those acquainted with mathematics could of course translate the formulæ into figures, but he found that to many chemists such formulæ were inaccessible. The sooner, however, his tables were replaced by more accurate ones, the better. But some one must make a beginning, and he hoped that this beginning was worthy of a place in the Journal of the Society.

Obituary.

DR. QUESNEVILLE.

We are indebted to the *Chemist and Druggist* for the following particulars of the career of the late Dr. Quesneville, Editor of the *Moniteur Scientifique* :—

DR. QUESNEVILLE (GUSTAVE-AUGUSTIN), born in Paris on January 1, 1810, died in the same city on November 11, 1889. A favourite pupil of Vauquelin and Chevreul, he at first studied medicine, and took the degree of doctor in 1834, but soon returned to chemistry, his father's profession, and succeeded to Vauquelin in his chemical manufactory, at a time when chemistry and pharmacy were terms almost

synonymous. His contributions to science generally consisted of short and practical notes, among which may be noted those on the analytical separation of iron and manganese; preparation of binocide of barium, of pure oxide of cobalt, of volatile chlorides, and of oxide of uranium without ammonia carbonate; combinations of chromic acid and silica; bismuth in large crystals; and medical uses of oxygenated water. But the principal work of Dr. Quesneville was his publication of the *Moniteur Scientifique*, an important monthly especially devoted to chemistry, theoretical and applied. The periodical, whose editor, publisher, and manager he was at the same time, first appeared in 1840 under the name of *Revue Scientifique*, and in 1857 changed its name to the present one. About a fortnight before his death he gathered together all his co-labourers in a banquet to celebrate the *Moniteur's* half-centenary, and there announced that it was his intention to cease publishing the paper with the current year. Feeling unequal to further efforts, and unwilling to see the work of his life pass into strange hands, he preferred to stop while he still had it within his power. Consequently the November number of the paper was headed with a notice advising the readers that the December issue would be the last published, and requesting subscribers not to send money for further subscriptions. Dr. Quesneville had the reputation of being very independent and a little peculiar—an appreciation apparently borne out by his determination to sacrifice to an idea the goodwill, no doubt valuable, of a long established publication.

It was only at the last meeting of the Council of the Society of Chemical Industry that it was unanimously resolved to acknowledge by an appropriate letter the Council's sense of the services rendered to Chemical Industry by the venerable Editor of the *Moniteur Scientifique*.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements in Dryers of Pulpy Moist Substances. A. Büttner and C. Meyer, Uerdingen, Germany. Eng. Pat. 13,369, September 17, 1888. 8d.

This apparatus is intended for the dessication of semi-fluid or pulpy substances, in three stages. The semi-fluid is first led through circuitous channels in the flue of a furnace, across the upper parts of which the hot gases are passing, and after partial drying and condensation therein, they reach an open trough provided with a longitudinal worm for mixing and transporting. At this second stage dry materials may be added, and, after mixing, the whole mass is delivered to the third part of the apparatus. This consists of a longitudinal metallic chamber, heated from below, in which two horizontal rotary beaters are placed side by side, and which throw the particles about. A strong current of air carries the dried powdery stuff towards the far end of the chamber, where it falls into a conveyor, which takes it away. All particles still containing moisture drop down between the beaters into the trough of a longitudinal worm placed along the bottom of the casing, and are conveyed back to the inlet end. There they are taken hold of again by the beaters, and the operation is repeated until such time as they are sufficiently dried to be carried away by the current of air.—B.

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows :—

If the price does not exceed 8d.	½d.
Above 8d., and not exceeding 1s. 6d.	1d.
" 1s. 6d., " " " 2s. 4d.	1½d.
" 2s. 4d., " " " 3s. 4d.	2d.

Improvements in and connected with Thermometers. R. Free, Manningtree, and H. J. Pierce, London. Eng. Pat. 14,683, October 12, 1888. 8d.

THE improvements are connected with thermometers, whereby they may be adjusted to any desired degree of heat, and caused to sound a bell, or otherwise give warning, when a certain temperature, previously determined, has been reached. The invention is specially intended for use in the drying of malt or other produce where it is desired to keep the heat within certain limits. Two mercury tubes are connected with electric bells, one tube and bell being intended to indicate a low temperature, and the other a high one. In the former case, so long as a rod is in contact with the mercury, the circuit of a relay battery is closed; but when it is broken by the sinking of the mercury from the rod, owing to a decrease of temperature, an armature drops and brings into operation another battery, which causes the bell to ring until the temperature is raised to the required degree, and the relay is again brought into action. If the temperature rise too high, the rod in the other tube is brought into contact with the mercury, and then closing the circuit, causes the other bell to ring until the temperature is reduced to the desired degree. The contact rods can be adjusted to any degree of heat.—E. S.

Improvements in Apparatus for Evaporating, Distilling, Refining, or Concentrating Liquids. T. Gaunt, New York, and E. H. Clapp, Boston. U.S.A. Eng. Pat. 16,335. November 14, 1888. 1s. 1d.

THIS invention relates to improvements in apparatus for evaporating liquids or for concentrating solutions, such as sugar, soda, and others. The improvements embrace the use of corrugated heated surfaces arranged vertically, over which the liquid to be evaporated is allowed to trickle or flow in a thin stream. The surfaces may be constructed of pipes arranged horizontally one above the other, and connected through their ends for the circulation within them of the heating medium, such as steam. The evaporating surfaces are placed within a casing which forms the receptacle for the vapour produced, whilst in the lower part the concentrated liquor may collect and be subjected to further heat applied to the bottom of the case. Several such evaporators may be combined for "multiple effect," and the vapour disengaged from the liquid in one evaporator may be used for heating the pipes of the next. The partly concentrated liquid may reach the next evaporator by gravitation, if the situation permit of such an arrangement, or the evaporators may be placed all on the same level and the liquid pumped or lifted from one to the other. The specification includes regulators for the supply and distribution of the liquid, separators for depriving the evolved vapour of moisture, and various modifications in the details and arrangements of the apparatus. The patent embraces eight claims, and is illustrated by seven sheets of drawings.—B.

Improvements in Filters. H. Roeske, Philadelphia, U.S.A. Eng. Pat. 7203, April 30, 1889. 8d.

THE filter, which is preferably of a cylindrical shape, has an outer and an inner chamber, each divided into compartments which communicate with each other by means of adjustable valves. Both chambers are partly filled with filtering material, that in the outer one being preferably gravel, sand, &c., and that in the inner chamber preferably coke in a granulated or crushed state. The liquid flows into the outer chamber through pipes provided with valves, and thence into the inner chamber, and through a connecting pipe into a central stand pipe which serves as the exit for the filtered fluid. In the outer chamber, and surrounded by the filtering material, are placed flushing and cleansing flues, preferably of a triangular form in cross section, and having their bases perforated. Pipes are also provided by which steam or hot water can be admitted into the inner chamber if required.

—E. S.

Improvements in Filtering Apparatus. C. B. Davis, Chicago, and E. H. Riddell, Cincinnati, U.S.A. Eng. Pat. 9651, June 11, 1889. 1s. 3d.

THE improvements consist in filtering apparatus adapted to the filtration of large quantities of water by passing the same under pressure through a bed of suitable filtering material contained in a closed tank, the object being to provide means for thoroughly washing the filter-bed without removing it from the tank, and with a minimum expenditure of time and water. For the mode by which this is effected, the specification, and the six sheets of drawings which accompany it, must be consulted. There are 15 claims.

—E. S.

Improvements in Filters. A. J. Boulton, London. From P. Varin, Bar-le-Duc, France. Eng. Pat. 9975, June 18, 1889. 6d.

THE filter consists essentially of a series of thin, juxtaposed metallic plates, the metal varying according to the nature of the liquid to be filtered. The plates are grooved in such a manner that chambers are formed both for the unfiltered, and filtered or clear liquid. Between every two plates is placed a sheet of filtering paper. The liquid to be filtered is introduced into one of the chambers, and fills the horizontal slots, but cannot enter into those of the other chamber, or that for the clear or filtered liquid, without first passing through the filtering medium. The plates are pressed together by suitable mechanism so that the whole is water-tight. The air contained in the chambers is driven out by the liquid itself; this is specially necessary in filtering liquids containing carbonic acid. The state of the process can be observed through indicator glasses. The plates and filtering papers can be cleaned by introducing clean water and reversing the flow of the current. The filter is mounted preferably on a three-wheeled carriage provided with two uprights into which the trunnions of the filter are placed, and can then be readily tilted if desired.—E. S.

Improvements in Apparatus for Use in Decomposing Chemical Compounds and Metallic Salts, and for Desulphurising Ores. H. H. Lake, London. From O. B. Peck, Chicago, U.S.A. Eng. Pat. 10,288, June 24, 1889. 8d.

THE inventor's idea is to mechanically separate the constituents of chemical compounds, such as metallic salts, sulphur ores, &c., by subjecting them in the molten state to centrifugal action. The vessel which he proposes to use for the purpose is by preference made in shape of a truncated cone, secured to the upper end of a vertical revolving shaft, and has a central opening at the top. Through this opening the molten material is poured in a thin central stream, whilst the lighter material of the compound subjected to centrifugal action rises and escapes all around the edge of the opening, and is caught in a surrounding casing. The heavier material remaining within and filling the cone after a certain time, can be removed by taking the cone to pieces, for which provision is made. The specification is illustrated by several drawings, and there are 13 claims relating to various arrangements and details of construction.—B.

Improvements in Pouring-in Funnels. W. Blakely, West Bournemouth. Eng. Pat. 12,290, August 2, 1889. 6d.

THE improvements are connected with funnels used in pouring oils or other liquids into jars or other receptacles. The improvements and claims are:—(1.) Fixing in any suitable manner on the inner surface of the funnel a series of downwardly projecting lips to prevent the splashing of the liquid when pouring in. (2.) Corrugating or fluting the spout of the funnel, or passing from the lower end of it to the top of the cone of the funnel, and fixing thereto a pipe, to allow the air to escape. (3.) Placing in the spout of the funnel a valve or float which indicates when the vessel is filled, and prevents overflowing. The float is

attached to a stem which moves in guides in the funnel, and has a loop at the upper end by which the funnel may be lifted so as to keep the valve closed and prevent the escape of the liquid whilst the funnel is being transferred from one vessel to another. (4.) Combining with the funnel a clamp by which it may be secured to the mouth of the vessel to be filled. (5.) Making the upper part of the funnel "half-moon-shaped" (in plan), so that it may be applied to the tilting aperture of lamps or similar receptacles without interfering with the globe or chimney.

—E. S.

Improved Evaporating Apparatus, Applicable for Cooling or Heating Liquids, and for Charging Gases with Vapours. R. Reichling, Dortmund, Germany. Eng. Pat. 13,212, August 21, 1889. 6d.

IN this invention the condensation of vapours or cooling of gases is sought to be accomplished by causing them to pass over moveable surfaces cooled by sprays of liquid. In one arrangement a number of corrugated discs are placed some distance apart, one behind the other, upon a hollow shaft, which is carried in the sides of the surrounding casing. The liquid issues in the form of spray through holes in the shaft between the discs, whilst the vapour passes across their surfaces as they rotate.—B.

II.—FUEL, GAS, AND LIGHT.

Gaseous Fuel. Sir Lowthian Bell. The Discussion. (This Journal, 1889, 761—764.)

MR. J. HEAD said there had been a great deal of confusion in the public mind with reference to water-gas. It was assumed, because this gas would give a higher initial temperature than producer-gas, that therefore it would be better. The real question was what was the loss of heat in the chimney; and, comparing the one gas with the other, the only difference was that the weight of the gases going up the chimney, at the same temperature in both cases, would be less in the case of water-gas than producer-gas. The difference for furnaces of water-gas, as compared with producer-gas, when everything was taken into account, was about 0.5 per cent. in favour of the former—that was to say, if they burnt 100 tons of coal with producer-gas, they might do with 99½ tons by using water-gas; and that was the only advantage. Another question was that of cost. He made a calculation for Mr. Siemens, based on the figures given by the friends of water-gas, and he found that, to melt two tons of steel and do a certain amount of other work, it would cost 18s. 3d. when using water-gas, and only 10s. 6d. with producer-gas.

MR. W. L. WILBY (Engineer to the Leeds Forge Company, Limited) said Sir Lowthian Bell had asserted that from 15 to 30 per cent. of the heat of the coal was employed in converting that coal into the gaseous form. From numerous records he found that the lower percentage was correct for producer-gas. In the author's calculations of the comparative calorific effect of producer-gas and the fuel from which it was made, he took credit for the whole of the carbon and hydrocarbons in the fuel, while it was well known that there was a large percentage of loss by condensation in the gas-tubes and flue; and that as for the producer-gas at the furnace showing a loss of 23.3 per cent., any number of analyses showed losses of from 30 to 40. Some of the figures relating to the foreign works were, while intended to be instructive, quite misleading. The most practical man admitted that gaseous fuel was the most perfect form of fuel known, from its easy applicability, control, and cleanliness. Yet the gases most usually employed showed a loss of at least 30 per cent. of the total heat-units in the fuel, and then gave a gas the flame of which was of far lower calorific intensity than the flame of water-gas, the proportion being 1,915 : 2,839. The detailed statement of the cost of production of water-gas at Witkowitz

was so extraordinary, and the cost per ton of gasifying the fuel so enormously high, that he could not but think that there must be some error, or that proper supervision had not been kept over the process. That it should cost 12s. 2½d. to gasify a ton of coal seemed enormous; and to steam a ton of fuel would decompose 980 lb. of water and produce 35,000 cubic feet of water-gas and 140,000 cubic feet of producer-gas. Therefore, to avoid steam for gas-making, 980 lb. of water were to be evaporated, to which might be added 980 lb. evaporated for engine purposes; making 1,960 lb., which, divided by 9, equalled 218 lb. of coal (or roundly, 2 cwt.), at 6s. The cost of fuel thus came to 7½d. instead of 3s. 6½d. Maintenance charges in the Moravian list were about three times what they would be in England. Having discussed this point, the speaker went on to deal at some length with Sir Lowthian's objection to the application of water-gas to the Siemens regenerative furnace; giving data respecting a comparison of mixed gases with solid fuel in the production of steel. He cited figures in disproof of the statement that coke at 36s. 5½d. per ton would produce heat as cheaply as water-gas; and contended that this sum should be divided by 2½ at least, bringing it down to 14s. 7.44d. The comparison of the producer-gas should, he said, be divided by 3 at least, bringing the value of the carbon in its original condition to 8s. 8d.—equal to coal of the quality taken at 7s. 5½d. per ton. He closed his remarks by pointing out that the quotations from Herr Kupelwieser in favour of producer-gas compared with water-gas were made in forgetfulness of a previous statement made by an official engineer of the Witkowitz works as to the advantages possessed by the latter gas.

MR. J. E. DOWSON remarked that in practice there was no general rule as to solid being more economical than gaseous fuel. In some cases it was better to have one, and in different circumstances the other. Gaseous fuel had the advantage—in the case of gas-engines, which were now being made of considerable power. He could speak with experience of engines which developed something like 1,500 horse-power; and the general result was that even when a small engine of about 10-horse power was used, the fuel consumption was only 1½ lb. per indicated horse-power, while in the larger ones it was 1½ lb. In the installation at Messrs. Spicer's paper-mill at Godalming, they employed gas power with "Otto" engines of about 240-horse power; and Mr. Spicer informed him that, after long working, he estimated that the fuel consumption was only about 1 lb. per indicated horse-power. Speaking generally, it might be, and doubtless was the case, that theoretically, solid fuel should give better results than gaseous fuel; but his contention was that in practice this was often not possible, and that for many purposes gaseous fuel was better and more economical, especially when the best appliances were used for getting as high a duty as practicable from the fuel.

MR. B. LOOMIS (Hartford, Conn.) said he had been largely connected with water-gas projects in America for many years. Producer-gas, to be effective, must be made and delivered under pressure, as an efficiency 30 to 35 per cent. better was obtained by pressure. Producer-gas, water-gas, and coal-gas should be made out of the cheap soft slack coals of the country. Actual demonstration and figures showed that they were able to make 40,000 cubic feet of water-gas, mixed with coal-gas, from a ton of bituminous coal. This mixture had about 350 heat-units per cubic foot, which was a very high calorific value. In the case of gas made from anthracite coal, it was 290 units; but from bituminous coal with more hydrogen in it, as well as some marsh gas, the heating power was increased to the extent he had mentioned. Producer-gas made from soft slack coal in properly built furnaces was far superior to the producer-gas or coke with a blast furnace; and it could be made entirely free from tar, as this might be converted into gas. Water-gas was being used for metallurgical purposes. At large works in Massachusetts, the entire forging was done at a saving of 30 per cent. of labour and nearly 50 per cent. of coal. Another works, near Boston, was entirely run with water-gas. In Cincinnati, gases were mixed together and used; and the cost of coal had been reduced more than half, and the time for drying the coal from 12 to 2 hours, besides the amount of labour that was saved.

MR. SAMSON FOX said he had many times found himself on the same side as Sir Lowthian Bell; but in the present matter he was ranged on an opposite platform. In supporting his contention, he did not rely on anything but absolute fact, the result of two years' experience in actual working. It was stated in the paper that water-gas would not give as good results as solid fuel. He could not deal with gaseous fuel generally; but he felt competent to speak as to water-gas. The author was wrong first of all in the cost of producing. In one place the paper said that 12s. 2½d. was the cost of gasifying a ton of fuel; and on the same page it was stated that the figures which the Leeds Forge gave were 2s. 8d. It was evident that one side or the other must be altogether wrong; and he would only remark that the 2s. 8d. was the result not only of their own calculations, but was deduced from figures taken out by entirely independent authorities. The cost of the fuel was also wrong, for in one place it was put down at 13s. 5d., and in another place at 10s. The paper said that coke was used by the Leeds Forge Company; and exception was taken to this because, if water-gas superseded ordinary gas, there would be no gas-works to go to for the coke. In reply to this objection, he would only say that they used coke because it was the most convenient form of fuel to be obtained; but it was to be remembered that this was a fuel out of which someone else had taken a large quantity of gas. In some works, however, there was a great quantity of breeze, which could be used just as well as any other material for making water-gas. Sir Lowthian was wrong in his estimate of the cost of steam, which he put down at 3s. 6½d. per ton of coal treated; this being according to the figures sent him from Germany. This item was included in the 12s. 2½d. charged to gasification. He (Mr. Fox) considered the estimate much too high, as he thought 6d. per ton of fuel would be sufficient to cover the item of steam required. Taking these three features—the cost of fuel, of gasification, and of steam—to be wrong, it would be found that the estimate of the author must be entirely recast in order to give a true idea of the commercial aspect of the question. As to the pressure at which the gas might be used, an instance was given in the paper, in which it was stated that as much water-gas was to be sent through a 1½-inch pipe as would be equivalent to ordinary gas passing through a 36-inch pipe. It should be explained that the gas was to be conveyed under considerable pressure. It had been arranged to supply a small town with water-gas for lighting purposes. Round this town were seven villages, lying at distances ranging between three and seven miles. The villages had arranged to take the gas if it could be conveyed to them. There was no difficulty in this, if the gas could be reduced in volume to an equivalent to 600 lb. pressure, so that small pipes and small gasholders could be employed. He hoped to do this in many cases; for there could be no doubt that, for general lighting, water-gas was better and cheaper than ordinary gas, and certainly very much cheaper than the electric light. At the Leeds Forge it had been used for 18 months; and he had had it in his own house for eight months. He found it in every way an advantage—first on the score of purity, but more especially in cost. The charge for ordinary gas with him was 3s. 9d. per 1,000 cubic feet, but he could supply the water-gas at 1s. 1d. Besides the many new openings there might be for utilising water-gas for manufacturing purposes in the future, within the next two or three months there would be a dozen plants at work which were now building. There were positions in which the new gas would be of the greatest value—such, for instance, as where ordinary gas would not be sufficiently clean. He concluded by inviting the author of the paper to visit the Leeds works, so that he might examine the whole process, and see for himself the carrying out of working details upon which his (the speaker's) estimates were based.

MR. E. RILEY asked Mr. Fox how he proposed getting over the difficulty of employing so poisonous a gas as carbonic oxide for the lighting of private houses—a gas, too, without smell.

MR. FOX said, in the first place, it might not be generally known that the larger part of the gas-piping in houses was in a leaky state at the present time, and that something like

25 per cent. of the amount of the gas bill was owing to the leakages existing throughout the country. Let them make thoroughly tight gas-fittings, and introduce into the gas a little volatile liquid that would give warning of a leakage the instant it occurred, and there would be no fear of injury resulting from an escape of gas. The percentage of carbonic oxide in water-gas was perhaps 0·45.

HERR KUPELWIESER said he wished to explain that at the time he wrote his first letter he gave about 13s. a ton for coke, whilst at another time, and taking an average, the price was 10s. 3d. a ton. At that price 1,000 cubic metres, or 35,316 cubic feet, of producer-gas would cost 3s. 1d., as against 1,000 cubic metres of water-gas at 11s. 6d., or 1,000 cubic feet at 4½d. This might be compared with 1,000 cubic metres of coal-gas at 3l., or 1s. 8½d. per 1,000 cubic feet. These prices were much the same as those given by Sir L. Bell, though arrived at differently. He wished to point out that the 1,000 cubic feet of steam, costing 3s. 6d., referred to German practice, and not to Witkowitz. The apparatus he used was similar to that adopted by Mr. Fox, and it had been working two years with satisfactory results.

SIR F. ABEL thought the Institute was much indebted to Sir Lowthian Bell, and also to Mr. Samson Fox, for the valuable information they had afforded on the subject of gaseous fuel. Water-gas itself was not used, pure and simple, for metallurgical purposes, but mixed with other gases. With regard to the danger from poisonous effects, he doubted if it would be wise to place their lives in the hands of the average gas-fitter, and admit a poisonous gas into their homes on the faith of his work being perfection.

M. POURCEL having made some few remarks, as representing France,

MR. F. SIEMENS said he had been much struck with Mr. Samson Fox's statement that he did not use water-gas pure for furnace purposes, but mixed it with the other gas made in the same apparatus. This practice would agree with his own experience in using gases; and as the resulting gas would be very similar to that made in the Siemens gas-producer, he could not see any advantage in the proposal to make two gases separately to be afterwards mixed. He had had a great deal of experience for a long period with various kinds of gases, using them for furnaces with which he had been experimenting; and the result of his experiments was to divide gases into two classes—luminous and non-luminous. He found non-luminous gases to be of very little use for furnace purposes, as they were only suitable when heating with contact. For incandescent gas lighting, for instance, the non-luminous gases could be used, as the flame struck upon the material which had to give the light. Non-luminous gases (to which class water-gas belonged) did not radiate light or heat sufficiently; and they could not therefore possibly heat large furnaces with them. They would be obliged to mix water with gas made from coal, or carburetted it in some other way, in order to use it in large furnaces. This would be a rather complicated operation. According to his (Mr. Siemens') experience, the presence of hydrocarbons in gas for furnace purposes was of the utmost importance. He read a paper a few years ago before the Institute, in which he stated that large furnaces could not be worked with non-luminous gases. If, however, water-gas was mixed with illuminating gas, as had been proposed by Mr. Fox, then, of course, it would do very well.

SIR L. BELL, in reply, said that he was at a loss to understand why Mr. Wildy and Mr. Fox should complain of the high price he had put on the fuel, for it was their object to show that the water-gas was cheaper than the solid fuel; and if the high price of fuel made the gas appear dear, it made the solid fuel dear also. The question was one of comparison. It was beside the question also whether coke or coal were used, from a scientific standpoint; the problem being whether, from a calorific point of view, a given amount of fuel could be used more advantageously in a solid state direct or by being previously gasified. He had seen water-gas in use at Frankfurt years before, and had come to the conclusion then—and this opinion he still held—that in some situations it would be good; but this was a very different thing from saying, as really seemed to be claimed for it,

that it would be suitable for all purposes. Exception had been taken to the construction he had put on the statement in the pamphlet as to the sizes of the pipes required to supply water-gas and the ordinary coal-gas. Mr. Fox had offered an explanation; but he (Sir L. Bell) would like to ask what power it was proposed to apply to force gas at 600 lb. pressure through a small pipe for 10 miles. For his own part he thought the friction would be so great that he should not be surprised if the pipe became red hot. Stress was laid on the fact that cheap water-gas could be made from breeze, which was a by-product of gasworks; but Mr. Fox proposed superseding existing gasworks by his system. Where, then would the breeze come from? As to the cost of converting solid into gaseous fuel, he himself had had some misgivings as to 12s. 2½d. being quite right until Mr. Kupelwieser spoke. Even the 2s. 8d. of Mr. Fox was, however, a heavy percentage on the price of coal or coke. In conclusion, he said he only desired to get at the truth of the matter. He should therefore gladly avail himself of Mr. Fox's offer to allow him to make a complete investigation at the Leeds works; and it would be found that, if he had been over bold in putting forward the statements in his paper, he would equally show his courage in acknowledging any errors he might have made.

Paris Gasworks' Experimental Data. The Gas World, 1889, 429.

THE following results have been obtained at the Paris gasworks during recent years, and are set forth in a report by M. Em. Sainte-Claire Deville:—

1. Those coals which contain most oxygen are those which most readily absorb and retain moisture. When the oxygen ranges from 5½ to 12 per cent., the latter ranges from 2·17 to 6·17 per cent.

2. The whole quantity of volatile matter in coal is greater the greater the percentage of oxygen. When the latter ranges from 5½ to 12 per cent., the former ranges from 26 to 40 per cent.

3. The quantity of carburetted volatile matter (after deducting the possible water) is also greater the greater the percentage of oxygen in the coal. The respective ranges are: oxygen, 5½ to 12; possible water, 6½ to 13½; carburetted volatile matter, 23·23 to 30·83 per cent. of coal free from ash.

4. There is no clear relation between the percentage of cinders and the analysis of the coal. Still, the least oxygenated (5 to 6½ per cent. of oxygen) and the most oxygenated (11 to 13 per cent.) coals contain most cinders, and the least cinders (rarely below 3 or 4 per cent.) are in the coals which contain from 6½ to 9 per cent. of oxygen.

5. There is no clear relation between the percentage of oxygen and the proportion of sulphur and chlorine. That depends on the geological stratum, and probably on the circumstances of deposit.

6. When a coal is distilled with its own coke the yield of gas is less in the most oxygenated coal, *because of the pooriness of its coke*. (Range = 10,641 cubic feet and 2,420° F., down to 9,691 cubic feet and 2,232° F.)

7. The more oxygenated coals are easier to distil; heated with their own coke they distil more uniformly than the less oxygenated, and at a lower temperature.

8. Carbonic acid diminishes lighting power by 2·73 per cent. for each per cent. of gas replaced by carbonic acid. (Date of research, September and October 1886. Agrees closely with Mr. Sheard—13/9/87—who says 2·69.)

Nitrogen, similarly, causes a loss of 1·8 per cent.

9. As we pass up from coal with 5½ to coal with 12 per cent. of oxygen, we find that in the analysis of the gas produced the carbonic acid rises from 1·47 to 3·13; the carbonic oxide from 6·68 to 11·93; the hydrogen sinks from 54·21 to 42·26; the marsh gas and nitrogen together rise from 34·37 to 37·14; the benzol rises from 0·79 to 1·04 (at between 9 and 11 per cent. of oxygen in the coal) and again sinks to 0·88; the other (non-aromatic) carburetted hydrogens rise from 2·48 to 4·66 per cent. Heating the coal by its own coke; temperature produced sinks from 1,326° to 1,222° C.

10. Under the same circumstances the density of the gas rises from 0·352 to 0·482, and the lighting power rises from 8·03 to 10·4 candles (assuming, that is, that the candle is 7·435 English candles) per 5 cubic feet of gas actually burnt per hour.

11. Under the same circumstances the amount of absolute lighting power obtainable from a metric ton of coal rises from 227 to 269 candles. This rise is not proportionate to the increase in volatile matter; the reason appears to reside in the presence of carbonic acid.

12. The most bulky coke is that from coal containing from 5 to 7½ per cent. of oxygen.

13. Coke from coal with 5 to 7½ per cent. of oxygen is good, though rather quick burning; 7½ to 9, small and dense, excellent; 9 to 11, mediocre or bad; 11 to 13, "detestable."

14. Weight of tar increases from 3·902 to 5·592 per cent. of the coal used; weight of liquor increases from 4·584 to 9·861 per cent.

15. The production of ammonia depends much more on the temperature, the season of the year, &c., than upon the nature of the coal; explained by the accumulation of ammoniacal salts in the coke towers in winter.

16. In coal from the same seam, the more oxygen, the greater the yield of ammonia.

17. In ordinary working the distribution of the impurities is:—

	NH ₃ .	HCl.	H ₂ S.	H ₂ Cy.	CO ₂ .
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Retained in condensers	63·1	96·3	8·1	3·3	9·8
" scrubbers (sawdust)	35·4	3·7	3·8	5·2	7·5
" purifiers (iron oxide)	1·5	..	88·1	91·5	Trace
Remaining in gas	Trace	..	..	Trace	82·7
	100·0	100·0	100·0	100·0	100·0

18. The best gas coals are those containing 7½ to 9 per cent. of oxygen. Less oxygen than this in the coal, there is plenty of coke but the gas is poor; more, the coke is bad.

19. As to the effect of the temperature of distillation, the Paris experiments of the last 12 years have simply confirmed the well-known statements that high temperatures (1) increase the volume; (2) diminish the density; and (3) lower the lighting power of the gas; (4) slightly decrease the carbonic acid (but not always so); (5) do not affect the proportion of carbonic oxide; (6) decrease the marsh gas; (7) diminish the percentage of heavy hydrocarbons, absorbable by bromine, other than aromatic hydrocarbons; (8) increase the hydrogen; and (9) decrease the yield in tar. The increase in volume is greater within limits than the decrease in lighting power; so that the ton of coal gives *more light*.

20. If the gas issuing from a retort be made to record its own yield by means of a pencil and rotating cylinder, the curve recorded presents a marked inflexion where the yield of gas becomes exhausted. If the heat be adjusted to suit the charge and the time, the yield is very steady until just before the end of the four hours. If the temperature be excessive, or if the coal be too highly oxygenated for the average heat applied, this inflexion is very strongly marked. If the temperature be inadequate, the inflexion is less well marked.

On the Recovery of Sulphocyanogen and Ferrocyanogen from the Spent Oxide of Gas Purifiers. J. V. Esop. Zeits. f. angew. Chem. 1889, 305—307.

See under VII., page 881.

Petroleum Supply of Baku. Board of Trade Journal, VII. 512.

A DESPATCH, dated the 22nd October last, has been received at the Foreign Office from Sir R. B. D. Morier, Her Majesty's Ambassador at St. Petersburg, enclosing an extract from the *Journal de St. Pétersbourg* of the 10th (22nd) October last, respecting the petroleum supply of Baku. The following is a translation of the extract in question.

The *Journal du Ministère des Finances* states that, contrary to the assertions of different foreign newspapers, the Caucasus naphtha industry is developing in a very satisfactory manner. Thus the Balakhani-Sabouutchinsk springs, which, it is said, are being exhausted, produced last year 173,472,226 pounds of naphtha. Compared with 1887, the production of these springs has increased by 15.1 per cent., and it may be observed that the production of 1887 exceeded by 12.1 per cent. that of the preceding year. It is a fact that since 1882 the production of naphtha at Baku has constantly increased, whilst it has gradually diminished in considerable proportions in the United States. Our contemporary makes on this head the following comparison of the average daily production of naphtha at Baku and in the United States:—

—	Baku.	United States.
	Pounds.	Pounds.*
1882	138,380	740,727
1883	165,410	570,024
1884	246,530	609,156
1885	318,510	512,289
1886	328,890	636,561
1887	415,000	531,603
1888	503,120	420,300

* A barrel of American naphtha is reckoned at the rate of 9 pounds.

Moreover, the stock of petroleum in the United States has fallen from 333 to 130½ million pounds, whilst at Baku, by reason of the construction of reservoirs, it is always increasing.

The *Journal* states, in conclusion, that there is still in the environs of Baku and in other localities of the Caucasus, a large number of springs of naphtha hitherto unworked, which is no longer the case in America.

The Turfa Mines of Brazil. United States Consular Reports, July 1889, 353.

CONSEL Burke, of Bahia, reports the discovery in that province of a mineral which has been called Turfa or Brazolina, and which furnishes an oil akin to petroleum, a paraffin suitable for the manufacture of candles, and a good lubricating oil. It was originally discovered by an English clergyman named Wilson, but a company has recently been formed which has bought the concession, and is now engaged in the development of the property. Petroleum extracted from it has already been placed on the market, and has been favourably received.—C. G. C.

Petroleum Discoveries in Netherlands-India. Board of Trade Journal, VII. 536.

THE *Deli Courant* states that search for petroleum along the banks of the Lapan river, in Langkat, has resulted in the discovery of large deposits of that oil. Raw petroleum oozes out of the ground at many places, where the natives have consequently dug pits. The output from most of the latter has never been considerable, and shows fluctuation. At Telaga Tunggal, where the boring reached a depth of about 350 feet, more important results have been arrived at. Appearances indicate that the main reservoir has been tapped there. The oil met with in the other pits and deposits proved to have found its way above ground from that storing place.

The oil tested yields 35 per cent. of lamp oil of good quality. It does not contain harmful ingredients, and offers advantages as a lubricator. The exact depth of the other deposits remains to be determined before an estimate of working expenses can be accurately made.

PATENTS.

Apparatus for the Manufacture of Gas. The Gas Patents Syndicate, Limited, London. From J. B. Archer, Washington, U.S.A. Eng. Pat. 8559, June 11, 1888. 8d.

This is a description of a somewhat complex apparatus for producing gas from steam and liquid hydrocarbon. An outer—containing an inner—retort is set vertically in a fire-flue leading upwards from a circular furnace below. A brick partition surrounding the central fireflue acts as a division wall between this and a second chamber through which the products of combustion have also to pass. In this chamber is set a series of retorts into which liquid hydrocarbon is drawn by steam, which has been superheated by passing first through a coil of pipes in the brick partition above mentioned, and then through a second coil situated around the retort in the central fireflue. After leaving what we may call the exterior retorts, the mixed gases enter the inner of the two central retorts, and traverse this from top to bottom, their passage being impeded by a number of perforated spherical segments forming horizontal partitions in the retort. Leaving the inner retort at the bottom, the gases pass upwards by the space between the two retorts, and leave the outer one at the top ready for use or storage.

—A. R. D.

Improvements in Steam Generator and other Furnaces. J. Fernee, Norton Woodseats. Eng. Pat. 11,643, August 13, 1888. 8d.

THE essential feature of this invention is that the gaseous products of incomplete combustion are taken from the fire-place to a combustion chamber situated overhead, where they are joined by a further supply of air heated by passing through a series of fireclay ducts, which communicate (through the firebars) between the combustion chamber above and an air space below. The invention is said to be specially applicable to marine and locomotive boilers.—A. R. D.

Improvements in Apparatus for Generating Illuminating Gas and Gaseous Fuel, and for Burning the Latter. O. Langberg, Brooklyn, U.S.A. Eng. Pat. 13,050, September 10, 1888. 1s. 1d.

GASEOUS fuel (made in the process) is mixed with a regulated supply of air and delivered into a chamber covered by a perforated slab of fireclay, terra-cotta, or other suitable material. Issuing from these perforations it enters into combustion and heats a number of retorts, connected in series, situated overhead. Higher still is a superheating coil, and steam is caused to pass through this previous to entering the retorts in conjunction with liquid hydrocarbon. The retorts are packed with deflecting cones in order to promote decomposition.—A. R. D.

Improvements relating to Artificial Fuel, Refractory Material for Lining Retorts, and Bricks and Tiles. R. Stone, London. Eng. Pat. 13,768, September 24, 1888. 4d.

To form a quickly burning fuel about 3 per cent. of oil of vitriol is mixed with about 97 per cent. of peat, peat litter, or other fibrous carbonaceous material. A small percentage of petroleum or other oil may also be added. For a more enduring fuel, coal is added in any desired proportions. A very refractory material suitable for retort- or converter-linings is prepared by intimately mixing 3 per cent. of vitriol with pulverised slate, slate refuse, or lava. In manufacturing bricks or tiles, the clay is mixed with 3 per cent. of vitriol and the same quantity of petroleum or other oil.

—A. R. D.

Improvements in Coke Ovens. H. H. Leigh, London. From T. von Bauer, Munich, Germany. Eng. Pat. 14,575, October 10, 1888. 1s. 1d.

THESE improvements have reference to the coke ovens described in Eng. Patents 11,010 of 1884, and 6342 of 1887 (this Journal 1885, 486, and 1888, 835). Openings are formed through the side walls of the oven either into the combustion chambers or into the outer air. In the absence of such openings the gases evolved from the oven during any stoppage of the apparatus for recovery of by-products were apt to interfere with the air supply or damage the internal flue structure of the oven. Provision is also made for the more perfect admixture of gas and air in the mixing chambers. The specification is illustrated by five sheets of drawings.—A. R. D.

Improvements relating to the Preparation of Tar, chiefly Designed for Use in the Manufacture of Artificial Fuel. H. H. Lake, London. From F. Homay, Fleurus, Belgium. Eng. Pat. 15,393, October 25, 1888. 6d.

COAL tar and blast-furnace tar are melted and mixed in suitable proportions with or without addition of heavy oils of creosote, the resultant tar being used in manufacture of blocks of artificial fuel.—D. A. S.

Improvements in Apparatus for Automatically Controlling the Generation of Gas from Oil or other Liquid Fuel. C. Brotherhood, Bristol. Eng. Pat. 16,118, November 7, 1888. 8d.

HEREIN is described an apparatus for the automatic control of the process for making gas from oil referred to in Eng. Pat. 1315 of 1888. The upper or moveable part of a gas-holder contains in its lower portion a tank, which is filled with water. The pipe conducting gas from the holder to the burner heating the retort is made to terminate directly over the tank, so that when the upper part of the holder rises, the mouth of the pipe is sealed, and the supply of gas cut off from the burner. As the pressure rises in the holder—and, of course, in the directly connected retort also—it is made to operate in the direction of checking the inflow of oil to be gasified. Four modifications of the apparatus are shown.—A. R. D.

Improvements in and connected with the Manufacture of Illuminating Gas. J. H. R. Dinsmore, Liverpool. Eng. Pat. 16,194, November 8, 1888. 8d.

ACCORDING to these improvements tar or other residual hydrocarbon liquor is introduced into a retort, either mixed with coal or separately therefrom, and the products of distillation, on leaving the retort, are caused to traverse a cooled passage; such cooled passage being preferably a portion of the ascension pipe. If the tar be introduced into the retort by itself, it may be allowed to flow upon a shelf so arranged as to form a kind of horizontal partition in the retort, and over which the gas has to pass on its way to the ascension pipe. The various condensable pitchy matters, which, in ordinary working, are so apt to create trouble by blocking up the apparatus, are arrested in the cooled passage.—A. R. D.

Improvements in Apparatus for use in the Treatment of Gas. J. E. Dowson and A. Dowson, London. Eng. Pat. 16,958, November 24, 1888. 8d.

THIS specification deals with an improved washer and an improved scrubber. The first consists of two or more chambers through which the gas has to pass. The gas inlet and the inter-chamber communications are sealed with water kept at a constant level in the chambers by suitable overflow arrangements. A feature of the apparatus is that the feed-water enters by the pipe which forms the gas exit, and flows thence by means of a suitable partition direct to the chamber where the gas first enters. The scrubber consists of a chamber provided with two or more partitions (formed of perforated gratings) set some distance apart, and having the intervening space filled up with sawdust or other suitable filtering material.—A. R. D.

Improvements in and in connection with Furnaces for Steam Generators and for other purposes. J. Davies, Llanfyllin. Eng. Pat. 316, January 8, 1889. 8d.

IT is proposed to admit a further supply of heated air at some point in the fireflue—preferable the bridge—where the sectional area can be still further diminished by a damper if necessary. The fireflue is also to be fitted internally with a series of fireclay rings decreasing in diameter towards the back, but not to such an extent as to impede the draught. This arrangement is intended to bring the products of combustion into closer contact with the surface to be heated. The furnace is preferably constructed outside the boiler flue, but communicating with it by a restricted passage where the supplementary air supply is admitted as prescribed above.—A. R. D.

Improvements in the Treatment of Coal and small Coke or Breeze in the Manufacture of Gas and Coke. J. Greenfield, London. From C. A. d'Assumpção and E. S. Dias, Lisbon, Portugal. Eng. Pat. 1326, January 24, 1889. 6d.

THE coal to be coked is mixed with a suitable proportion of coke screenings, known as breeze. This is said to increase the brightness and firmness of the coke, and to render it slower of combustion, while a greater quantity of gas of a greater illuminating power is produced per ton of coal.

—A. R. D.

A Method of and Apparatus for Adding Volatile Substances to Gases. S. Fox and E. Blass, Leeds. Eng. Pat. 6130, April 10, 1889. 8d.

THIS method and apparatus is particularly suitable for imparting an odour to water-gas to facilitate the detection of escapes. The apparatus consists of a vessel to which the volatile liquid is supplied from a closed reservoir above, and in which it is maintained at a constant level. This is effected by making the supply pipe from the reservoir terminate at the required height, so that when the liquid in the lower vessel falls below this point, gas makes its way up the supply pipe into the reservoir, and allows a corresponding volume of liquid to descend. A portion of the gas traversing the main is taken by a kind of by-pass through the lower vessel of the apparatus, and, returning to the main, imparts the odour of the volatile liquid to the rest of the gas there.—A. R. D.

New or Improved Regenerating Double Shaft Furnaces with Change of Current. J. von Ehrenwerth, Leoben, Austria. Eng. Pat. 6295, April 12, 1889. 8d.

THIS invention relates to furnaces for heating ingots, tempering or annealing wire, rivets, castings, &c., for smelting metals, burning bricks, and other purposes. The furnaces, which may have either upward or downward inlet flame, have a combination of two furnace shafts, connected together at their ends remote from the inlets by a passage or passages with combustion chambers so that the combustion of the gases may be commenced before entering the shafts. Each shaft communicates through its combustion chamber with a regenerator and arrangements for changing the direction of the current so that the furnaces may be heated alternately, directly and indirectly. The specification is accompanied with two sheets of drawings.

—D. A. S.

Improvements in or Connected with the Manufacture of Water-Gas. J. von Langer and L. Cooper, Leeds. Eng. Pat. 6659, April 18, 1889. 11d.

THIS invention is intended to lessen the cost of manufacturing water-gas by construction of producers and system of working the appliances in groups.

Fig. 1 and Fig. 2 show the producer described. B is the hot blast pipe and *g* the steam entrance. The producer-gas is led off by *c* (Fig. 2), and the water-gas by *h*. The fire-bars are tubular, and are connected with a water service to keep them cool. I (Fig. 1) is an outlet for smoke when neither air blast or steam are on. The sloping hearth facilitates the cleaning of the fire from the doors *a*¹ *a*². The

Fig. 1.

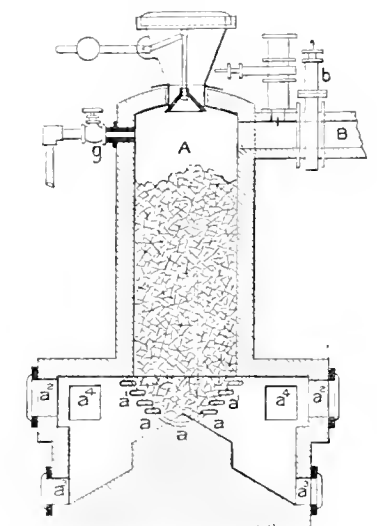
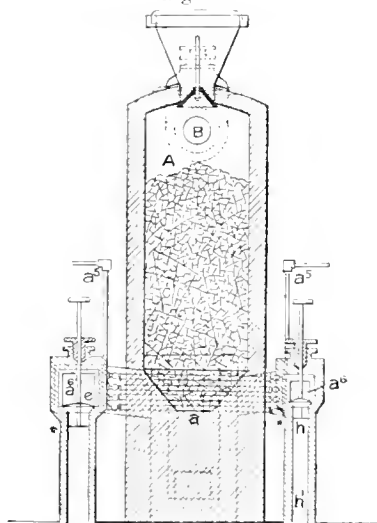


Fig. 2.



producer can be worked with slack and other kinds of soft coal, and may be used as described in Eng. Pat. 8192 of 1889 (this Journal, 1889, 696). In working, after charging and firing, the hot air blast B is turned on (the steam pipe being closed), the producer-gas generated is divided by the double slope of the hearth, and passes downward to outlets $a^1 a^1$. When fuel is highly incandescent the air blast is stopped and steam (which is superheated) admitted, and the water-gas valve h opened. There is a belt pipe a^6 by which the water-gas is led to the scrubber.—D. A. S.

An Improved Method of and Apparatus for Causing complete Combustion of Fuel in Furnaces for Heating Purposes and also Effecting the Abatement of Smoke Nuisance. A. and W. T. Harkness, Sunderland. Eng. Pat. 7044, April 27, 1889. 8d.

Air is conducted from the outside of the furnace or boiler to the combustion chamber by means of pipes or conduits

of iron, fire-brick, fireclay, or other suitable material so that in its passage it may be heated as highly as possible. In most cases it will be best mixed with the furnace gases at the bridge, which may for this purpose be built or made hollow with numerous apertures for the exit of the heated air.—D. A. S.

Improvements in Coke Ovens or Furnaces. A. Weber,
New York, U.S.A. Eng. Pat. 12,092, July 30, 1889. 11d.

BELOW the coking chamber is situated a combustion chamber, wherein the gas made in the process is burned after having been treated for tar, ammonia, &c. The walls of the combustion chamber are channelled to form passages in which this gas and the air necessary for its combustion may be heated before reaching the combustion chamber. The coking chamber is provided with a muffle or mantle, and the products of combustion are caused to pass uniformly round its sides and over the top, finally taking a regenerative part in the heating of the gas and air supply. Full drawings accompany the specification.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS. Etc.

Utilisation of Spent Acid in Petroleum Refineries and Tar Distilleries. C. von Wolniewicz. Chem. Zeit. **13**, 1089.

ALTHOUGH the amount of real sulphuric acid in this by-product is large, nevertheless it is with difficulty recovered, and does not pay for recovery by methods so far put forward. In Galicia the nuisance caused by this acid tar has been felt, and endeavours have been made to remove it. The author proposes to dilute the acid material and then to dissolve in it such metals as iron, zinc, and copper, and use the solution for the impregnation of such materials as wooden railway sleepers. It is stated that the impregnation answers exceedingly well, and especially when carried out hot at about 40° C.

Separation of the Three Xylenes of Coal Tar. A. Renter.
Chem. Zeit. **13**, 830 and 850.

SULPHURIC acid containing over 80 per cent. of H_2SO_4 still acts on meta-xylene, whilst diluted to contain about 84 per cent. its action on para- and ortho-xylene ceases. Ordinary sulphuric acid (93—to 95 per cent.), which was exclusively employed by the author, acts, therefore, on meta-xylene, until in the mixture the ratio of sulphuric acid to water is about 80:20. In para- and ortho-xylene the action will have already ceased when the ratio attains 80:16. This happens, for instance, as soon as 202 grms. of sulphuric acid (93 per cent.) have dissolved 100 grms. of meta-xylene, or as soon as 233 grms. of the same acid have dissolved 100 grms. of para- or ortho-xylene. Hence it follows that to a sulphuric acid saturated with meta-xylene, about one-sixth of its original weight of new acid may be added without the mixture being rendered inoperative for dissolving para- and ortho-xylene.

The crude xylene which the author worked with contained generally more than 60 per cent. of meta-xylene. The treatment with sulphuric acid was carried out in a cast-iron cylinder with a stirring apparatus, or for analytical purposes, in glass flasks with good shaking apparatus. The temperature during the operation rose as high as 80°. Under these conditions the sulphuric acid, if added in sufficient quantity, attacks meta-xylene only. In the selection of the raw material care should be taken to select a product which does not begin to distil under 136°, otherwise the toluene will afterwards render the para- and ortho-xylene impure. Good results were obtained with products that began to distil at 136°, and of which 90 per cent. had passed over at 145°. The raw material should, before separation, be repeatedly washed with small quantities of sulphuric acid (which is to be kept cold) till it becomes not more than slightly brown.

Meta-xylene.—It follows from these remarks that the total amount of meta-xylene can be separated from the raw xylene as sulphonic acid in one operation, by means of sulphuric acid, the quantity of which is determined by a preliminary trial.

The complete removal of the meta-xylene is the object of a subsequent preparation of pure ortho-xylene. One kilo. of washed raw xylene is put into a (graduated) flask, which can be mechanically shaken during several hours, while the quantity of sulphuric acid, sufficient to dissolve 60 per cent. of meta-xylene, calculated as shown above, is gradually added. After allowing it to settle it will not often be found that too little of the substance has been dissolved—that is, that the meta-xylene present was less than 60 per cent. If the solution was normal, a further addition of one-sixth of the sulphuric acid employed will, in most cases, dissolve a few more per cents. If by this the decrease of hydrocarbon is made greater by nearly 60 per cent., the addition of sulphuric acid is, of course, to be repeated. The necessary amount of sulphuric acid roughly estimated in this manner should be controlled by repeating the experiment.

One-third of the quantity of acid thus determined is added to the raw xylene in a suitable stirring apparatus; the remainder and about one-sixth of the acid in excess is added after some time. The influx is to be so regulated that the temperature during the reaction does not exceed 80°. Under these conditions all the meta-xylene passes into solution exclusively as 1, 3, 4 meta-xylenesulphonic acid. After allowing it to settle for some time the acid is drawn off. It still contains 2—3 per cent. of hydrocarbons mechanically dissolved; most of them separate when the acid is diluted. The mixture of acids is, by the addition of water, brought to a specific gravity of 1.4. A considerable rise of the temperature above 100° is of direct advantage, as it prevents a too early crystallisation of the sulphonic acid so that the mechanically dissolved hydrocarbons can separate at the surface. At the same time the greater part of the sulphonic acids of the olefines of the raw xylene, which are present in small quantities, is decomposed. The sulphonic acids of the xylenes begin to decompose only very slightly at 150°.

On cooling slowly the whole mass consolidates to a firm cake of crystals of the *a*-meta-xylenesulphonic acid. The mother-liquor obtained by treating the crystals in a centrifugal machine separates into two layers, a lower one containing nearly pure sulphuric acid of sp. gr. 1.57—1.6, and above it a layer of sulphonic acid for the most part still in a liquid state. From this, repeated crystallisations of *a*-meta-xylenesulphonic acid are obtained after destruction of the olefinesulphonic acid still present by heating, and subsequent addition of sulphuric acid.

If the pure hydrocarbon is to be regenerated from the sulphonic acid, the latter may be decomposed quantitatively with water in a boiler at 220° under pressure. In the case of meta-xylene, a carefully-directed dry distillation of the ammonium salt is also possible, but not in the case of para- and ortho-xylene. The meta-xylene is first acidulated a little with sulphuric acid, and will then give a better yield than by dry distillation of the free acid, without any other secondary decomposition except a partial carbonisation. The yield by distillation of the ammonium salt amounted to 80—90 per cent.

Para-xylene.—The remainder of hydrocarbon separated from the meta-xylenesulphonic acid is, in the same stirring apparatus, at once treated with an excess of sulphuric acid. The elevation of temperature is, if necessary, supported by indirect steam, and is to be kept for some time at 80°; the whole substance, except about 5—10 per cent., will then dissolve. The mixture of acids is drawn off, and again diluted, as in the case of meta-xylene, and left to crystallise in a cool place. The mass at once separates into two layers, of which the lower, containing the sulphuric acid, considerably exceeds in quantity that of the meta-xylene, but also contains no appreciable quantity of dissolved hydrocarbons. The upper layer coagulates to a pulp of needles of the para-xylenesulphonic acid, in the still liquid ortho-xylenesulphonic acid.

The para-compound crystallises completely, and may be obtained so pure, by means of a good centrifugal machine, that the hydrocarbon isolated from it melts at 5°—7°. As

the sulphonic acid is deliquescent, a quick and thorough separation of these crystals is essential for the subsequent preparation of pure ortho-xylene.

Toluenesulphonic acid behaves like para-xylenesulphonic acid, is not easily distinguishable from it externally, and, in the above operation, renders the para-xylenesulphonic acid impure, if the amount of toluene in the raw xylene be considerable.

If a greater purity in the para-xylene be desired, the sulphonic acid, freed from mother-liquor by the centrifugal machine, is to be dissolved in water, and recrystallised by addition of sulphuric acid. The barium salts have not rendered any particularly good service in the separation of the xylenes. For the preparation of absolutely pure para-xylene the beautifully crystallising sodium salt of the sulphonic acid, obtained from the calcium salt, is most preferable.

The only way of isolating the para-xylene is by decomposing it with water in the pressure boiler, where decomposition will take place quantitatively; the sodium salt must previously be acidulated. A dry distillation of the acid, or of the acidulated ammonium salt, is inadmissible, scarcely 20 per cent. of the theoretical produce being obtainable.

Ortho-xylene.—The mother-liquors of the para-xylenesulphonic acid contain, indeed, all the ortho-xylene, but do not, by simple decomposition, produce any hydrocarbon of sufficient purity. It is best to form first the lime salts, and to prepare the sodium salt, which, of ortho-xylene, is particularly easy to obtain in fine crystals, needing not even to be recrystallised in order to furnish, after decomposition, a pure hydrocarbon with a constant boiling point between 143° and 145°. In experimental decompositions the sodium salt behaves like the para-compound. With dilute sulphuric acid or hydrochloric acid the decomposition in the pressure boilers takes place quantitatively. Dry distillation produces even worse results than with para-xylene.

The portion of raw xylene which remained undissolved in sulphuric acid consists of paraffins, and not polymerised terpenes. A hydrocarbon, with its boiling point between those of para- and ortho-xylene, is not present, according to the author's experiments.

After removal of the meta-xylene from larger quantities of the mixture by means of sulphuric acid, the two hydrocarbons might, with advantage, be obtained sufficiently pure for most purposes by fractional distillation with a difference of 7° in the boiling point. The raw sulphonic acids become turbid on the addition of water, not only on account of the separation of the excess of sulphuric acid, but also because, besides a few aromatic hydrocarbons, they contain mechanically dissolved olefines and the like, which separate out on dilution as mentioned under meta-xylene. If the operation were conducted with sulphonic acid only, the mechanical separation from these accompanying bodies is to be effected, if necessary, by dilution or heating, before the preparation of the hydrocarbons can take place. If salts of the sulphonic acids are used, these impurities are not taken into account.

PATENT.

An Improved Construction of Moulds for Casting Rectangular Slabs of Naphthalene or like Material. Fleming's Oil and Chemical Company, Limited, and G. H. Fenner, London. Eng. Pat. 909, January 17, 1889. 6d.

The mould is made in two halves, each having an angular recess. When the two halves are put together, face to face, the recesses form a hollow rectangular prism divided diagonally in the plane of the junction of the two half moulds. Each portion of the mould is made hollow so that it may be kept cool by the circulation of water. The molten material is poured into a kind of elongated funnel, half of which is cast on the top of each half mould.—A. R. D.

IV.—COLOURING MATTERS AND DYES.

The Reactions effected with a Concentrated Aqueous Solution of Formaldehyde. G. Lösekann. Chem. Zeit. 13, 1089—1090.

If a 40 per cent. solution of crude formaldehyde be treated with aniline the latter is dissolved to a clear liquid. After a short time a turbidity arises, and if a large excess of aldehyde were employed, a pasty mass settles to the bottom of the vessel, and is easily soluble in methyl alcohol, and, by evaporation of the solution, furnishes colourless needle-shaped crystals, which are saturated with an oily substance. By taking about equal volumes of aniline and crude formaldehyde, solution is effected; turbidity soon sets in, but then the action seems to cease. If heat be now applied, the reaction proceeds very vigorously, and a portion of the excess of aldehyde is volatilised. As a residue there remains a hard sponge-like mass, which, triturated in a mortar and washed with water, is not so soluble in methyl alcohol as the preceding substance. After washing with alcohol, a quantity of small white needles remain, which appear to be identical with the crystals first obtained. This crystalline substance was found to be identical with the anhydroformaldehyde-aniline obtained by Wellington and Tollens (Ber. 1885, 18, 3309). Similar products were obtained from *o*-toluidine and *p*-toluidine.

Benzamide, warmed with a concentrated solution of crude formaldehyde, undergoes solution; but the expected separation of the product of the reaction did not take place. The solution evaporated on the water-bath remains liquid for some time, and then all at once solidifies to a hard colourless cake of crystals. The crude product melted at 203°, after washing with alcohol, at 212°, after once recrystallising from alcohol, at 216°, and after twice recrystallising, at 218° C.

If a solution of magenta be treated with crude aldehyde, the colour becomes much more intense and acquires a violet shade. Probably the action has taken place in such wise that the aldehyde has reacted upon an amido-group, for the colour will be observed to have taken a shade of violet, a peculiarity also perceived when the hydrogen atoms of an ammonia group are replaced by hydrocarbons. If now some free hydroxymethyl sulphonic acid be added, the colour becomes still more intense. When added directly to magenta solutions, in presence of the hydroxymethyl sulphonic acid, soluble and insoluble violet-red compounds are produced of much greater intensity of colour than is possessed by magenta. Rosaniline, prepared from commercial magenta, was next treated with aldehyde. The base was dissolved with a violet-red colour. The whole was now evaporated on the water-bath to dryness. A residue was obtained, which was at first coloured like the solution, but afterwards became greyish-yellow. Treated with a little hydrochloric acid, a violet-red coloured solution was again formed, which, with more acid, like magenta, was decolourised. This proves that there was present a substituted rosaniline. If the latter be heated with an aqueous solution of hydroxymethyl sulphonic acid, an intensely coloured violet dyestuff is produced. It thus appears that the hydroxymethyl sulphonic acid effects a still further substitution.

The hydroxymethyl sulphonic acid can either be used in the free state or in the form of its alkaline or barium salts.

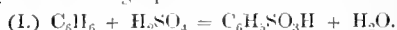
On the Difference of Action of Sulphuric and Selenic Acid in Organic Chemistry. M. Istrati. Bull. Soc. Chim. [3], 1, 480—481.

SULPHURIC acid acts on benzene, producing sulphonic acid, a sulphonic and francine. ("Francine": Peculiar colouring matters formed together with sulphonic acids by the action of sulphuric acid on the higher chlorinated benzenes. Bull. Soc. Chim. 48, 35; Compt. Rend. 106, 277; J. Chem. Soc. 1888, 259 and 591.) In the formation of this latter product probably an oxidation takes place, and the author tried the action of other acids containing oxygen and benzene to see whether a similar reaction took place. The experiments with phosphoric acid and selenic acid were

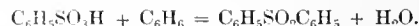
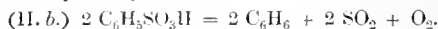
without result; in the case of the latter, only a small quantity of crystals of what was probably barium benzeneselenate being obtained. Acting on pentachlorobenzene with selenic acid a selenate was formed, but no selenobenzene, nor the corresponding "francine."—A. L.

On the Transformation of Sulphonic Derivatives under the Influence of Heat in Presence of Sulphuric Acid. M. Istrati. Bull. Soc. Chim. [3], 1, 492—496.

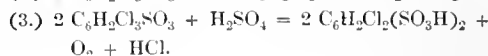
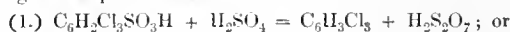
THE author describes some experiments made on benzene and chlorobenzene with sulphuric acid. If 200 cc. of benzene be treated with 300 cc. of concentrated sulphuric acid at 80° C. for 3—4 days, the benzene is converted into its monosulphonic acid. If now the temperature is raised to 100° C. part of the sulphonic acid is reconverted into benzene, water and sulphurous acid being formed at the same time. When all benzene has been removed by distillation the temperature rises to 150° C., the sulphuric acid becomes black, and a crystalline body, sulphobenzide, sublimes into the neck of the flask. The author explains these reactions by the following equations:—



or more probably



If the calcium salt of trichlorobenzenesulphonic acid be boiled with two parts of sulphuric acid, sulphurous acid, water, hydrochloric acid, and an oily liquid trichlorobenzene are formed, besides, probably, the calcium salt of dichlorobenzenesulphonic acid. By the following equations it is sought to explain these reactions:—



—A. L.

On Diphenoltrichlorethane and p-Dihydroxystilbene. K. Elbs and O. Hoermann. J. Prakt. Chem. 1889, 39, 498—502.

DIPHENOLTRICHLORETHANE, like diphenyltrichlorethane, yields, on treatment with zinc dust and alcohol, a stilbene derivative, *p*-dihydroxystilbene. To prove its constitution, the product was acetylated and oxidised in acetic acid solution by potassium permanganate. *p*-hydroxybenzoic acid was thus formed. A further proof was forwarded by converting *p*-diamidostilbene, through the diazo-compound, into the dihydroxy-compound, which corresponded in its properties exactly with the compound prepared by the authors. It combines with diazo-compounds, and forms dyes. Ammonia does not change the phenol into an amide at 230° C. Addition of three parts of nitric acid (sp. gr. 1.52) to one part of the diphenoltrichlorethane dissolved in five parts of glacial acetic acid, produces dinitro-*p*-dihydroxydiphenyltrichlorethane, melting at 159° C., little soluble in glacial acetic acid, xylene, and alcohol, easily in nitrobenzene and acetone. It explodes when heated above its melting point. Its diacetyl-compound forms light yellow plates, melting at 197° C. On further nitration with nitric and sulphuric acid, a tetranitro-compound is formed, crystallising in needles melting at 252° C. The dinitro-compound yields, on reduction, a diamido-compound crystallising from alcohol in colourless needles, turning black at 95° C., and decomposing without melting at a higher temperature. The authors give, further, an easy method of preparation for *p*-diamidostilbene. 10 grms. of dinitrostilbene are heated on the water-bath with 100 cc. of alcohol. The calculated amount of hydrochloric acid (sp. gr. 1.18—1.19) and the calculated amount of tin are then added. After boiling for 2—3 hours, the same quantity of tin and hydrochloric acid as before are added, and the boiling is continued for about 1½ hours, the

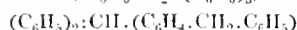
flask being well shaken until the solution appears light brown. After filtration and evaporation of the alcohol, the filtrate is poured into an excess of caustic soda, which must not be too dilute. The precipitate of diamidostilbene settles easily, and the liquid is removed by decantation. After washing with dilute caustic soda, it is filtered, washed with water, and recrystallised.—A. L.

On the Oxidation of Triphenylmethane. M. Harriot and O. Saint-Pierre. Bull. Soc. Chim. [3], 1, 773—774.

The authors suspected a specimen of triphenylmethane, prepared by the action of chloroform on benzene in presence of aluminium chloride, to contain a homologue due to the presence of toluene in the benzene. To decide this question the body was oxidised. 50 grms. of it were boiled for 15 hours with 500 grms. of potassium bichromate and 2 kilos. of a mixture of one part of sulphuric acid and one part of water. The excess of bichromate is then destroyed by alcohol and the mixture filtered through glass wool after cooling. The filtrate and the residue were shaken with ether. The latter yielded to caustic potash the acid products which were on acidulation with sulphuric acid precipitated. Steam was passed through to remove benzoic acid and the remaining product crystallised from water and alcohol. It melts at 87° C., becomes then again solid, and remelts at 125° C. It was proved to be *o*-benzoylbenzoic acid. The ethereal solution contained also benzophenone and triphenylcarbinol, melting at 159° C. The sulphuric acid solution of chrome alum was observed to contain anthraquinone, which originated probably from benzoylbenzoic acid. The latter, however, could not have been produced unless there had been a side chain in the hydrocarbon.—A. L.

The Action of Potassium on Triphenylmethane. M. Harriot and O. Saint-Pierre. Bull. Soc. Chim. [3], 1, 774—780.

TRIPHENYLMETHANE is not acted upon by sodium. If, however, it is heated with potassium to 200° C., hydrogen escapes, and the metal enters into combination with the hydrocarbon. When carbonic acid is passed over this new compound, triphenyl acetic acid is formed identical with the one obtained by Fischer. Benzylchloride forms benzyltriphenylmethane ether, $C_6H_5CH_2C(C_6H_5)_3$, or—



By the action of benzoylchloride on the metal compound benzoylphenylene, diphenylmethane is formed.

If the compound of potassium and the hydrocarbon be heated to 250° C., again hydrogen is evolved, and a new compound, is formed, $C_{19}H_{11}$, boiling above 360° C. and melting at 148.5° C., identical with a body obtained by Hemilian. Its constitution, according to the authors' view, is $C_6H_4:C(C_6H_5)_2$.

Potassium acts also on tetraphenylethylene, and the product, when treated with benzylchloride, forms a hydrocarbon, melting at 237° C., which has to be considered as a benzyl-derivative of tetraphenylethylene. Some bromo- and nitro-derivatives of the above-described compounds are mentioned.—A. L.

Action of Dimethylaniline in Presence of Aluminium Chloride. H. Giraud. Bull. Soc. Chim. [3], 1, 691—693.

ALUMINIUM chloride combines with dimethylaniline with evolution of great heat. The product of the reaction crystallises in long prisms, melting at 88° C., but decomposing rapidly, so that its composition could not be exactly determined. If dimethylaniline be heated with five parts of aluminium chloride in a sealed tube, no reaction takes place. Air having access, a product is formed, which is obtained pure by adding an excess of caustic soda to dissolve the aluminium hydrate, and removing the dimethylaniline by distillation with steam. A solid base—



remains, crystallising in small needles melting at 195° C. By the action of gaseous hydrochloric acid, the base forms

at 180° C. benzidine and methyl chloride. The reaction between dimethylaniline and aluminium chloride is due to oxidation by the air. If a mixture of ferric and aluminium chloride be used and air excluded, the ferric chloride is reduced, but only red substances are obtained, which were not examined. When, however, pure aluminium chloride and dry oxygen were applied, a considerable quantity of methylbenzidine was formed. By acting on dimethylaniline containing dimethyltoluidine, a new base, tetramethyldiamidodiphenylmethane, was obtained, melting at 90° C.

—A. L.

PATENTS.

The Manufacture of the Sulpho Acids of a Red Basic Naphthalene Dyestuff. J. Y. Johnson, London. From "The Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 15,259, October 23, 1888. 8d.

WHEN naphthoquinone dianilide is heated with aniline and its hydrochloride a red basic colouring matter is obtained to which the name *Rosinduline* has been given (Chem. Soc. J. (Trans.) 1888, 1291). This, by the action of sulphuric acid, is converted into sulphonic acids, which can be used for dyeing and printing. Naphthoquinone dianilide is produced by the action of aniline on derivatives of α - and β -naphthoquinone and upon nitroso- and azo-naphthalene derivatives. By heating the last-named compounds with aniline and its hydrochloride, the formation of naphthoquinone dianilide and its conversion into the red colouring matter can be effected in one operation. The following compounds yield naphthoquinone dianilide:—Amidonaphthoquinonimide, β -naphthoquinone and its anilide, benzolazo- α -naphthylamine, benzolazo-ethyl- α -naphthylamine, benzolazo- α -phenyl-naphthylamine, benzolazo- α -naphthol, nitrosophenyl- α -naphthylamine, nitroso- α -naphthol, nitroso- β -naphthol and dibromo- α -naphthol. The following compounds also yield rosinduline when heated with aniline and its hydrochloride: α -naphthoquinone, chloro- α -naphthoquinone (m.p. 111°), hydroxy- α -naphthoquinone, α -naphthoquinone anilide and benzene-azodimethyl- α -naphthylamine. The following are the details of the invention:—10 kilos. of benzolazo- α -naphthylamine hydrochloride are mixed with 10 kilos. of aniline hydrochloride and 35 kilos. of aniline in an enamelled vessel. The melt is continually agitated and the temperature is raised in about 4 hours to 130°. It is then gradually raised in another 4 hours to 170°, and this temperature is maintained for 4 hours longer or until a sample dissolved in sulphuric acid shows a pure green colour. The melt after cooling is boiled with dilute hydrochloric acid, and the residue purified by heating 10 kilos. of it with 30 kilos. of toluene to 100° which dissolves out the impurities. The undissolved residue is dissolved in about 20 kilos. of hot alcohol, filtered, and caustic soda added to the filtrate until alkaline, when the base separates out. It crystallises from toluene in dark reddish-brown crystals, melting at 234°. By the action of sulphuric acid sulphonic acids of this substance are produced, containing one or more sulphonic groups according to the concentration of the acid and the temperature at which the sulphonation is effected.

Monosulphonic Acid.—10 kilos. of the compound, or of its hydrochloride or sulphate, are mixed with 50 kilos. of sulphuric acid containing 96 per cent. of H_2SO_4 and heated to about 100° for 5 hours, or until a sample after precipitation with water dissolves to a clear solution in caustic soda. The melt is then poured into 10 times its weight of water, and if necessary purified by conversion into the sodium salt, which is afterwards decomposed by dilute sulphuric acid.

Disulphonic Acid.—10 kilos. of rosinduline or of the monosulphonic acid just described, are mixed with 30 kilos. of sulphuric acid containing 23 per cent. of SO_3 and heated to 40° until a sample when diluted with water gives a red precipitate which is perfectly soluble in pure boiling water. The melt is then poured into 200 litres of water at 0°, and the precipitate after filter-pressing is suspended in 400 litres of water, and caustic ammonia added until it dissolves. The ammonium salt crystallises out on evaporation.

Soluble Sulphonic Acid.—The monosulphonic acid above mentioned is heated with six times its weight of

sulphuric acid containing 23 per cent. of SO_3 to 100° , until a sample is easily soluble in 20 parts of cold water. The melt is then diluted with about 10 times its weight of water, limed, filtered, and the solution decomposed with sodium carbonate to obtain the sodium salt. Either of the two last mentioned acids dye animal fibres crimson from an acid bath, and are recommended as substitutes for archil.

—T. A. L.

Improvements in the Preparation of a Beta-Naphthylamine Sulphonic Acid and of Colouring Matters therefrom. A. G. Green, London. Eng. Pat. 15,849, November 2, 1888. 4d.

THIS patent describes a new method for the production of the acid commonly known as the δ -sulphonic acid of β -naphthylamine.

Equal molecular proportions of β -naphthol and sulphuric acid containing 100 per cent. of H_2SO_4 are heated to 100° — 130° until the sulphonation is complete. The melt is dissolved in water, salt added until all tar is precipitated, and the solution is filtered, when the sodium salt of the acid separates out on cooling. It is converted into β -naphthylamine sulphonic acid or a salt thereof by heating dry in a current of ammonia gas or in an autoclave with caustic ammonia or with a salt of ammonia and an alkali. The product is dissolved in water, precipitated by an acid, and the β -naphthylamine- δ -sulphonic acid is separated from the β -naphthylamine- β -sulphonic acid which is formed simultaneously, by well-known methods. By decomposing the former with sodium carbonate the sodium salt is obtained which can be employed directly for the production of colouring matters either by acting on it with diazo-compounds, such as diazobenzene, diazotoluene, diazonaphthalene, tetrazodiphenyl, tetrazostilbene, &c., and their sulphonic acids, or by diazotising the β -naphthylamine sulphonic acid described and combining it with amines and phenols or their sulphonic acids.—T. A. L.

Manufacture of Induline Colouring Matters Soluble in Water. O. Imray, London. From "The Farbwerke vormals Meister, Lucius and Brüning," Höchst, Germany. Eng. Pat. 16,325, November 10, 1888. 4d.

COLOURING matters of the induline series soluble in water are obtained by heating induline with *p*- or *m*-diamines to 150° — 190° . 10 parts of induline, 15 parts of *p*-phenylenediamine, and 2 parts of benzoic acid are heated to 150° — 180° until a sample dissolves to a clear solution in dilute hydrochloric acid. The melt is then dissolved in dilute hydrochloric acid, filtered, and the dyestuff precipitated with salt. The colouring matter so formed dyes a greenish-blue shade, whereas if 12 parts of *m*-phenylenediamine be employed in place of the *p*-diamine a reddish-blue is produced.—T. A. L.

Improvements in the Production of Colouring Matters resembling the Indulines. C. D. Abel, London. From "The Farbwerke vormals Meister, Lucius and Brüning," Höchst, Germany. Eng. Pat. 16,393, November 12, 1888. 6d.

AMIDAZOBENZENE hydrochloride, when heated with secondary or tertiary aromatic amines, such as mono- or dimethyl- or ethyl-aniline, to about 150° , forms colouring matters soluble in water. 15 kilos. of amidazobenzene hydrochloride and 20 kilos. of dimethylaniline are slowly heated to 150° in an enamelled vessel under constant agitation. Between 110° and 130° a reaction sets in, and care must be taken that the temperature does not rise above 150° . The melt becomes ultimately bluish-violet, and when no further reaction takes place at 150° it is mixed with dilute hydrochloric acid (1:3) until all the dimethylaniline in excess is dissolved. Salt and zinc chloride are then added and the colouring matter filtered off. It is used preferably in the form of a paste, as it becomes somewhat less soluble in water on drying. It dyes cotton a bluish-violet shade.

—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

PATENT.

Improvements in or applicable to the Treatment of Esparto Grass for obtaining Fibre therefrom. J. Mactear, London. Eng. Pat. 16,943, November 21, 1888. 4d.

THE improvements consist in a preliminary mechanical disintegration and partial separation of the silicious coating of esparto grass by piercing it with a number of fine pins fixed to a plate driven rapidly with a reciprocating motion. In this way the subsequent process of boiling with soda is performed in less time and with a saving of chemical.

—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

On the Power of Resistance of Dyed Fibres to the Action of Light. J. Joffre. Bull. Soc. Chim. [3], 1, 553—555.

CHEVREUL has shown that if coloured materials be submitted to the action of light in vacuo, in most cases no decolourisation takes place. The author has made some experiments in the same direction, submitting the dyed fibres to the action of sunlight instead of to an atmosphere of nitrogen in vacuo. He operated in glass tubes, removing the oxygen by pyrogallie acid and potassium hydrate. A great number of colouring matters remained unchanged. The results with cyanine were most striking; this colouring matter did not suffer at all under the conditions named. The shades obtained with picric acid, however, turned orange. The same results were produced when the dyed fibre was surrounded by a layer of transparent paraffin. Albumen and gelatin also offered very efficient protection.

—A. L.

PATENTS.

Improvements in Apparatus for Treating Cloth, Yarn, and other Materials. F. Moore, Trowbridge. Eng. Pat. 15,103, October 20, 1888. 8d.

THE material to be dyed is hung on a frame which is made to rotate in a cylinder containing the dye; or the cylinder itself may be made to rotate.—E. J. B.

Improvements in the Method of and Apparatus for Dyeing Woollen Cloths and other Fabrics. J. H. Hepworth, Churwell. Eng. Pat. 15,955, November 5, 1888. 6d.

THE inventor claims the use of a perforated partition, which prevents the material to be dyed from coming in contact with the steam pipe used for heating the dye-bath.—E. J. B.

A New or Improved Dyeing Material, and Method of Employing the Same. C. F. Z. Noroy, Paris, France. Eng. Pat. 17,094, November 24, 1888. 6d.

THIS invention relates to the preparation and use of a new material applicable to the dyeing of animal and vegetable fibres and skins of all kinds. It is produced by the action of nitric acid upon "fecula, starch, or flour, or more generally upon lignine and cellulose," being the product which is formed between the first and last stages of oxidation of these materials by nitric acid. Its usefulness depends upon its property of dissolving almost all known metallic and earthy oxides (such as are used as mordants), and of preventing their reprecipitation by excess of alkalis. For its preparation, two parts of nitric acid are added to one part of starch, and the mixture heated slightly in an enamelled vessel. As soon as the reaction is fairly established, the vessel is removed from the source of heat, and the action allowed to complete itself. The resulting liquid is termed "nitrated or denatured starch." Its use is illustrated in the following recipe for dyeing black:—

1st Bath.—30–40 parts of dry extract of logwood; 1,000 parts of warm water. Dissolve, cool, and add a mixture of 6–10 parts of sulphate, nitrate, acetate, or other salt of copper; 20–30 parts of water; 5–7 parts of hydrochloric acid; 10–15 parts of acetic acid.

This bath may be modified by addition of tannic extracts, rosewood, turmeric, coal-tar dyes, &c.

2nd Bath.—130 parts of “nitrated starch”; 21 parts of sulphate of copper (or its equivalent of oxide); 40 parts of sulphate of alumina (or its equivalent of hydrate); 12 parts of arsenious acid dissolved in a solution of 6 parts of potash; sufficient ammonia added to make the mixture neutral; then 1,000 parts of water; and, finally, 5 parts of carbonate of soda.

Modified baths are described, containing sulphate of iron, chloride of antimony, sulphate of magnesia, protochloride of tin, &c.

In performing the dyeing process, the material operated upon is immersed in bath No. 1 for one or two hours, wrung, and partly dried in the open air or in a stove; it is then immersed in bath No. 3 for from three-quarters of an hour to an hour and a half, care being taken that the bath is kept alkaline. The material is wrung out lightly and exposed to the air for from one to three hours, until the black is completely developed, well washed, and dried. These dyeing operations are conducted in the cold, except with materials difficult of penetration, in which latter case the baths may be heated to 40°–60° C.; but the second bath must only be heated towards the end of the operation.

—W. E. K.

Improvements in Apparatus for Washing, Soaping, Scouring, Bleaching, Dyeing, and otherwise similarly Treating Textile Fabrics. 1. Pollard, Hyde. Eng. Pat. 18,987, December 29, 1888. 6d.

The inventor claims an improved roller made up of a number of blades or scoops fixed on a skeleton roller, and caused to revolve in a tank containing the necessary liquid. The shape of the roller causes the fabric to be beaten, and at the same time subjected to the action of liquid caught up by the scoops.—E. J. B.

VII.—ACIDS, ALKALIS, AND SALTS.

On the Utilisation of the Heat of Pyrites-Burner Gases. G. Lunge. Zeits. f. angew. Chem. 1889, 297–299.

It is not very long since the gases from pyrites-burners were deprived of their superabundant heat before entering the sulphuric acid chambers by being cooled, in long conduits, with air or water, and without making any use of this heat. At present, as is well known, this heat is either utilised in concentrating sulphuric acid in evaporating pans placed over the gas flue, or, in a still more direct way, in concentrating chamber acid in the Glover tower, or by the adoption of both these plans. As shown by the author some years ago, the denitrating action in the Glover tower takes place almost completely in the upper part of the tower, whilst in the lower part the acid is concentrated, and this concentration is effected entirely at the expense of the heat of the burner-gases. To a certain extent, at least, it is perfectly practicable to carry on this concentration of chamber acid by means of the heat of the burner-gases outside of the Glover tower—their heat can be first utilised in

Fig. 1.

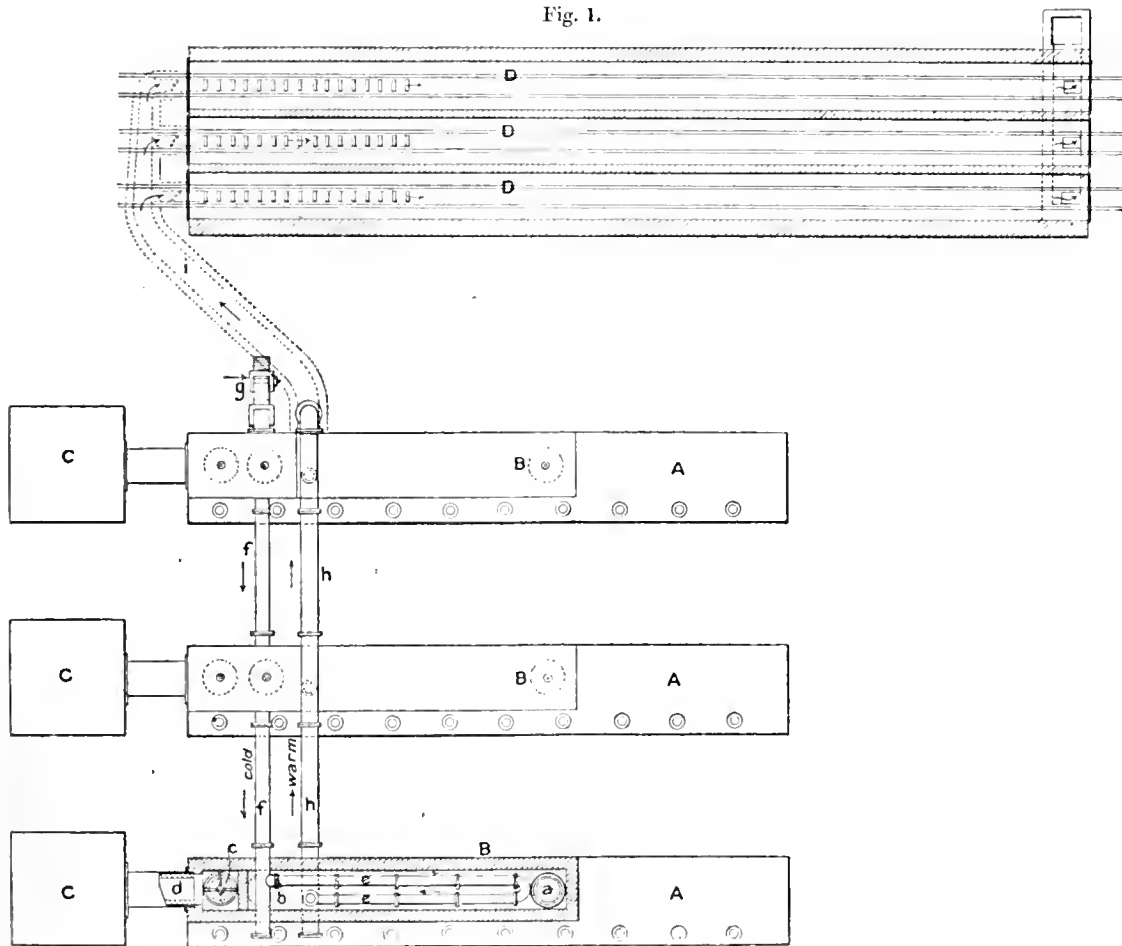


Fig. 2.

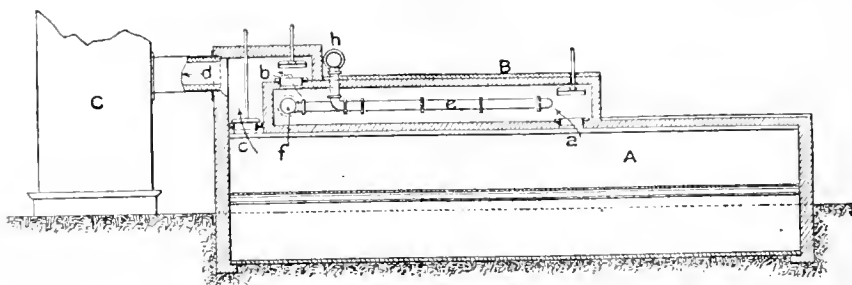
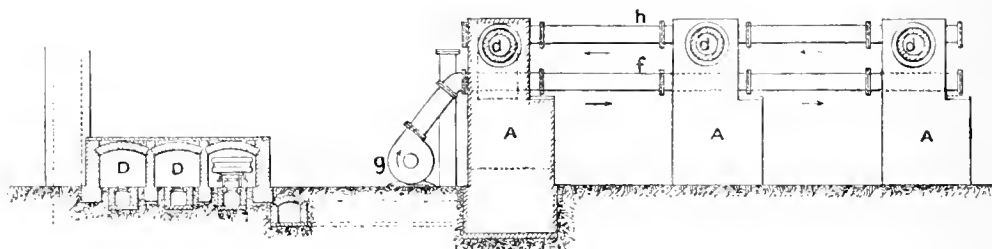
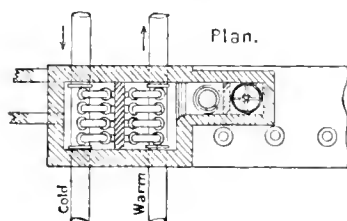
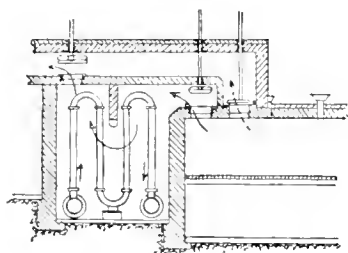


Fig. 3.



concentrating chamber acid by an indirect system of heating in pans, or by lead piping, &c., and the partially-cooled gases can then be lead into the Glover tower, where, in this condition, they will naturally effect merely a denitrating action. By adopting such an arrangement, there is a decided gain when acid is manufactured for sale or when it is to be concentrated to 66° B. (sp. gr. 1.842), as the acid can then be obtained free from the iron and alumina which are otherwise unavoidably derived from the Glover tower. At the same time the author states, in a footnote, that the temperature of the gases must not be lowered beyond a certain limit, and in a future communication he will show that the working of the Glover tower requires a certain moderately high temperature.

Figs. 4 and 5.



The advantage to be gained by the above method is not so great when the acid is made for use in the manufacture of sulphate of soda or superphosphate. There may be cases, however, in which, owing to lack of space, the Glover tower has been placed too near the burners, so that it is damaged by the high temperature of the burner-gases.

Such a case occurred, among others, in the large manure works of Messrs. H. and E. Albert, in Biebrich, where the Glover towers are only 1.5 metres distant from the burners, and the hot gases made the stones at the inlets red hot, and destroyed the towers and their stone packing. These objectionable features have been avoided by first utilising the excess heat of the gases for warming air, which is afterwards used for drying purposes. The firm of Messrs. Fellner and Ziegler of Bockenheim erected the plant, drawings of which are given in Figs. 1—5. Figs. 1—3 represent a horizontal system of cooling pipes; Fig. 1 is the ground plan; Fig. 2, a longitudinal section; and Fig. 3, a cross section.

On each of the burners, A, is built a gas chamber, B, whose length is two-thirds that of the burner. The burner-gases enter these chambers through valvular openings, a, and pass through similar openings, b, into the pipes, d, leading to the Glover towers, C; a third opening, c, permits the gases, if desired, to pass direct into d and C. In each of the chambers, B, lie horizontal cast-iron pipes, e, which form branches of a main pipe, f, through which cold air is forced by means of a blower, g. This air is thus exposed to the heat of the burner-gases in the chambers, B, becomes itself heated, and leaves the chambers through branch pipes leading into the main, h. The latter is protected by non-conducting material, and opens into the flue, i, whence the drying apparatus, D, can be supplied with heated air. In these works the air is heated to a temperature of 100° C., but, by regulating the speed of the blower, the temperature can be reduced or increased (up to 135° C.). The burner-gases, which enter the Glover towers, C, through d, are still hot enough to carry out all the usual concentrating and denitrating operations. But the acid, which formerly ran off at a temperature of 140°, is now reduced to from 115° to 120°, and, therefore, requires less cooling for use in the Gay-Lussac tower, and the durability of the Glover towers is increased. At the same time an economy of fuel has been effected in the drying process, amounting to 5,000 kilos. of coal daily, and the character of the manufactured product

is much improved by the use of pure air for drying, instead of the smoke gases formerly used.

Figs. 4 and 5 show an upright system of cooling pipes, and need no further explanation. This system is, nevertheless, not so much to be recommended as the horizontal one, in which the direction of the draught is unaltered, and there is no irregularity in the working.—H. S. P.

On the Recovery of Sulphocyanogen and Ferrocyanogen from the Spent Oxide of Gas Purifiers. J. V. Esop. Zeits. f. angew. Chem. 1889, 305—307.

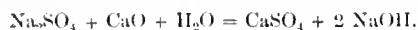
THE sulphocyanates in spent oxides are soluble in water and alkalis, whilst the ferrocyanogen, which exists in the form of a double compound of Prussian blue and ammonium-ferrocyanide, is insoluble in water but soluble in alkalis. Besides the cyanogen compounds the spent oxide also contains ammonium and sodium sulphates, small quantities of sulphites and sulphides, and a considerable quantity of sulphur associated with tar.

Below are given the percentages of sulphocyanic acid, ammonia, and potassium ferrocyanide obtainable from various samples of spent oxide:—

Spent Oxide from	HCNS.	NH ₃ .	K ₄ FeCy ₆ +3 aq.
Stuttgart	0·85	1·03	3·54
Leipzig	1·62	2·06	4·42
—	1·98	2·31	4·51
Ulm	1·05	1·42	5·43
Pforzheim	2·32	2·43	4·37
Heilbronn	3·53	3·21	4·84
Nürnberg	3·72	1·24	4·53
Zürich	4·07	1·64	3·87
Mainz I.	3·87	2·23	4·07
Mainz II.	4·25	2·26	4·38
Wiesbaden	1·12	0·23	8·27
Remscheid	4·06	2·42	9·03

It happens sometimes that spent oxides cannot be conveniently worked up just after using, and have to be stored. When this is the case great care should be taken in storing to prevent heating, which easily takes place in the presence of so much sulphur (30—40 per cent.); on heating the sulphocyanate decomposes, a portion being converted into ammonium sulphite and sulphate, and another portion into ferrocyanide. This "heated" spent oxide is more difficult to treat, and the cyanogen compounds cannot so readily be extracted.

The author has tried several mechanical methods of lixiviating the spent oxide without obtaining entirely satisfactory results; viz., washing in Shank's lixiviators (as used in the Leblanc soda process); also a method of mechanical stirring, first with water to extract the sulphocyanates, and next with alkaline solutions (of caustic soda or caustic lime) to remove the ferrocyanides and expel ammonia; and a process patented by Kunheim and Co. (Jahresb. 1884, 470), consisting in grinding the oxides, exhausting with water, then heating with quicklime in closed vessels to liberate ammonia, and again lixiviating with water to remove the ferrocyanide. He finally arrived at a convenient and cheap method of extraction by treating the spent oxide with lime and sulphate of soda at a certain temperature. The solvent action on the double salt of Prussian blue and ammonia is explained as follows:—The lime liberates a portion of the ammonia, and this brings about the double decompositions of the caustic lime and sodium sulphate forming caustic soda and calcium sulphate, a reaction which under ordinary conditions does not take place:—



About as much sodium sulphate is required as there is potassium ferrocyanide obtainable from the spent oxides. By this method the sulphocyanates and ferrocyanides are obtained in the same liquor, and are afterwards separated by fractional precipitation and worked up into sulphocyanates and Prussian blue. As a result of many extractions the author found that more sulphocyanate was obtained by this alkaline process of extraction than when the spent oxide was treated with water only, leading to the conclusion that a sulphocyanogen compound insoluble in water occurs in the spent oxide. Some of the results are shown below:—

Spent Oxide from	HCNS dissolved in	
	Water.	Alkali.
Mainz	3·56	5·98
Zürich	2·56	2·85
Hanau	3·72	4·40
Pforzheim	3·56	5·98

The process of lixiviation is carried on in an upright wrought-iron boiler, provided with a stirring apparatus. Steam is led into the mixture and the air exhausted by a pump. The required temperature is soon reached and the ammonia evolved is drawn off by the pump and forced into acid. A cooling apparatus between the pump and the boiler condenses the steam. After some hours the material is exhausted and the whole driven over into a settling tank. The clear liquor, containing the sulphocyanates and ferrocyanides, is drawn off, whilst the residue is pressed or filtered to obtain the adhering liquid.—H. S. P.

The Formation of Hydrogen Peroxide from Sulphur Peroxide. M. Traube. Ber. 22, 1518—1528.

THE sulphur peroxide compound is prepared by electrolysis of 40 per cent. sulphuric acid solution. This is made up to 70 per cent., brought into a flask with inlet and outlet tubes and tap funnel, and cooled to -12° . Oxalic acid is now run in and the air drawn through baryta water. No carbon dioxide was evolved.

The amount of hydrogen peroxide and SO_4 present were then determined in the same sample. The results obtained were as follows:—

The oxalic acid is unacted upon by SO_4 in presence of 70 per cent. sulphuric acid. In the first hour about two-thirds of the SO_4 had decomposed, the available oxygen combining to form H_2O_2 , without interruption from the presence of oxalic acid. If the action of SO_4 in presence of oxalic acid lasts 2—3 hours a secondary reaction begins with evolution of CO_2 , but this the author finds is due to the oxidising action of H_2O_2 .

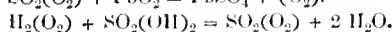
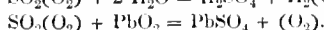
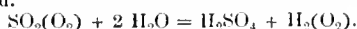
SO_4 is indifferent towards carbonic oxide. It has, therefore, a weak oxidising action. The statement of Richarz that H_2O_2 is only formed in presence of 70 per cent. sulphuric acid is not confirmed by the author, who finds that 40 per cent. acid acts equally well.

The apparent anomaly that hydrogen peroxide is produced by a weak oxidising agent is readily explained because the former body cannot exist in presence of a strong oxidiser, becoming rapidly oxidised to water.

SO_4 and H_2O_2 react slowly on one another. Sulphur peroxide has a slow and often scarcely perceptible action on organic bodies. Indigo sulphonic acid is slowly decolourised. The peroxide in neutral solution is reduced by alcohol after several days. As_2O_3 is also oxidised.

The author considers the peroxide to belong to the type of hydrogen peroxide from its characteristic chemical properties, which accord with those of the hydrogen compound. The compound has therefore the formula $\text{SO}_2(\text{O}_2)$.

On this assumption the various reactions are readily explained.



Hydrogen peroxide with sulphuric acid gives sulphur peroxide.

That hydrogen peroxide is not formed by oxidation of water is shown by bringing barium peroxide into hydrochloric acid. If any free oxygen were formed, chlorine would be evolved, but this is not the case. The author concludes his paper by discussing the formula of hydrogen peroxide, which he regards as a compound of hydrogen with molecular oxygen $H_2(O_2)$, and not, as usually considered, the result of the union of two hydroxyl groups.

—J. B. C.

The Action of Acids and of Metallic Salts on Sodium Thiosulphate. G. Vortmann. Ber. **22**, 2307—2312.

The author differs from the opinion expressed by Vanbel as to the action of acids on sodium thiosulphate (see this Journal, 1889, 704), according to which $H_2S_2O_3 = H_2S + SO_3$, and points out that owing to the long time (two hours) during which the experiments were carried on, secondary decompositions would be likely to occur, and also that the use of strong acids, especially of sulphuric acid, would also have a similar tendency.

In the experiments described, an aqueous solution of sodium thiosulphate is treated in a small flask with dilute acid or with a solution of a metallic salt, the mixture heated to boiling, to drive out the sulphur dioxide, and the other products of decomposition determined in the residue. The removal of the sulphur dioxide is promoted by passing a current of hydrogen or of carbon dioxide through the apparatus during the experiment; this also prevents oxidation to sulphuric acid, by the oxygen of the air, taking place. The primary decomposition is, according to the author—



whilst the nature of the final decomposition products depends upon various circumstances. Either the oxygen acts on the sulphuretted hydrogen with separation of sulphur and formation of sulphur dioxide, or sulphuretted hydrogen is liberated and the sulphur dioxide oxidised to sulphuric acid, or finally the oxygen acts upon undecomposed thiosulphate with the formation of sodium tetrathionate. On boiling pure sodium thiosulphate with dilute hydrochloric acid the following decomposition takes place:—



At the same time, up to 20 per cent. of the thiosulphate is converted into sodium tetrathionate, and a little pentathionate is also formed. Quantitative experiments show that the amount of free sulphur actually obtained corresponds very closely to that required by the above equation. In no instance was the formation of sulphuric acid noted, and the author states that traces of this acid present as impurity in the thiosulphate are liable to be overlooked in testing with barium chloride, and recommends titrating with decinormal iodine until the solution is just yellow, and then acidifying with hydrochloric acid before testing with barium chloride. The decomposition by hydrochloric acid is the same whether an excess of acid or of thiosulphate is present; certain salts of the alkali and alkaline earths modify the reaction slightly—potassium iodide, for example, increases the amount of sulphur separated and gives rise to the formation of a little sulphuric acid.

A neutral solution of aluminium chloride decomposes sodium thiosulphate as hydrochloric acid does. At the start a little hydrogen sulphide is evolved, then aluminium hydrate mixed with sulphur is separated; 3.25—4.25 per cent. of the thiosulphate is converted into tetrathionate, but no trace of sulphuric acid results except when potassium iodide is added, as in the case of hydrochloric acid. Sodium thiosulphate heated with copper sulphate is decomposed with the liberation of sulphuric acid, a fact which the author is taking advantage of for establishing an acidimetric method for the determination of copper. Mercury salts decompose sodium thiosulphate with formation of sulphide, the filtrate from which contains much sulphuric acid, little tetra- and no pentathionic acid. With arsenious and arsenic acids, also with antimony chloride, the corresponding sulphide is precipitated, and only a trace of sulphuric

acid results. Tetrathionic acid is formed in the case of arsenious acid and of antimony chloride; with arsenic acid pentathionic acid is obtained. Stannous and stannic chloride act similarly on sodium thiosulphate. A precipitate consisting of mixed sulphide and hydrate is obtained, while the filtrate contains sulphuric and pentathionic acids. From these experiments it appears that when sodium thiosulphate is decomposed in absence of a metal forming an insoluble sulphide, the sulphur dioxide liberated acts upon the hydrogen sulphide with the separation of sulphur. In presence of metals whose sulphides are not soluble, or only slightly soluble in dilute acids, the oxygen set free in the decomposition either oxidises the sulphur dioxide to sulphuric acid or converts unchanged sodium thiosulphate into tetra- or pentathionate.—C. A. K.

Researches on the Sulphites. P. J. Hartog. Compt. Rend. **109**, 179—182; 221—223; 436—439.

Potassium Sulphite, K_2SO_3 , is obtained by dissolving 100 grms. of pure potash in 200 grms. of water in a current of nitrogen, and then saturating the solution with sulphur dioxide. 100 grms. of potash dissolved in the least amount of water are then added. The flask is exhausted and heated in an oil-bath. The crystals formed are filtered off through wadding in a current of nitrogen, pressed rapidly between filter paper and dried in a vacuum. The salt crystallises in hexagonal prisms; these are deliquescent, and oxidise in the air. Cold is produced by their solution in water.

Sodium Sulphite, Na_2SO_3 , is prepared in exactly the same way as the potassium salt, though it is always impure, containing crystals of the hydrated sulphite $Na_2SO_3 \cdot 7 H_2O$. The crystals are sometimes 2—3 mm. in length, and crystallise as hexagonal prisms.

Double Sulphite of Sodium and Potassium, $KNaSO_3$.—This was obtained by crystallising equivalent parts of the sulphites of sodium and potassium, and exactly resembles these salts.

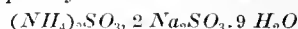
Double Sulphite of Potassium and Ammonium.—Sulphite of potassium was evaporated with a large excess of sulphite of ammonium. If equivalent quantities be taken, almost pure potassium metasulphite first crystallises out, and then a mixture of potassium and ammonium sulphites. The salt crystallises in hexagonal prisms.

Acid Bisulphite of Sodium and Potassium—



This salt was prepared by saturating two equivalents of carbonate of soda with sulphurous acid, and then adding one equivalent of potassium carbonate. The salt is very soluble in water, and it cannot be dehydrated without decomposition. The crystalline form could not be determined.

Acid Bisulphite of Sodium and Ammonium—



A current of ammonia was passed into a saturated solution of bisulphite of sodium, when crystals of this body at once separated. It is stated that the heat of solution of the metasulphite of sodium when freshly prepared is different from that of the metasulphite which has been prepared for some time, and hence that this latter must be an isomeric modification of the metasulphite.—S. G. R.

“Kaliborite,” a New Mineral. W. Feit. Chem. Zeit. **13**, 1188.

SEVERAL years ago Staute discovered the mineral pinnoite at Stassfurt (Ber. **17**, 1584). The present author has noticed, in Schmidtmannshall, white masses which resemble pinnoite except in fracture. In this particular they resemble kieserite, and like kieserite, fall to powder in water. The powder, on examination under the microscope, was found to consist of small particles, on which no crystal faces could be distinguished. Analysis showed the constituents to be potassium, magnesium, boric acid, water,

and a very small quantity of chlorine (as sodium chloride). The new mineral has been named "Kaliborite," as hitherto no mineral has been known containing potassium combined with boric acid. Several analyses of the mineral were made, and all agreed well with each other, and with that calculated for the formula, $2 K_2B_5O_{10} + 9 MgB_4O_7 + 39 H_2O$, thus:—

	Found.	Calculated.
K ₂ O	6.48	6.42
MgO	12.06	12.28
B ₂ O ₃	57.46	57.34
H ₂ O	24.00	23.96
	100.00	100.00

The disintegration of the mineral in water is due in all probability to the solution of the small quantity of sodium chloride, which acts in the capacity of a binding agent. Water has very little action on "kaliborite," but warm dilute mineral acids dissolve it easily. Its specific gravity is 2.05.—T. L. B.

The Solubility of Salts in the Presence of Acids, Bases and Salts. The Hydrochlorides of the Chlorides. Engel. Ann. Chim. Phys. [6], 17, 338.

THE following are the hydrochlorides of the chlorides as yet known, with the exception of those of the chlorides of mercury:—

(SbCl₃)₂.HCl.2 H₂O
 SbCl₃.5 HCl.11 H₂O
 (BiCl₃)₂.HCl.3 H₂O
 (ZnCl₂)₂.HCl.2 H₂O
 (ZnCl₂)₂.2 HCl.4 H₂O
 CuCl₂.HCl.3 H₂O
 CuCl₂.2 HCl.5 H₂O
 CdCl₂.2 HCl.7 H₂O
 Fe₂Cl₆.2 HCl.4 H₂O
 AuCl₃.HCl.4 H₂O
 PtCl₄.2 HCl.6 H₂O
 SnCl₄.2 HCl.6 H₂O
 SnCl₂.HCl.3 H₂O

From this it is seen that:—

- (1.) All the hydrochlorides of the chlorides contain water.
- (2.) The smallest quantity of water is 2 mol. for each molecule of HCl.
- (3.) When the hydrochloric acid combines at the same temperature with a varying number of molecules of a chloride the amount of water increases at the rate of 2 mol. of water for each additional molecule of HCl.

The facts seem to point to the conclusion that in these compounds the hydrochloric acid exists as the hydrate HCl.2 H₂O, combined with either anhydrous or hydrated chlorides. This is rendered all the more probable, as the hydrate HCl.2 H₂O has been obtained in the crystalline state. Such a consideration is perfectly applicable to all the salts given above, with the exception of the hydrochlorides of the chlorides of bismuth and cadmium; it would be necessary to assume the existence of (BiCl₃)₂.H₂O and CdCl₂.3 H₂O.

Bismuth chloride, however, is anhydrous, and cadmium chloride crystallises with two, not three, molecules of water. It is possible, however, that some decomposition may go on after formation of the hydrochloride.

Mercuric chloride, which forms anhydrous crystals, gives rise to a series of hydrochlorides containing more than two mols. of water for each molecule of HCl.

HgCl₂.2 HCl.7 H₂O
 (HgCl₂)₃.4 HCl.14 H₂O
 (HgCl₂)₂.HCl.6 H₂O
 (HgCl₂)₃.HCl.4.5 H₂O
 (HgCl₂)₃.HCl.5 H₂O

It may be noted that—

- (a) no hydrochloride of a chloride is insoluble;
- (b) the solubility of these salts is greater than that of the corresponding chloride, cupric chloride excepted;
- (c) the increase in the solubility of certain chlorides in presence of hydrochloric acid must thus depend on the formation of a hydrochloride, which can generally be isolated.

—T. L. B.

On the Action of Hydrochloric Acid on the Solubility of Cuprous and Lead Chlorides. R. Engel. Bull. Soc. Chim. [3], 1, 693—695.

THE author gives a comparative table of experiments made on the solubility of cuprous chloride by Chatelier and himself.

Quantity of cuprous chloride in 10 cc. of saturated solution in presence of various quantities of hydrochloric acid.

EXPERIMENTS OF LE CHATELIER.

T = 17° C.			T = 0° C.		
Density.	$\frac{Cu_2Cl_2}{2}$	HCl.	Density.	$\frac{Cu_2Cl_2}{2}$	HCl.
...	0.475	8.975	1.04	...	...
1.050	1.4	15.7	1.04	1.5	17.5
...	1.575	18.2	1.065	2.9	26.0
1.080	4.5	34.5	1.132	8.25	44.75
1.135	8.25	47.8	1.261	15.5	68.5
...	11.5	57.0	1.345	33.0	104.0

The figures give the number of $\frac{1}{1000}$ equivalents of cuprous chloride and hydrochloric acid in 10 cc. of the liquid.

Lead Chloride.—The following table shows the solubility of lead chloride in presence of varying quantities of hydrochloric acid in a saturated solution of 10 cc.

PbCl ₂ .	HCl.	Sum of Equivalents.
0.42	.. ..	0.42
0.22	0.35	0.57
0.125	0.675	0.800
0.11	1.125	1.235
0.103	1.5	.. ..
0.099	2.3	.. ..
0.090	3.4	.. ..
0.08	4.5	.. ..
0.072	5.8	.. ..
0.088	11.7	.. ..
0.100	29.5	.. ..
0.209	46.7	.. ..
0.95	72.0	.. ..
1.9	96.0	.. ..
3.01	111.5	.. ..

The figures represent the number of $\frac{1}{1000}$ equivalents of lead chloride and hydrochloric acid. The table is sufficiently clear without any further comment.—A. L.

PATENTS.

Improvements in Furnaces and Apparatus for Heating Pots and Crucibles. W. G. Foster, Streatham Common. Eng. Pat. 14,394, October 6, 1888. 8d.

THE furnace consists of a conical or dome-shaped well of brickwork, into which the pot is lowered from the top by means of a convenient arrangement of chains or rods. Immediately below the pot (in position) is a circular fire, resting on bars radiating outwards from a central pier of brickwork, the height of which regulates the depth of the fire. The fuel—preferably gas coke—is charged in from the top of the furnace.—A. R. D.

Process and Apparatus for Producing Phosphorus. J. Readman, Edinburgh. Eng. Pat. 14,962, October 18, 1888. 8d.

THIS invention relates to a process for obtaining phosphorus by subjecting materials containing phosphoric acid or acid phosphate of lime, incorporated with carbon or carbonaceous matter, to heat generated by the electric current, and applied directly to the materials contained within a furnace.

—C. N. H.

Improvements in or appertaining to the Separation of Chlorate of Potash (and, if desirable, the Chloride of Calcium or Magnesium, or other similar Salt in the Mother-Liquor) from Solutions thereof. J. R. Wylde, M. J. Hammill, and H. Auer, Widnes. Eng. Pat. 15,097, October 20, 1888. 4d.

A CONSIDERABLE loss of potassium chlorate arises in its manufacture from its solubility in the calcium or magnesium chloride mother-liquors. The inventors refrigerate the mixture, which, from the former process, should have a specific gravity of about 72° Tw., and from the latter of about 51° Tw. to 0° F. A considerable further crop of chlorate crystals is thus obtained. The operation lasts about a week. By still further cooling, the chlorides of calcium and magnesium in combination with six molecules of water, can be crystallised out.—S. G. R.

Improvements in the Production of Carbonate of Soda. H. W. Wallis, London. Eng. Pat. 15,367, October 25, 1888. 4d.

WHEN lead has been reduced from its sulphur compounds by fusion with an alkali, the slag contains the alkali as sulphide. This is dissolved in water, and carbon dioxide passed in with the production of the carbonate of the alkali; the sulphuretted hydrogen liberated can be used for precipitating metals, such as copper, as sulphides from their solution.

—S. G. R.

Improvements in or Connected with the Concentrating of Caustic Alkali and other Liquors by Multiple-Effect or Yargun Plant, for the Purpose of Preventing Incrustation or Deposit in or on the Tubes. G. H. Bolton and J. R. Wylde, Widnes. Eng. Pat. 15,624, October 30, 1888. 4d.

IN order to free the liquors which are to be concentrated from matter in suspension, they are passed through mineral filter beds. The liquors can then be concentrated by the multiple-effect system of evaporation, i.e., passing the liquors through a large number of pipes of small diameter and surrounded by steam, without risk of clogging the small pipes by the deposition of insoluble matter.—S. G. R.

Improvements in Treating a Product obtained from Sea-Weed. R. H. Steedman, Dumbarton. Eng. Pat. 15,815, November 2, 1888. 4d.

IN the evaporation of the liquors obtained by the lixiviation of kelp, a salt termed kelp-salt is produced. To this there is added, either when in solution in the original liquor, or after the salt has been redissolved, chloride of calcium or the chlorides of other metals, such as magnesium, strontium,

and barium. Calcium carbonate is thus precipitated with the formation of chlorides of sodium and potassium, which can be used in the manufacture of alkali.—S. G. R.

Improvements in the Construction of Ammonia Stills. G. E. Davis, Manchester. Eng. Pat. 16,349, November 12, 1888. 8d.

IN this improved apparatus the cap or rose by which steam is passed into the layer of liquor on each shelf of the ammonia stills has a deeply sinuous outline, through which pass the perforations by which the steam is distributed. In Fig. 1, A represents the rose, S the stops cast upon the

Fig. 1

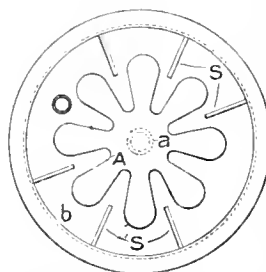
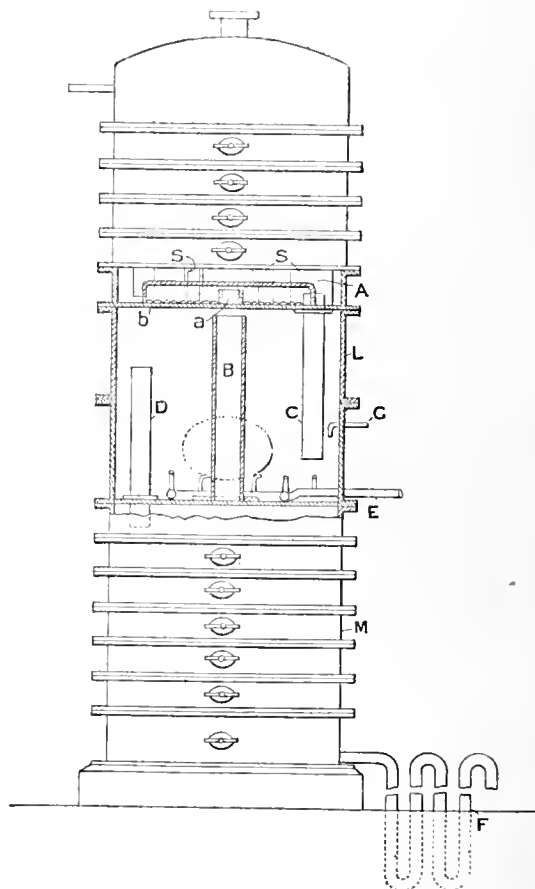


plate b, to ensure a still further control over the path of the steam. Fig. 2 represents the column still, in which is

Fig. 2.



included the liming box. The upper trays hold the liquors containing free ammonia, and which is here evolved. The

liquors then pass, by the pipe C, to the chamber L. This is filled with milk of lime by the pipe G, kept agitated by the steam pipe E. The milk of lime and the liquors which now contain only fixed ammonia, pass to the lower trays by pipe D, are there steamed, and the ammonia then given off passes up through the pipe B to the exit. The spent liquors are run off by the U-shaped pipes F. (See this Journal, 1888, 719.)

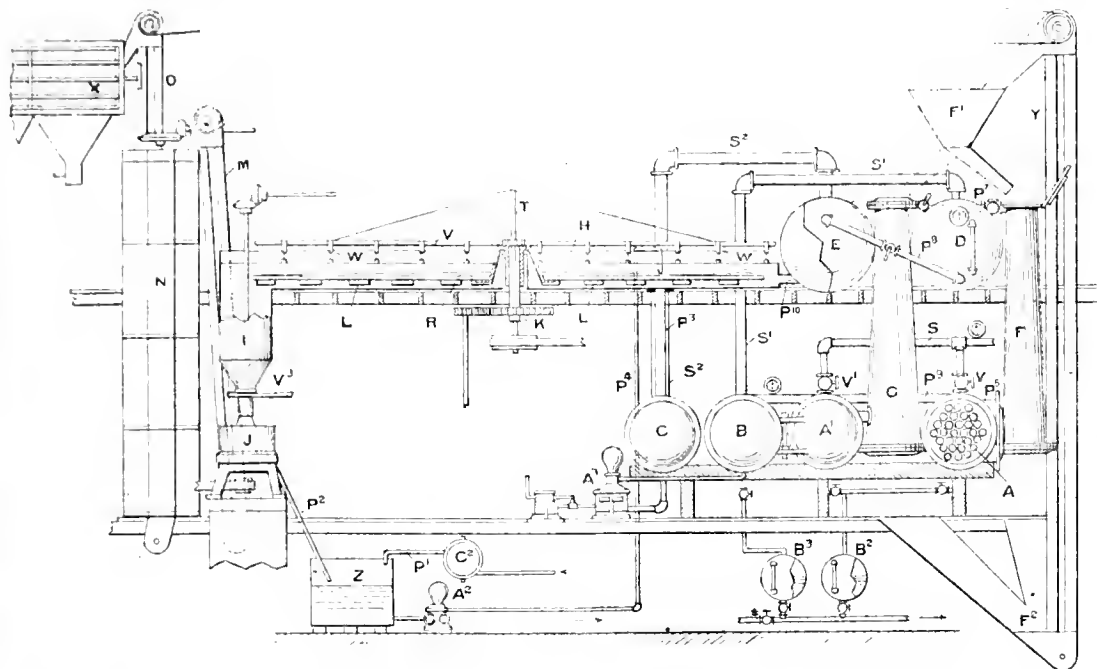
—S. G. R.

Improvements in Apparatus for the Manufacture of Salt.

H. H. Lake, London. From J. L. Alberger, H. Williams, and L. R. Alberger, New York. Eng. Pat. 6118, April 9, 1889. 8d.

The operations which are carried on within the apparatus will be best learned from a description of the plant. There are four tubular heaters, A and A', B and C. The heaters A and A' are heated by steam brought to them by the pipe S, whilst B and C are heated by the waste steam from the

evaporators D and E, carried to them by the pipes S' and S''. The brine is raised to a temperature of about 300° F. under hydraulic pressure. Any lime present as sulphate or carbonate is found to become insoluble, and will crystallise on a suitable surface. The brine is therefore passed through the purifiers F and G, only one of which is in use at a given time. The purifiers are charged with gravel at the top, the deposited lime and the gravel being removed from the bottom. From the purifiers the brine passes to the evaporators D and E, and thence at a temperature of about 226° F. to the "grainer" H by the pipe P'. The grainer is a circular iron pan, within which the brine is forced to travel in a circular direction, and is furnished with two revolving arms. To the one, R, are attached scrapers L, which move the salt as it separates towards the vessel I. To the other arm are attached small pendant chains, W, carrying small metal plates which just plunge below the surface of the brine. The brine is heated by pipes (not shown in figure) which have a superficial area about two-thirds that of the brine covering them.



The salt passes from the vessel I to the centrifugal J, thence by the elevator N to the "bolts" XX where it is separated into the right sizes. The mother-liquors are run into the tank Z, into which the fresh brine is also fed, and then by the pump A' and pipe P' to the steam-jacketed pipe P'', which carries off the brine from the grainer to the heater C, and thence to the pump A'', and so back again to the other heaters. It is found to be necessary to pass the brine through the heater C to prevent the choking of the pump A' by deposited crystals of salt. The purifiers F and G act so efficiently that only about 0.044 per cent. of calcium salts are left in the brine.—S. G. R.

Process for Removing Salts of Calcium, Magnesium and other Metals from Aqueous Solutions. C. A. Doremus, New York, U.S.A. Eng. Pat. 8883, May 28, 1889. 6d.

For waters either temporarily or permanently hard, the inventor adds some fluoride such as sodium fluoride, whereby the calcium and magnesium are completely precipitated. If much calcium or magnesium be present, then the water may be first treated by Clark's process with subsequent addition of the fluoride, thus lessening the amount of the latter required. It is stated that any fluoride of calcium or magnesium which may remain in suspension does not produce with soap a precipitate containing any fatty acid,

whereas under the same circumstances the carbonate of these bases do form insoluble precipitates. Attention is called to the imperfect manner in which other bodies act when used for purifying waters.—S. G. R.

A Process for Preparing Plumbates of Calcium, Barium and Strontium, and employing the same for Oxidising Purposes, and for producing Oxygen and other Bodies. C. Huelser, London. From G. Kassner, Breslau, Germany. Eng. Pat. 11,899, July 26, 1889. 6d.

The carbonate, oxide or hydrate of calcium is fused with the oxides or carbonates of lead, when plumbate of calcium is formed, Ca_2PbO_4 . In a similar way the plumbates of strontium and barium are prepared. These bodies can be used as oxidising agents in various ways. They may be suspended in water and boiled with the bodies to be acted upon either with or without the simultaneous passage of carbon dioxide. They can be heated with carbonated salts under pressure, whereby the salts are obtained as hydrates, and the lead as peroxide, and this insoluble residue of lead peroxide and calcium carbonate is allowed to act on the body to be oxidised. Other applications are given, but in principle they all rest on the oxidising power of lead peroxide either *per se* or in combination.—S. G. R.

An Improved Mixture for Use in Apparatus for Producing Cold. J. Y. Johnson, London. From "La Compagnie Industrielle des Procédés Raoul Pictet of Paris, France." Eng. Pat. 12,514, August 7, 1889. 6d.

In this invention a mixture containing carbonic and sulphurous acids in certain proportions is substituted for the liquid sulphurous acid, SO_2 , usually employed in refrigerating machines, and is obtained by causing gaseous carbonic acid to bubble through liquid sulphurous acid at a low temperature. To determine the exact quantity of carbonic acid to be dissolved in the sulphurous acid it is necessary to take into consideration at the same time: (1.) The lowering of the boiling point of the mixture; and (2.) The dynamic or mechanical work done by the apparatus employed to liquefy the mixture. The advantages claimed for this mixture are: (1.) For a given quantity of cold to be produced a smaller compressing pump can be employed; and (2.) At the same time the amount of work necessary to produce cold is diminished. The invention is illustrated by curve diagrams.—E. S.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

The Manufacture of Red Glass for Church Windows (12th and 13th Centuries). C. E. Guignet and L. Magne. Compt. Rend. 109, 448—451.

THE secret of this manufacture was only recovered by Boutemps in 1826, who showed that the red colour was due to the presence of cuprous oxide. The modern manufacture, however, is not equal to that of early times. The authors show that the glass of the 12th and 13th centuries may be divided into three main classes.

1. Glass veined on the surface. These markings are only on the one surface, and have been produced during the blowing by the spreading out and flattening of the glass, due to centrifugal force, at the end of the blow pipe.

2. Glass coloured in the middle. This was obtained by fusing a very thin layer of red glass between two colourless surfaces. The effect is much finer than that obtained by the present method of flashing, i.e., having the coloured glass outside and the colourless within.

3. Glass marbled in its substance. This was of two kinds. In the one case the markings were bent, twisted and turned back on themselves in no sort of order, whilst in the other the colours occurred in exceedingly thin layers always parallel to one another, and the whole wavy in outline. The colour is made up of different shades of red, and the veinings are only red on the surface. They have been produced by glass of a yellowish tint arising from the presence of protoxide of iron coming in contact with the greenish-blue glass due to cupric oxide. The great beauty of this glass seems, therefore, to depend on the use of two coloured glasses.—S. G. R.

The Variations in the Zero-Points of Thermometers made of Jena Normal Glass. F. Allihn. Zeits. Anal. Chem. 28, 435—438.

EXPERIENCE has shown that the zero-points of thermometers are liable to considerable variations. It is found that thermometers made of glass containing fair quantities of both potash and soda are very subject to this after-effect, whilst glass containing only one alkali is much less irregular in its behaviour (this Journal, 1888, 438). This after-effect consists partly of a temporary depression of the zero-point, and partly of a permanent increase of the same. The first phenomenon is observed when a heated thermometer is suddenly cooled. The bulb of the instrument takes some time to return to its original size. In the case of thermometers made of Jena glass this takes place in 2—3 days; ordinary

thermometers require weeks, and even months, to return to their original size. The temporary depression of the zero-point averages 0.05° for instruments made of Jena glass, 0.4° for Thuringian glass thermometers, and 0.15° for English glass (containing lead) thermometers. A number of experiments were made with thermometers constructed of Jena glass. Its composition is:—

	Per Cent.
Zinc oxide	7
Lime	7
Soda	14½
Alumina	2½
Boric acid	2
Silica	67

The results of these experiments are given below:—

Thermometer used.	First Determination of the Zero-Point shortly after Manufacture.	Second Determination of the Zero-Point after Long Storage.	Rise of the Zero-Point.
Warmbrunn, Quilitz, & Co. No. 106	0°00 Mar. 1886	+0°03 Feb. 1889	0°03
" 108	+0°01 " "	+0°02 " "	0°01
" 665	+0°01 Aug. 1886	+0°03 " "	0°02
" 667	+0°02 " "	+0°04 " "	0°02
" 668	+0°02 " "	+0°05 " "	0°03
" 669	+0°03 " "	+0°06 " "	0°03
" 670	0°00 Sept. 1886	+0°03 " "	0°03
" 671	+0°05 Aug. 1886	+0°00 " "	0°04
" 672	+0°05 " "	+0°08 " "	0°03
" 673	+0°03 " "	+0°07 " "	0°04
" 850	0°00 Feb. 1888	+0°03 " "	0°03
" 853	0°00 May 1888	+0°04 " "	0°04

—H. T. P.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Permeability of Cements and Cement-Mortars under Pressure. L. M. Haupt. Jour. Franklin Inst. 1889, 199.

THE experiments here noticed were made by G. W. Hyde and W. J. Smith, University of Pennsylvania, by means of four cylinders 3 in. in diameter, in which the specimens to be tested were placed, joined to a 3-in. main pipe, through which the pressure was transmitted to the specimens from a hand-pump at one end. The specimens were 3 in. thick. The pressure was maintained at three degrees—75 lb., 100 lb., and 200 lb. per square inch respectively—and for three hours in each experiment. Six series of experiments were made: with neat cements, after setting seven days and after setting 28 days; cement-mortars, composed of equal parts of cement and sand, after seven days and after 28 days; and cement-mortars mixed in the proportions of 1 to 2, after seven days and after 28 days. The samples were allowed to drain for one day. Each sample of cement was sifted through a sieve of 40 meshes to the lineal inch. The sand was passed through a sieve of 25 meshes to the inch. Eight brands of cement were tested.

The results are given in several large tables, with diagram curves of discharge of water, from which the following table is made out:—

DISCHARGE OF WATER THROUGH SAMPLES UNDER PRESSURE.

Sample.	Number of Samples.	Pressure per Square Inch.		
		75 Lb.	100 Lb.	200 Lb.
		Water passed per Square Inch in 24 Hours.		
Neat cement, 7 days....	5	Quarts. 0'033 to 0'091	Quarts. 0'006 to 0'092	Quarts. 0'019 to 0'267
Neat cement, 28 days...	1	0'034	0'052	0'138
Mortar, 7 days.....	3	1'503 to 12'397	2'336 to 17'096	6'323 to 36'297
Mixture, 1 to 1.....				
Mortar, 7 days.....	5	2'107 to 42'546	3'310 to 52'554	10'508 to 101'268
Mixture, 1 to 2.....				
Mortar, 28 days.....	3	0'328 to 1'704	0'551 to 2'482	1'413 to 4'471
Mixture, 1 to 1.....				
Mortar, 28 days.....	5	1'941 to 34'006	3'012 to 13'815	6'616 to 31'482
Mixture 1 to 2.....				

The Manufacture and Properties of the Cements of the Isère. A. Gobin. *Annales des Ponts et Chaussées*, **17**, 1889, 755, through Abstr. Papers Inst. Civil Eng. **48**, iv. 8.

In the Department of the Isère in France are a number of deposits of argillaceous limestones, suitable for the manufacture of hydraulic cements. This paper describes the most important deposits in detail, together with the processes of manufacture, and the resulting products in each case. One of the oldest known deposits is that of Porte-de-France, near Grenoble, on the right bank of the Isère. This was discovered in 1842, and has since been worked by various firms. There are three layers, belonging to the lower cretaceous series, their position being nearly vertical. One of them is 14 ft. 9 in. thick, and each of the other two about 5 ft. The stone is extracted through underground workings, by means of a wire rope-way. The cables are 600 metres (656 yards) long, and the difference in level between the two extremities is 310 metres (339 yards). The tension is regulated by means of a moveable truck loaded with 2,000 kilos. (1 ton 19 cwt.), and attached to the lower end of the cable. The speed is controlled by a Prony brake.

The limestone is burnt in continuous kilns by pulverised anthracite, which is wetted previous to use. The stone is reduced to pieces of uniform size to ensure regularity in burning. The consumption of fuel is 180 kilos. (397 lb.) per ton of stone, and the operation lasts 10 days. On leaving the kiln about two-thirds of the charge consists of yellowish fragments, retaining their original shape. This forms the quick-setting cement. The remaining third is composed of black heavy clinker, which is picked out by hand, and used for making the slow-setting cement.

Both kinds of cement are ground in ordinary horizontal mills 1·70 metres (5 ft. 7 in.) in diameter, and making 70 revolutions a minute. The quick-setting cement is sifted through a No. 50 sieve, and passed into stores, where it is kept two or three months. The cement has a density, when not shaken down, of 1·15, and sets in from five to 10 minutes, according to the prevailing temperature. The slow-setting cement, called natural Portland, is sifted through a No. 60 sieve, and then stored for three or four months at least before being issued. It sets in 15 to 20 minutes. Although the bulk of this natural Portland is a by-product from the manufacture of the quick-setting cement, yet the greater part of the charge of the kilns can be obtained as clinker

by augmenting the proportion of fuel to 250 kilos. (551 lb.) per ton. In this case the burning is intermittent, and any yellow fragments must be picked out by hand. The burning takes 21 days.

This slow-setting cement has a density of 1·4, when not shaken down, and sets in from 15 to 20 minutes.

An artificial Portland cement is also made at Porte-de-France. The materials used are the waste from the manufacture of hydraulic lime, and the clinker which gives the natural Portland cement. Four parts of the waste are ground with six parts of clinker, and the resulting powder is stored for at least four months before use. Cement made in this way has a density of 1·35, and sets in three hours. At these works a new grinding apparatus has been introduced to take the place of the horizontal mills. It consists of a vertical cylinder 1 metre (3·28 ft.) in diameter, within which a shaft, provided with six arms, revolves, carrying with it six loose steel balls, each 0·20 metre (7·87 in.) in diameter, and weighing 35 kilos. (77 lb. each). The upper part of the cylinder is furnished with a wire sieve, through which the ground product passes. The speed is 180 to 200 revolutions a minute. The power required is said to be less than with the ordinary horizontal mills.

In some of the factories a conical sieve is in use, which contains only 3 square metres (3·588 square yards) of wire netting. Eight of these sieves are required for three pairs of stones.

During the process of manufacture numerous samples are taken and tested. Should any of these samples show signs of weakness when immersed in water for eight or ten days, the bulk of the cement is retained in store until renewed tests show it to be reliable.

Analyses of the materials and finished cements are given, from which it appears that the two natural cements contain about 56 per cent. of lime, while the artificial Portland contains 57 per cent. The amount of magnesia in the Portland cement is 2·4 per cent., and of sulphuric acid 1·8 per cent.

At Voreppe, near Grenoble, four kinds of cement are made. The materials are of the same geological formation as at Porte-de-France, but the layers are inclined at an angle of 45°. They are worked by means of inclined underground galleries.

The kilns are 10 metres (32·8 ft.) in height, and the draught is increased by means of a main chimney, connected by flues with the kilns. The draught is further regulated by iron covers to the kilns, which can be raised or lowered as required. The fuel used is anthracite, with a little steam coal. For the quick-setting cements the working of the kilns is continuous, and for the Portland cement intermittent. The general process of manufacture is similar to that adopted at Porte-de-France, and the finished cement is stored at least six months before being issued. The sieves used are flat, inclined at an angle of 45°, and are kept in a state of vibration.

In chemical composition these cements differ but little from those of Porte-de-France. The Portland cements are slightly richer in lime, and consequently set more slowly. The crushing strength per square centimetre of the slow-setting Portland cement is 129 kilos. per square centimetre (1,834 lb. per square inch) in 10 days, and 458 kilos. (6,514 lb. per square inch) in one year.

At Grenoble and Tonnay six kinds of cement are manufactured, the time of setting of which varies from three minutes to three hours. Here again the materials belong to the same geological formation as those of Porte-de-France. The bulk of the cement is made from a layer of limestone 1·50 metres (14·76 ft.) thick, containing about 24 per cent. of clay. The outer portions of this layer contain a larger proportion of carbonate of lime, and can be distinguished after burning. They are picked out by hand, shaken by sprinkling with water, and afterwards ground and sifted.

The artificial Portland cement is made of a mixture of three materials, viz., the waste from the manufacture of hydraulic lime, clinker produced during the burning of the quick-setting cement, and clinker made of an artificial mixture of marl and limestone. The latter mixture is burnt for a fortnight in intermittent kilns. The finished Portland cement contains 50 per cent. of lime and 3 per cent. of

magnesia. The tensile-strength of the neat cement in 28 days is 48·6 kilos. per square centimetre (691 lb. per square inch).

A limestone belonging to the Lias formation yields the raw material for two varieties of cement manufactured at Valbonnais. The layer used is 4 metres (13 ft.) in thickness, and is worked through three galleries, the lower of which forms an inclined plane. The stone is burnt in kilns working continuously, and the product is afterwards picked by hand. The harder clinkers yield a slow-setting cement, which is stored two or three months before use. The percentage of lime in this Portland cement is 55·7, and of magnesia 0·5. Sulphuric acid is present to the extent of 2 per cent. At La Mure, a church, 52 metres (170·5 ft.) in length, is being built almost entirely of concrete blocks made with this cement.

Vicat's slow-setting Portland cement has been made since 1857 at Genevray, near Grenoble. The original factory was pulled down last year to make room for the new stores. The raw materials are a rich lime, made by burning a pure limestone, and a highly argillaceous limestone, containing 40 per cent. of clay. These two are mixed in such proportions that 23 parts of clay would unite with 77 parts of carbonate of lime. The argillaceous limestone is heated at a temperature which is too low to expel the carbonic acid, and is then ground and sifted through a No. 55 sieve. An automatic apparatus takes a sample from each sack of ground material. These samples are analysed, and serve to regulate the proportions of the mixture. The rich limestone is first burnt, then slaked by placing in perforated iron vessels, which are immersed for an instant in water. The contents are then discharged upon a grating, where the lime slakes and falls through, leaving the slags and imperfectly-burned pieces upon the grating. In six or seven days the slaked lime is sifted through a No. 60 sieve and removed to stores, where samples are taken for analysis. The pulverised raw materials are mixed by weight in proportions dependent upon the chemical composition. The mixed powder is then moistened, moulded into bricks and dried in the open air. The kilns, which are 42 in number, have a total height of 10·50 metres (34 ft.), and a diameter of 2·50 metres (9·2 ft.) or 3 metres (9·84 ft.). Before charging into the kiln the bricks are broken into small fragments, which are arranged in layers alternately with anthracite. The proportion of fuel used is one-sixth of the weight of the briquettes, and varies in different parts of the kiln. The clinker from the kilns is first broken in a stone-crusher, and ground in mills of the usual type. The cement is then sifted through a No. 60 sieve. Samples of the finished product are taken, and the briquettes are not only tested for tensile-strength but are frequently analysed as a check upon the proportions of the raw materials. The tensile-strength of a mixture of one part by weight of cement with three parts by weight of standard sand is also ascertained. The sand is prepared by sifting siliceous sand through a sieve of 64 meshes per square centimetre (413 meshes per square inch). That which passes through is again sifted through a sieve of 144 meshes per square centimetre (929 meshes per square inch), and the sand remaining upon the latter is used for the experiments. Each series of tests is made with 44 briquettes of a breaking section of 16 square centimetres (2·48 square inches). These are broken at periods varying from five days to a year, the same system having been carried out since the establishment of the factory. The time of setting of this cement varies from 8 to 24 hours, according to the temperature. The percentage of lime is 61·25, of magnesia, 1·90, and of sulphuric acid, 1·70. The tensile-strength of the neat cement in 28 days is 33·83 kilos. per square centimetre (481·16 lb. per square inch), and the crushing-strength in the same time 372·3 kilos. per square centimetre (5,295·16 lb. per square inch). Mixed with three parts of sand, the figures are 19·67 kilos. per square centimetre (365·5 lb. per square inch) and 177·3 kilos. per square centimetre (2,521·7 lb. per square inch) respectively.

At Uriage a natural cement is made by the same firm from a limestone of the Lias formation. This stone is traversed by irregular white veins of carbonate of lime, which are carefully picked out before burning. The kilns

are 6 metres (19·68 ft.) high, and 3 metres (9·84 ft.) in diameter, and are worked continuously. The manufacture of this cement is similar to that of the other natural cements of this district. The finished product contains 47·30 per cent. of lime, and 1·95 of magnesia, with 2·20 per cent. of sulphuric acid.

Near La Grande Chartreuse two kinds of cement are manufactured from a layer 3 metres (9·84 ft.) thick, belonging to the Neocomian formation. The strata are inclined at an angle of 43°, and the stone is extracted through 22 galleries, each 3·50 metres (11·48 ft.) in height. The difference in the quality of the two cements produced here is chiefly due to the mode of burning. The heavy, or slow-burning, cement is burned for three weeks, during which process about 10 per cent. of dust is produced, which is rejected. The proportion of lime in these cements is 54·5, of magnesia, 3·5, and of sulphuric acid 4 per cent.

The quick-setting Grenoble cements are largely used for gas- and water-pipes, sewers, and other hydraulic work which must be executed rapidly. The general composition of the concrete is one part, by volume, of gravel to one of cement.

Referring to the discrepancies so frequently noticed in the weights of the same cements when taken by different observers, the author proposes to weigh a given volume of cement after it has been subjected to a series of 250 or 300 shocks in a litre vessel of metal 0·172 metre (0·564 ft.) in height, and 0·086 metre (0·282 ft.) in diameter. The cement should fill the measure loosely at the commencement of the experiment, and the distance to which it sinks when shaken down will be an indication of the relation between the weight when weighed in the loose state and when packed. It was found that the density of a cement did not perceptibly increase when the number of shocks given to the vessel was greater than 300. The increase in density by this method was about 30 per cent., as compared with the powder measured loose. The microscopic examination of a cement is recommended as a means of detecting impurities, and of controlling the fineness of grinding.

In storing the ground cement, it has been noticed that there is an increase of temperature of about 8° C. (14·4° F.), especially during moist weather. Storing the cements for two or three months before using is general, and appears to be necessary. With the Portland cements especially the time of setting is considerably increased by storing. In the cements examined, the percentage of sulphuric acid varied from 1·65 to 3·70. Experience has shown that even 4 per cent. of this substance has no injurious effect when the cement is used in fresh water. When exposed to salt water, so high a proportion of sulphuric acid would prove injurious, owing to the formation of sulphate of magnesia.

The Manufacture of Slag Cement. J. Grosclaude. *Annales Industrielles*, 1889, 89, through Abstr. Papers Inst. Civil Eng. 48, iv. 12.

THE manufacture of cement from slag has, in the last few years, become rapidly extended, and works are now in operation in France at Saulnes and Marnaval, in England at Middlesbrough, in Switzerland at Choindez, at many places in Germany, and at Bilbao in Spain. The quality of the cement varies considerably in accordance with the composition of the raw products employed, and the care exercised in the manufacture, but the material when well made will bear comparison with the best Portland cement. The slag employed should be basic, and must be previously granulated on the system of Mr. C. Wood, as otherwise it is devoid of hydraulic properties. According to Professor Tetmajer, of Zurich, the lime, silica, and alumina in the slag should bear to one another approximately the following proportions, as 46, 30, 16. Fat or pure limes are generally selected to add to the slag, but the author counsels the adoption of poor or clayey limes in cases where the cement is to be used above ground. Where much calcium sulphide is present, as in the Bilbao slags, the cement takes a greenish tinge, but this does not impair its quality. A sample, tested by Professor Tetmajer, composed of 100

parts of Bilbao slag and 15 parts of lime, was found, on analysis, to give the following percentage results:—Silica, 30.56; alumina, 13.31; oxide of iron, 0.25; oxide of manganese, 1.74; oxide of lime, 45.01; magnesia, 2.96; sulphate of lime, 1.41; and sulphide of calcium, 4.63. Briquettes of the neat cement were tested as follows:—

	Seven Days.	Twenty-eight Days.
	Kilos.	Kilos.
Strength in compression per square centimetre:—		
In water.....	96.9	120.0
In air.....	..	141.0
Tensile strength per square centimetre:—		
In water.....	19.3	28.7
In air.....	..	19.5

The mode of preparing the slaked lime, and the apparatus used for the purpose, is explained by reference to diagrams. Drawings are given of various descriptions of drying machines which have been employed for desiccating the granulated slag; the rotary drier, invented by Mr. Ruelle, is preferred by the author, and a novel form of apparatus, patented by Mr. Raty, of Saulnes, is described and fully illustrated. For the intimate admixture of the slag and slaked lime, and for grinding the same to a fine powder, the apparatus of Mr. Luther, of Brunswick, is employed. This consists of an iron cylinder, with a corrugated lining, partly filled with small metal balls, by means of which the materials are both ground and mixed in one operation, which lasts about three-quarters of an hour for each charge. The cement thus prepared leaves a residue of from 5 to 6 per cent. on a sieve of 2,500 meshes per square centimetre. A sample of slag cement made at the Donjon factory was officially tested at the École des Ponts et Chaussées in September 1888, with the following percentage results:—Combined silica, 23.85; alumina, 13.95; peroxide of iron, 1.10; lime, 51.40; magnesia, 1.95; sulphuric acid, 0.45; sand, 0.25; loss on ignition, 7.05. It left on a sieve of 5,000 meshes per square centimetre a residue of 23 per cent.; gauged with 28 per cent. of water, the initial set took place in one and a quarter hour, and the set was complete at the end of three hours. On the mean of six tests the neat cement showed the following tensile strength per square centimetre:—In 7 days, 21.87 kilos.; in 28 days, 26.88; and in 84 days, 31.15 kilos. (equivalent per square inch to 311.06 lb., 382.32 lb., and 443.05 lb. respectively). Briquettes of three parts sand to one cement broke in 7 days at 14.93 kilos., in 28 days at 26.03, and in 84 days at 29.23 kilos. (equivalent per square inch to 212.35 lb., 370.23 lb., and 415.74 lb. respectively). Tables, too long for abstract, indicate the composition of 23 different samples of slags from various foreign furnaces, together with tests of the cements made from the same.

An estimate is given of the cost of the plant for a works capable of producing 6,000 tons of cement per annum, and of the necessary materials for the same, also of the expense of manufacturing the cement and the profits on the manufacture. The estimate is accompanied by plans and sections of the factory.

Utilisation of Waste Products. Wochenschr. des öst. Ing. und Archit. Ver. 1889, 215, through Abstr. Papers Inst. Civil Eng. 48, iv. 14.

THE author shows that a good and useful building material may be produced by roasting, at a temperature of 302° F., the rubbish obtained from old buildings; that by such process so much water is driven out of the material as to reduce the volume from 20 to 40 per cent., and hence the employment of such a perfectly dry material in a building will prevent the settlements so often observed, resulting from the drying of the material within the walls of the building itself. A further advantage is a sanitary one, for while the original waste product may contain within itself

the germs of disease, these are destroyed by the intense heat to which they are subjected in roasting, and the material is therefore completely disinfected.

Another useful building material is manufactured from blast furnace refuse in the form of bricks and paving slabs, and this has established a new industry in the smelting houses on the Schwechat, near Vienna, where the furnace slag is broken up and mixed with hydraulic lime, and then moulded under steam pressure into bricks. The value of the product consists in the formation of silicate of lime from the combination of the silica in the slag with the lime, resulting in a hard material, which increases in hardness on exposure. The brick in this condition is of a uniformly greyish-white colour of rather coarse grain and very sharp edges, and possesses in a high degree the two valuable properties of permeability and porosity, and thus constitutes an essentially healthy building material. The durability of the material, too, has been tested by a 15 years' exposure in some cases, and no signs of wear or weathering have been noticed; in short, the results of its employment have been so favourable that it has been recommended by the Board of Works for general purposes, and to be used with a mortar made from slag, sand, and hydraulic lime.

Paving slabs are now made according to a patent process by mixing furnace slag with Portland cement and other constituents, which produce rapid hardening and great strength, and such pavements are now laid down for special purposes in London, Paris, and Vienna.

X.—METALLURGY.

Investigations on Cobalt and Nickel. G. Krüss and F. W. Schmidt. Ber. 22, 2026—2028.

THE authors have continued their investigations on this subject (see this Journal, 1889, 307) and confirm their former communication. The nickel salts employed gave no reactions indicative of the presence of any known impurity, before they were resolved into the two constituents by any of the methods previously described. Fractional precipitation as basic ammonium arsenite resolves nickel into two constituent portions, one of which possesses a lower, the other a higher, atomic weight than that of ordinary nickel (58.6). The lower atomic weight varies between 56 and 58, the higher between 61 and 100; these were determined by reducing the oxides of the corresponding fractions in a current of hydrogen. The metal resulting in both of these cases gave no evidence of the presence of any known impurity, and thus this appears as a confirmation of the composite nature of nickel, but whether the metal is a mixture of two or more elements the authors, who are continuing their work, are unable to say as yet.—C. A. K.

Some Metallic Sulphides. A. Gautier and L. Hallopeau. Compt. Rend. 108, 1111—1113.

METALLIC nickel, treated with carbon bisulphide at a red heat, yields fused masses of the sulphide Ni_2S_3 , and a black powder consisting of the ordinary sulphide NiS , a carbide of nickel and free carbon. The sulphide Ni_2S_3 has a yellow colour and metallic lustre, is not magnetic, is a little harder than fluor spar, easily pulverised, and has a sp. gr. of 5.66. The powder, at first crystalline, loses its metallic lustre and becomes dark green and eventually black. This sulphide is stable hot and cold, slowly attacked by hydrochloric acid or sulphuric acid, rapidly by aqua regia.

Metallic chromium, prepared by Wöhler's process, gives, under like treatment, the ordinary sulphide Cr_2S_3 , as a greyish-black, graphitic substance, mixed with a carbide of chromium, which resists aqua regia.

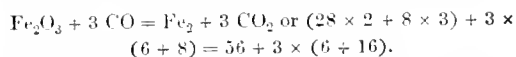
Lead, at a cherry-red heat, is converted by carbon bisulphide vapour into brilliant cubic crystals of galena. At a higher temperature, some yellowish needles of lead sulphocarbonate are formed.—J. M. H. M.

On the Results of Blast-Furnace Practice with Lime instead of Limestone as Flux. C. Cochrane. Read before Institute Mech. Engineers, October 30, 1889.

To Sir Isaac Lowthian Bell we are indebted for a most carefully conducted series of experiments upon the blast-furnace, recorded in his work entitled "Chemical Phenomena of Iron Smelting." To M. Grüner is the scientific world further indebted for embodying in his "Études sur les Hauts-Fourneaux" the results of those experiments in the most carefully developed mathematical order and algebraical formulae that blast-furnace practice has witnessed. Neither M. Valérius nor MM. Flachet, Barrault, and Petiet have approached Sir Lowthian Bell and M. Grüner in their exposition of the phenomena of the blast-furnace reactions; although, as happens in all scientific progress, those earlier works have been stepping-stones to the great stride accomplished by Sir Lowthian Bell and by M. Grüner. It is true that Sir Lowthian Bell pointed out how the presence of carbonic acid in the gases escaping from the blast-furnace had a distinct bearing upon the economy of fuel consumed in the production of a unit of pig iron; but he further insisted on the fact, as he supposed, that there was an absolute limit to the attainable ratio of carbonic acid to carbonic oxide in the escaping gases beyond which further economy was impossible, by reason of alleged reactions between these two gases as soon as ever that limit was reached. The limit he assigned was one volume of carbonic acid to two volumes of carbonic oxide; which is equivalent to a ratio by weight of three of carbonic acid to four of carbonic oxide, or $\text{CO}_2 : \text{CO} = 0.75 : 1.00$. M. Grüner gave, presumably for the first time, the maximum of perfection possible in any blast-furnace in terms of the maximum ratio of carbonic acid to carbonic oxide; but he seems too readily to have fallen in with Sir Lowthian Bell's idea that there was a practical limit to this ratio, by reason of the reactions which Sir L. Bell alleged took place when the limit was exceeded of one volume of carbonic acid to two of carbonic oxide.

The conclusion drawn by Sir L. Bell is believed by the writer to have been experimentally correct under the conditions under which he assumed the gases to exist in the blast-furnace; but the writer's practice has shown him that there are conditions hitherto unrecorded, which govern the attainable ratio of carbonic acid to carbonic oxide, and it has been his aim for many years past to arrive at the true law which governs the relations of these two gases, and the resulting economy or sacrifice of fuel in the blast-furnace. M. Grüner stated that the ratio of carbonic acid to carbonic oxide was the keynote of the position, and he was right; but it has needed years of practical experience, in the light of Sir Lowthian Bell's analytical experiments and of M. Grüner's inferences, to solve the problem.

There are two leading factors in the conduct of a blast-furnace, which are readily intelligible:—The combustion of carbon at the tuyeres into carbonic oxide wholly, and the reduction of the oxide of iron by the reaction of the carbonic oxide thus produced, so as to form carbonic acid, according to the well-known formula in the case of peroxide of iron—



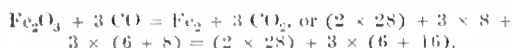
Now supposing there were no other reactions than these, and that there were needed 15 cwt. of pure carbon to produce 20 cwt. of pure iron, the ratio of carbonic acid to carbonic oxide would be found as follows:— $15 \times 14 \div 6 = 35$ cwt. of carbonic oxide produced at tuyeres; and according to the above formula, for every 56 cwt. of iron, 42 cwt. of carbonic oxide would be required with production of 66 cwt. of carbonic acid. Hence for every 10 cwt. of pure iron there would be required $42 \times 20 \div 56 = 15$ cwt. of carbonic oxide, and there would be produced $15 \times 66 \div 42 = 23.57$ cwt. of carbonic acid. There would therefore be left $35 - 15 = 20$ cwt. of carbonic oxide, and there would be formed 23.57 cwt. of carbonic acid, and the ratio of these would be $\text{CO}_2 : \text{CO} = 23.57 : 20.00 = 1.18$. Now Sir Lowthian Bell's assertion is that such a ratio would be impossible, because the moment the limiting ratio of 0.75 is exceeded, the immediate effect would be to cause a reconversion of

carbonic acid into carbonic oxide, and so to undermine the economy due to such a ratio as the foregoing of 1.18 by the unburning of carbon oxidised to its highest degree. Yet he himself gives an illustration of Styrian furnaces where pig iron is made with from 12 to 15 cwt. of charcoal per 20 cwt. of pig iron produced: so that on the merits of the case there would seem to be something wrong in his deductions. Although as a matter of fact so high a value as 0.75 for the ratio of carbonic acid to carbonic oxide has not been attained with Cleveland ironstone, the author purposes showing that the cause is to be sought deeper than in the mere arbitrary limit assigned to the ratio of carbonic acid to carbonic oxide, and is to be found in reactions of carbonic acid upon red-hot carbon, and in the consequent production of carbonic oxide, so that the ratio $\text{CO}_2 : \text{CO}$ is essentially an effect and not a cause.

In a blast-furnace the perfection of work is that carbonic acid, having once been formed in the process of reduction, should never be allowed to come into contact with red-hot coke; for the immediate reaction between carbonic acid and carbon at a red heat is to convert the carbonic acid into carbonic oxide with most destructive waste of fuel. Thus the units of heat developed by one unit (or cwt.) of carbon burnt into carbonic oxide only are 2,473 (centigrade), whereas the units of heat developed by one unit of carbon burnt into carbonic acid are 8,080; hence the units of heat developed by one unit of carbon in carbonic oxide burnt into carbonic acid are $8,080 - 2,473 = 5,607$. It will thus be seen that, if by any unfavorable reaction in the furnace, such as happens when carbonic acid finds itself in the presence of red-hot coke, any carbonic acid once formed becomes reconverted into carbonic oxide, the unburning of the carbonic acid to carbonic oxide must be accompanied not only by the absorption of carbon but also by serious loss of heat. The reaction which takes place is represented by the formula $\text{CO}_2 + \text{C} = 2 \text{CO}$; in which for every unit of carbon in the carbonic acid a unit of carbon of the coke is dissolved and becomes carbonic oxide; whilst the unit of carbonic acid becomes two units of carbonic oxide by the absorption of the second equivalent of carbon. Just as one unit of carbon as carbonic oxide develops 5,607 heat-units in becoming carbonic acid, so one unit of carbon as carbonic acid in going back to carbonic oxide will absorb 5,607 heat-units, which is equal to the combustion of $5,607 \div 2,473 = 2.26$ units of carbon burnt into carbonic oxide, of which one unit of carbon has absolutely disappeared by absorption in the process, leaving 1.26 units to be supplied and burnt into carbonic oxide at the tuyeres by means of the oxygen in the blast, to compensate for the balance of loss incurred in the region of the furnace in which the reaction has taken place, because by hypothesis the carbonic acid has been evolved or come into contact with red-hot coke under conditions under which it could not exist as carbonic acid. To make the ultimate result, if necessary, yet clearer, the absorption of the one unit of carbon by the carbonic acid to form carbonic oxide will develop 2,473 heat-units, while the reconversion of the carbonic acid to carbonic oxide will subtract from the furnace 5,607 heat-units: so that the balance will be a loss of $5,607 - 2,473 = 3,134$ heat-units, which represent $3,134 \div 2,473 = 1.26$ units of carbon burnt into carbonic oxide. Hence there is a total loss to the efficiency of the furnace of $1.26 + 1.00 = 2.26$ units of carbon burnt into carbonic oxide for every unit of carbon once existing as carbonic acid which shall have been reconverted into carbonic oxide.

When limestone is employed as a flux there are two sources of carbonic acid:—firstly, that contained in the carbonate of lime CaCO_3 , which has necessarily to be evolved in contact with red-hot coke, because at less than a red heat it is impossible to separate the carbonic acid from the lime; and secondly that evolved in the process of reduction of the ore or ironstone, which, if previously calcined so as to become peroxide of iron, undergoes the following reaction: $\text{Fe}_2\text{O}_3 + 3 \text{CO} = \text{Fe}_2 + 3 \text{CO}_2$. Now, according to the construction of the furnace, and the more or less imperfect appliances at command, much or little of the latter, which will be called the carbonic acid of reduction, may be evolved in the same red-hot region in which the carbonic acid from the flux is driven off. In old furnaces

of very small capacity, extravagant waste of fuel took place from this very cause, namely, the evolution of carbonic acid of reduction in the red-hot region, owing to the plunging of the ironstone down into that region before its complete reduction had been effected in a higher and cooler region. How great could be the mischief will appear by assuming the extreme case of a furnace so badly constructed that the whole of the reduction of the peroxide of iron should take place in the red-hot region. From the formula



it will be seen that for the reduction of 56 cwt. of iron there are required 18 cwt. of carbon as carbonic oxide; and 56 : 20 :: 18 : 6.43; therefore 6.43 cwt. of carbon are required for the reduction of 20 cwt. of iron from its assumed condition of peroxide. But inasmuch as 20 cwt. of pig iron contain only 18.80 of pure iron, the carbon required per ton of pig iron will be $6.43 \times 18.80 \div 20 = 6.04$ cwt. Now suppose the whole of this carbon, which should in a perfect furnace pass away as carbonic acid, became carbonic oxide; it would first absorb 6.04 cwt. of carbon for conversion into carbonic oxide according to the reaction $\text{CO}_2 + \text{C} = 2\text{CO}$; and the heat to be furnished at the tuyeres would be $6.04 \times 1.26 = 7.61$ cwt. of carbon burnt into carbonic oxide. Hence a total loss would arise of $7.61 + 6.04 = 13.65$ cwt. of carbon per ton of pig iron.

It was in the direction of reducing this mischievous tendency that, at Middlesbrough especially, important economies ensued on increasing the capacity of the blast-furnace from 6,000 or 7,000 cubic feet to 20,000 cubic feet or more. Thereby more time was given for the reduction of the ironstone; so that it became more possible to secure, in the analysis of the escaping gases when employing limestone as flux, a nearer approach to the presence of the entire quantity of carbonic acid of reduction and in certain cases even the entire quantity. Indeed, M. Grüner was quick to discover in Sir Lowthian Bell's experiments the presence in some cases of a little more carbonic acid than was due to the possible formation of carbonic acid by the reduction of all the ironstone; and the excess must have proceeded from the evolution of carbonic acid from the limestone. As the writer has himself on several occasions since confirmed M. Grüner's observation, he now deems such increase of carbonic acid beyond the carbonic acid of reduction to be the result of a trifling wave of carbonic acid displaced from the surface of the limestone just before it plunges into the red-hot coke region. The amount is so little as not to disturb the main conclusion that the carbonic acid of the flux takes up a weight of carbon practically equal to that which it already contains. Nor must it be lost sight of that in thus taking up carbon and becoming 2CO the result it produces is not altogether prejudicial; for the carbonic oxide so formed enriches the deoxidising gas of the furnace, and promotes the more complete deoxidation of the ironstone in the cooler region above, so as to make it possible to attain to a perfect reduction thereof without absorption of carbon by carbonic acid of reduction.

At this stage it may be interesting to refer to the effect of displacing the carbonic acid from the flux by calcining the latter before employing it in the blast-furnace. The following is a comparison between the results obtained at the same furnace under the two different conditions, and will fully illustrate the benefit to be obtained under favourable conditions by the substitution of lime, CaO , for limestone, CaCO_3 , in a blast-furnace of capacity adapted to the materials employed, although there may seem room for a little regret that the balance of heat received (Table I.) and heat expended (Table II.) is not somewhat closer than here appears.

In these comparative accounts of receipts and expenditure of heat it will be noticed that, in working on limestone, the expenditure falls short by 0.72 cwt. of carbon of the total heat received in fuel and heated blast, and reckoned in carbon burnt to carbonic oxide; whilst in working on lime, the expenditure account shows an excess of 0.81 cwt. of carbon over that which was received. These are errors on either side, amounting to $2\frac{1}{2}$ and 3 per cent. respectively,

to which calculations of this kind are liable, owing to the impossibility of recording accurately all the conditions under which a blast-furnace works. Imperfectly calcined ironstone, for instance, will contain more or less carbonic acid, which if at the surface will pass away as such, but if imprisoned in the core of a large piece of ironstone will descend into the red-hot region of the blast-furnace, there to be liberated with absorption of carbon and resultant loss of heat. Such fluctuations in the ironstone would produce some influence upon the ratio of carbonic acid to carbonic oxide; but all things considered, the above errors of 0.72 and 0.81 cwt. respectively might fairly be spread over the whole of the expenditure account, indeed probably over both receipt and expenditure accounts, and so become inappreciable whilst leaving the salient points of the account undisturbed.

ORMESBY IRON WORKS, MIDDLESBROUGH.

TABLE I.—BLAST-FURNACE of 20,454 cubic feet capacity, and 76 feet height. Comparison between working on limestone and on lime respectively as flux.

Supply of Heat per Ton of Pig Iron made.		Working on	
		Lime-stone.	Lime.
Chemical composition of the escaping gases :—		Per Cent.	Per Cent.
By volume	{ Nitrogen, N.....	58.28	59.90
	{ Carbonic acid, CO ₂	9.25	9.79
	{ Carbonic oxide, CO.....	30.89	28.95
	{ Hydrogen, H.....	1.58	1.36
By weight	{ Nitrogen, N.....	56.19	57.43
	{ Carbonic acid, CO ₂	14.04	14.80
	{ Carbonic oxide, CO.....	29.66	27.68
	{ Hydrogen, H.....	0.11	0.09
Ratio of CO ₂ to CO by weight .....ratio		0.473	0.535
Temperature of } F. 1,485° and 1,490° = centig.		807°	765°
Temperature of } F. 621° and 574° = centig.		327°	301°
Coke consumed per ton of pig iron		Cwt. 23.28	Cwt. 19.49
Deduct :—			
Ash .....7.70 and 7.65		Per cent. 9.07 and 10.59 =	2.09
Sulphur, 0.84 and 0.90			
Moisture 0.53 and 1.95			
Net carbon in coke consumed per ton of pig iron		21.19	17.44
Limestone consumed per ton of pig iron		13.18	{ 7.86 12.28
Deduct foreign matter in flux 3½ and 3.71 per cent.....		0.46	0.45
Net pure carbonate of lime, CaO CO ₂		12.72	11.83

* When working on lime the actual weight of flux charged into the furnace per ton of pig iron made was 7.86 cwt. of impure lime, resulting from the calcination of 12.28 cwt. of raw limestone. The latter was found by analysis to contain 3.71 per cent. of foreign matter, amounting therefore to 0.45 cwt.; and the net pure carbonate of lime was accordingly $12.28 - 0.45 = 11.83$ cwt. of CaO CO_2 , which contained $11.83 \times 22 \div 50 = 5.21$ cwt. of CO_2 . But instead of the whole of this CO_2 being expelled from the limestone in the calcining kiln, the actual weight driven off was only $12.28 - 7.86 = 4.42$ cwt. Consequently there remained in the lime used as flux $5.21 - 4.42 = 0.79$ cwt. of CO_2 ; and this unexpelled CO_2 contained $0.79 \times 6 \div 22 = 0.22$ cwt. of carbon, which corresponds with 1.83 cwt. of CaO CO_2 .

TABLE I.—BLAST FURNACE.—*cont.*

Supply of Heat per Ton of Pig Iron made.	Working on	
	Lime-stone.	Lime.
Carbon contained in flux, $12.72 \times 6 \div 50$ and* $0.79 \times 6 \div 22$	Cwt. 1.52	Cwt. 0.22
Total carbon supplied into furnace per ton of pig iron, $21.19 \div 1.52$ and $17.44 \div 0.22$	22.71	17.06
Deduct carbon absorbed by pig iron	0.60	0.60
Net carbon for producing joint CO_2 and CO	22.11	17.06
Carbon required per ton of pig iron for perfect reduction	6.04	6.04
If all CO_2 passed away without change, total CO_2 in escaping gases would be $(1.52 + 6.04$ $= 7.56) \times 22 \div 6$	27.72	..
and $(0.22 + 6.04 = 6.26) \times 22 \div 6$ .....	..	22.96
Whilst there would then pass away as CO $(22.11 - 7.56 = 14.55) \times 14 \div 6$	33.95	..
and $(17.06 - 6.26 = 10.80) \times 14 \div 6$ .....	..	25.20
In that case the furnace would be working perfectly with ratios $\text{CO}_2 : \text{CO} = 27.72 \div$ 33.95 and $22.96 \div 25.20$	Ratio. 0.816	Ratio. 0.911
But the actual working ratios given above were	0.473	0.535
This reduction of ratios, as will be explained further on, is attended with transfer of carbon from condition of CO_2 to that of CO, amounting to	Cwt. 2.44	Cwt. 1.93
The transfer, as will also be explained, is derived from the two following sources:— Carbon from CO_2 of flux, as above	1.52	0.22
Carbon from CO_2 of reduction, by differ- ence	0.92	1.71
Total carbon transferred per ton of pig iron, as above	2.44	1.93
Moisture in atmosphere per cubic foot, grains	4.776	3.243
Weight of air supplied into furnace is found as follows:— Carbon supplied for producing CO_2 and CO, as above	Cwt. 22.11	Cwt. 17.06
Deduct carbon transferred from CO_2 of flux and of reduction, as above	2.44	1.93
Net carbon to be converted into CO by air	19.67	15.13
Weight of oxygen required $19.67 \times 8 \div 6$ and $15.13 \times 8 \div 6$	26.23	20.17
Weight of nitrogen required $26.23 \times 77 \div 23$, and $20.17 \times 77 \div 23$	87.82	67.52
Total weight of dry air required per ton of pig iron	114.05	87.69
Total heat supplied into furnace by blast, reckoned in cwt. of carbon burnt into CO, each unit of carbon thereby developing 2,473 heat-units, and specific heat of air being 0.239 $114.05 \times 807 \times 0.239$ and $87.67 \times 765 \times 0.239$ 2473 2473	8.89	6.18
If to this heat so measured be added the actual carbon contained in the coke	21.19	17.44
and also the carbon in the flux	1.52	0.22
There is a total of carbon to be accounted for as supplied into the furnace, both directly as carbon and in its equivalent of heat carried in by the hot blast, amounting per ton of pig iron to	31.60	24.14

* See footnote on previous page.

TABLE II.—BLAST FURNACE of 20,454 cubic feet capacity
and 76 feet high.Comparison between working on Limestone and on Lime
respectively as Flux.

Expenditure of Heat per Ton of Pig Iron made.	Working on	
	Lime-stone.	Lime.
Gases escaping at tunnel head are found as follows: Net carbon for producing CO_2 and CO, as before	Cwt. 22.11	Cwt. 17.06
Deduct carbon escaping in CO_2 , $6.04 - 0.92$ and $6.04 - 1.71$	5.12	4.33
Leaves carbon escaping in CO	16.99	12.73
CO_2 escaping $5.12 \times 22 \div 6$ and $4.33 \times 22 \div 6$, CO escaping $16.99 \times 11 \div 6$ and $12.73 \times 11 \div 6$	18.77	15.88
Nitrogen escaping, as before	87.82	67.52
Total weight of dry gases escaping...	146.23	113.10
Heat carried away by waste gases, reckoned in cwt. of carbon burnt into CO, each unit of carbon thereby developing 2,473 heat- units, and specific heat of escaping gases being 0.237 $146.23 \times 327 \times 0.237$ and $113.10 \times 301 \times 0.237$ 2473 2473	4.58	3.26
Carbon absorbed by pig iron, as before	0.60	0.60
Carbon absorbed by CO_2 of flux, 1.52 and 0.22	2.44	1.93
Carbon absorbed by CO_2 of reduction 0.92 and 1.71	2.44	1.93
Extra carbon needed to be burnt into CO at tuyeres for meeting loss of heat due to un- burning of CO_2 into CO, 2.44×1.26 and 1.93×1.26	3.07	2.43
Heat required to drive off CO_2 from flux, reckoned in cwt. of carbon burnt into CO, each unit of flux requiring 373.5 heat-units to drive off CO_2 , $12.72 \times 373.5 \div 2473$ and $1.83 \times 373.5 \div 2473$	1.92	0.27
Decomposition of moisture in blast	1.33	0.73
Carbon remaining as CO_2 and passing away as such in escaping gases is $6.04 - 0.92$ and $6.04 - 1.71$	5.12	4.33
The slag, weighing about 32 cwt. per ton of pig iron, requires for its melting 550 heat- units per unit of slag, or $32 \times 550 \div 2473$ of carbon burnt to CO	7.11	7.11
Melting of the iron requires	0.90	0.99
Evaporation of water from coke	0.03	0.00
Sundries, including loss of heat by tuyere water, radiation from sides of furnace and tuyere houses, &c.	3.78	3.30
Total carbon accounted for as expended ..	30.83	24.95
Error	+ 0.72	- 0.81
Total carbon to be accounted for as received	31.60	24.14
Consumption of calcined ironstone per ton of pig iron	Cwt. 50.13	50.00
Make of pig iron per month	Ton 2,141	2,453
Quality of pig iron	No. 3.25	3.31
Blast, pressure per square inch at tuyeres	Lb. 3.87	3.73
Area of tuyeres	Sq. in. 142	142

It will be seen that when working on lime, with even an imperfect calculation of the flux, an economy was obtained of $24.19 - 17.44 = 3.75$ cwt. of carbon; whereas the theoretical saving should have been only 2.94 cwt. of carbon, according to the weight of carbon in the carbonic acid displaced from the flux, namely $(1.52 - 0.22 = 1.30) \times 1.26 \div 1.30 = 2.94$.

The calculation which needs explanation in Table I. is the one whereby, from an analysis of the gases and from a knowledge of the carbon consumed per ton of pig iron and of the unexpelled carbonic acid in the flux, it is possible to arrive at the exact mischief done in the red-hot coke region by each of the two sources of that mischief, namely, the carbonic acid of reduction and the carbonic acid from the flux. In his last paper read before this Institution in January 1883, the author showed how this could be accomplished by a laborious method of calculation and by special tables; but continued study has enabled him to simplify the calculation, and by a simple algebraical formula to test the effective working of a blast-furnace by accounting in the form of an expenditure column for every unit of carbon consumed, whether in the heating of the blast or in the carbon burnt within the furnace. His own practice is to account in this expenditure for all fuel by reducing it to units of carbon burnt to carbonic oxide, each unit thereby developing $2,473$ centigrade units of heat. In this way he hopes to have made a complicated problem clear.

Taking the ratio 0.473 determined by analysis as that of carbonic acid to carbonic oxide in the escaping gases when working on limestone, we begin by ascertaining what this ratio should have been, had there been no reconversion whatever of carbonic acid into carbonic oxide. Then would the furnace have worked perfectly, and the ratio would have been found as follows. The net carbon available for producing joint carbonic acid and carbonic oxide has been found in the foregoing statement to be 22.11 cwt. per ton of pig iron. In perfect work all carbonic acid should pass away as such; and the total quantity produced in the furnace will be that from the 6.04 cwt. of carbon for the reduction of the ironstone and that from the 1.52 cwt. of carbon in the flux, namely:—

	Cwt.
Carbon for reduction $\dots 6.04 \times 22 \div 6 =$	22.15 of carbonic acid.
Carbon of flux $\dots\dots\dots 1.52 \times 22 \div 6 =$	5.57 of carbonic acid.
Total carbon $\dots\dots\dots 7.56 \times 22 \div 6 =$	27.72 of carbonic acid.

If these 7.56 cwt. of carbon all appeared in the escaping gases, the balance should pass away as carbonic oxide, namely $22.11 - 7.56 = 14.55 \times 14 \div 6 = 33.95$ cwt. of carbonic oxide. Therefore the perfect ratio of carbonic acid to carbonic oxide would be $27.72 \div 33.95 = 0.816$; but the actual ratio determined by analysis was only 0.473 , and has been lowered from the perfect to the actual by the transfer of a certain amount of carbon from the condition of carbonic acid to that of carbonic oxide. Let x be the weight of the carbon so changed; then from the total carbonic acid possible in perfect work there will have been subtracted $\frac{22}{6}x$, and to the total carbonic oxide possible in perfect work there will have been added $\frac{14}{6}x$. Hence the new ratio of carbonic acid to carbonic oxide will be $(27.72 - \frac{22}{6}x) \div (33.95 + \frac{14}{6}x) = 0.473$. Whence $x = 2.44$ cwt., as taken in the foregoing Table I. for the quantity of carbon transferred from the condition of carbonic acid to that of carbonic oxide per ton of pig iron.

In like manner where lime was employed, containing 0.22 cwt. of carbon as carbonic acid unexpelled, the perfect ratio of carbonic acid to carbonic oxide would have been $22.96 \div 25.20 = 0.911$; whereas in actual work it fell to 0.535 , showing that the carbon transferred from the condition of carbonic acid to that of carbonic oxide amounted to 1.93 cwt. per ton of pig iron.

It is most important to notice the sources of these two different transfers. Obviously it might fairly be supposed that there should have been a difference between them of $1.52 - 0.22 = 1.30$ cwt.; so that the transfer of 2.44 cwt. in the limestone furnace should have been lowered to 1.14 cwt. in the lime furnace; whereas it appears at 1.93 cwt. Let us therefore examine how the 2.44 and

1.93 are made up in the respective cases of working with limestone and with lime.

	Limestone.	Lime.
Carbon transferred from carbonic acid of flux $\dots\dots\dots$	1.52	0.22
Carbon transferred from carbonic acid of reduction by reason of its evolution in region of red-hot coke $\dots\dots\dots$	0.22	1.71
	2.44	1.93

The use of lime has therefore failed to accomplish some of the benefit which the author ventured to hope and predict in January 1883; thus showing that its employment is not an unmixed good. For through a combination of causes the reduction of ironstone when working with lime as flux has been less effective to the extent of $1.71 - 0.22 = 0.79$ cwt. of carbon per ton of pig iron, equivalent in the present comparison to a loss of $0.79 \times 1.26 \div 0.9 = 1.79$ cwt. of carbon per ton of pig iron. To make this point clearer, in the case of working on limestone the proportion of ironstone reduced in the cooler regions of the furnace out of contact with red-hot coke was $50.13 \times 5.12 \div 6.04 = 42.49$ cwt. per ton of pig iron; whilst there passed down into the red-hot zone for reduction there $50.13 \times 0.22 \div 6.04 = 7.64$ cwt. For working on lime the corresponding figures are $50.00 \times 4.33 \div 6.04 = 35.84$ cwt., and $50.00 \times 1.71 \div 6.04 = 14.16$ cwt. In neither of these cases does the dreaded proportion appear of one volume of carbonic acid to two volumes of carbonic oxide; for from the analysis given in Table I. it is seen that the proportion when working on limestone was only $9.25 : 30.89$ or $1 : 3\frac{1}{3}$, and when working on lime $9.79 : 28.95$ or $1 : 3$ nearly. The consideration of these volumetric proportions may therefore be dismissed as inoperative in the present instances.

What then are the causes of the diminution in the weight of carbonic acid of reduction—that is, of the increase in the weight of carbon transferred from the carbonic acid of reduction into the condition of carbonic oxide—despite the removal of 85 per cent. of the carbonic acid from the lime used as flux? The causes of this disappointment when working on lime are twofold:—

Firstly, as intimated at the outset (page 890), when limestone is used, all or nearly all the carbonic acid it contains is necessarily converted into carbonic oxide, thus increasing and prolonging the activity of the reducing zone in a cooler region, while at the same time this cooler region is extended downwards by the absorption of the heat due to the unburning of the carbonic acid to carbonic oxide; thus protracting or prolonging the period of reduction of the ironstone within the extended reducing region; so that the employment of limestone is not an unmixed evil.

Secondly, when lime is used, the weight of carbonic oxide is comparatively diminished, the cool reducing zone is curtailed in its depth, and the total volume of gases is greatly diminished, by reason of the greatly diminished consumption of fuel in the furnace, due to the very economy secured by the expulsion of carbonic acid from the flux. When working on lime, the ironstone undergoing the process of reduction is thus subjected both to the passage of a smaller quantity of reducing gas over it, and to that passage during a shorter period of time before entering the red-hot zone, which zone by the use of lime has been raised somewhat higher in the furnace.

To reduce the above conditions to actual figures, we have when working on limestone, according to Table II., a weight of 116.23 cwt. of gas per ton of pig iron, which are passing over the materials entering the furnace, and of which 39.64 cwt. consist of carbonic oxide, or 27 per cent. of the total. When working on lime, we have only 113.10 cwt. of gas per ton of pig iron passing over the ironstone as it enters the furnace, of which only 29.70 cwt. are carbonic oxide, or 26 per cent. of the total. It will thus be seen that there is only a trifling difference in the percentage of carbonic oxide in the total gases as they leave the furnace; so that, in explanation of the diminished reduction of ironstone in the cooler reducing regions of the

furnace when working on lime, there remains the important fact that the materials from which a ton of iron is produced are exposed to the influence of only 29.70 cwt. of carbonic oxide when lime is employed as flux, instead of to that of 39.64 cwt. when limestone is employed; a proportion of about 3 to 4, or 25 per cent. less carbonic oxide when working on lime.

But whilst disappointment has to be confessed to the extent indicated, there are one or two conclusions to be drawn from the above comparisons, which will well reward further consideration.

The air required for consuming the coke per ton of pig iron is seen from Table I. to have been in the case of limestone 114.05 cwt., and with lime only 87.69 cwt., showing a direct economy of 26.36 cwt. of air, or 23 per cent.; whilst with the same pressure of blast and the same tuyere area the furnace when working on lime turned out 2,453 tons of iron per month against 2,141 tons per month when working on limestone (Table II.). It is in consequence of this increase in the output that the item of sundries in the statement of expenditure of fuel (Table II.) has been reduced from 3.78 with limestone to 3.30 with lime. It is not generally known how far the constancy of the loss by radiation and by tuyere-water, &c., affects the consumption of fuel by reason of increased output; within certain limits this explains the fact that extra driving may be and is accompanied by reductions of fuel consumed to make a ton of iron.

Before passing away from the subject of the smaller quantity of air required to make a ton of iron when lime is employed as flux, it will be proper here to refer to M. Grüner's claim that he was the first to show how, from a knowledge of the quantity of coke consumed and the ratio of carbonic acid to carbonic oxide, the weight of air needed could be accurately ascertained. This in itself was a great stride towards the correct understanding of the phenomena of blast-furnace practice; and the writer has never seen his claim challenged. That method is absolutely correct, and must in any future calculations supersede all other rough and ready methods hitherto in vogue for determining the quantity of air needed.

Attention may here be drawn to two errors into which the author fell in the comparative results given in his paper in 1883. Firstly, he omitted to allow for the carbon needed to melt the ton of pig iron on which the calculations were based, and was under a misapprehension at the time that it was included elsewhere. Secondly, he also assumed that the total loss of carbon in the transfer of a unit of carbon from the condition of carbonic acid to that of carbonic oxide was 3.26 times the amount of that unit; whereas it should have been 2.26 times; namely, 1 unit absorbed by the carbonic acid in the red-hot region, and 1.26 unit needed to be burnt into carbonic oxide at the tuyeres in order to meet the cooling effect of that absorption. In the present comparison of limestone and lime an allowance of 0.90 cwt. has been made for melting the 20 cwt. of pig iron, notwithstanding that M. Grüner adopts Sir Lowthian Bell's figure of 330 calories, which is equivalent to $330 \times 20 \div 2,473 = 2.67$ cwt. of carbon burnt to carbonic oxide for melting a ton of pig iron, whereas in practice a good cupola can melt a ton of pig iron with from $1\frac{1}{2}$ to $1\frac{3}{4}$ cwt. of coke. The author strongly suspects some error in the determination of heat contained in pig iron running from a blast-furnace or cupola, and is glad to learn that M. Grüner investigated the matter further after accepting Sir L. Bell's suggested average of 330 calories. In an admirable pamphlet by M. J. Wolters, written in 1876, on the lines of M. Grüner's work, and called "Etudes sur la fabrication de la fonte blanche pour fort au moyen des minettes ou minerais oolithiques du Luxembourg," he refers to M. Grüner's researches on the fusion of white iron, and gives the reduced figure of 265 calories, equivalent to 2.14 cwt. of carbon per ton of pig iron; but according to actual cupola practice this is still far too high, and the author has always pictured to himself that the blast-furnace must necessarily surpass the average cupola in economy of melting iron, so that he trusts the figure he has adopted of 0.90 cwt. of carbon burnt to carbonic oxide per ton of pig iron will not be found far from the truth.

Method of Treating Gold Ore at Deloro, Canada. J. E. Rothwell. Rep. of the State Mineralogist, California, 1888, through Abstr. Papers Inst. Civil Eng. 48, iv. 69.

At Deloro the ore treated is an arsenical iron sulphide in a gangue of quartz and calcite. It contains about 42 per cent. of arsenic, 20 per cent. of sulphur, and 38 per cent. of iron. On arriving at the mill the ore is crushed in rock breakers and Cornish rolls; it is then sized and concentrated in jigging machines. The concentrates are roasted in two large Howell-White revolving cylinders. In the first a preliminary roasting is carried on, and in the second the ore is roasted sweet. The ore falls from the lower end of the second cylinder, and, when cool, is sent to the chlorinators. These are cylinders of $\frac{3}{4}$ -inch boiler iron, lined with 20-lb. sheet-lead. The truck from the cooling floor is raised to a platform over the chlorinators, and the charge of chloride of lime is placed on the top of the ore. Water is measured into the cylinder first, the proportion being 120 gallons to the ton of ore, and then the contents of the truck are let in; sulphuric acid is then poured in through a funnel, the cover fastened on, and the cylinder started revolving. After from one and a half hour to three hours the excess of gas is drawn off, and an exhaust pump attached to produce a partial vacuum. In this way most of the free gas is removed. The cover of the discharge aperture is rapidly removed, and the charge emptied on to a sand filter in a tank with a tight-fitting cover and exhaust pipe. A better method is to wash the charge in the chlorinator until the liquor decanted into settling tanks shows no sign of gold. A charge of three tons may in this way be washed in two to three hours, while a 1-ton charge on a sand filter requires six to eight hours. From the settling-tanks and filters the clear solution is run into precipitating tanks, where it is treated with sulphuretted hydrogen, generated from equal parts of paraffin and sulphur in a small cylinder of heavy boiler-iron. The gas first passes into a receiving-tank to collect the volatile oils; thence it is forced through the solution to be precipitated. When the precipitation is complete the tank is allowed to stand for a short time, and then the solution is allowed to flow through pressure-filters. Three of these small filters will empty a 1,500-gallon tank in three to four hours, and leave it ready for another precipitation, or the precipitate can be collected in another filter-press, pressed into cakes, dried, roasted, and melted with borax. By means of this process 96.16 per cent. of the gold in the ore is extracted.

The Development and Present Condition of Puddling in Gas Furnaces. E. Goedicke. Stahl und Eisen, 1889, 554, through Abstr. Papers Inst. Civil Eng. 48, iv. 73.

THE regenerative gas furnace has of late years been very successfully adapted to puddling in the ironworks of the Austrian Alps. After discussing the earlier forms of furnace, including those of Siemens, Borbely, and Prie, the author proceeds to describe that of Springer, which is now largely used. This furnace, introduced in 1883 at Völklingen on the Saar, is a large Siemens furnace, having its regenerators built in two square blocks above the ground-level, and two double puddling-furnace beds placed between. These beds are about 6 ft. 4 in. broad, and 6 ft. 2 in. long, and are only separated by a narrow throat-flue of the breadth of the iron framing of the bed. Each takes a charge of $10\frac{1}{2}$ cwt., and they are worked alternately, the flame passing first over the bed in use, then over the second, which contains the materials of the next charge, and finally through the regenerators on the chimney side. When the charged is finished and the balls have been removed for shingling, that in the second bed is already melted, so that on the reversal of the flame, the boiling period commences at once. In this way a very large production is realised; from 6.2 tons to 7 tons of best, and as much as $8\frac{2}{3}$ tons of common iron, being obtained in the turn of 12 hours, the number of heats varying from 13 to 15 in the former, to 16 to 18 in the latter case. The loss experienced is 1.5 to 2 per cent. on the weight of the charge in the best work, but may be as much as 5 per cent. when the furnace is driven hard. The consumption of fuel varies with the

quality, being from 45 to 50 per cent. for the best large coal, 57 to 65 per cent. for small slack, and 60 to 70 with lignite. In addition to this, from 20 to 25 per cent. is required for raising steam, as the stack boilers of the old puddling furnaces are of course done away with.

The form of construction described above, with regenerators above ground, although advantageous in many ways, and more particularly in allowing the regenerators to be easily opened for cleaning, has the defect of requiring a very long gas-passage between the top of the regenerator and the point of combustion, and, therefore, in the newer furnaces, the regenerators are placed underground and at right angles to the furnace proper, an air space being interposed between the roof and the ground, to prevent excessive heat by radiation. By this arrangement the length of the furnace is reduced from 42 ft. to 29 ft. The tops of the air and gas ports and the beds are covered with strongly curved roofs, making capacious combustion chambers. The cast-iron frame-plates are protected by layers of magnesite bricks, which are also used to bring the bridges to the proper height. These latter require renewal after two or three turns. The regenerators require cleansing at intervals of 12 to 15 weeks; they are filled with bricks measuring 12 by 6 by 3 in. (Austrian). One-third of the filling is in Dinas bricks, a second third in ordinary clay fire-bricks, and the last third is common building bricks. When the heating is done with large coal, two slack producers, with a total grate surface of 2·6 square metres, and capable of gasifying 3 tons of fuel in 21 hours are required; but with small slack, four step-grate producers, 4 square metres of surface are necessary, the consumption being increased to 76 cwt. In the former case the grates require to be thoroughly cleaned at intervals of eight hours, but with the step grates and dirtier fuel, one producer must be cleaned every two hours. This is done during the balling period, when the demand for gas is less than at other times, and the furnace is at its hottest. When puddling white charcoal iron and a proportion of greyer coke-melted metal, about 14 heats of about 10·4 cwt. are obtained in 12 hours, from 2 to 3 cwt. of cinder being required for fettling. The rabbling of the charge lasts from 20 to 25 minutes, making up the balls 15 minutes, and their removal 10 minutes, giving a total time of about 50 minutes for the heat. At this rate there is time for 14 heats with 20 minutes to spare in the turn of 12 hours. These figures refer to pig iron free from phosphorus. At the Hermannshütte in Bohemia, where the metal contains 1·7 per cent. of phosphorus, only 10 to 12 heats can be got in the turn of the iron if it is to be properly purified.

From the rapid nature of the work in these furnaces, it has been found better to reduce the turn from 12 to 8 hours, so as to give the puddler 16 hours rest out of the 24. In this way at one work a notable increase in yield and economy of material has been obtained, taking the average output of the year 1887.

FURNACE WITH SLACK PRODUCER.

	Twelve Hours.	Eight Hours.
	Tons.	Tons.
Yield per ton	6·77	7·21
Charge per cent.	102·24	101·20
Coal per cent.	69·20	37·70

FURNACE WITH LARGE COAL PRODUCER.

	Twelve Hours.	Eight Hours.
	Tons.	Tons.
Yield per turn	7·06	7·90
Charge per cent.	102·04	101·20
Coal per cent.	47·00	42·00

Another system of furnace described by the author is that of Jullich, which is used at some works in Bohemia, consuming brown coal from Dux. This is essentially a combination of two large puddling furnaces placed side by side with a dividing wall between them, having a system of regenerators common to both. The flame is divided over the two beds which are heated simultaneously, and mites to pass through the regenerators on the chimney side. The charge is worked on one bed, while that on the other is being melted down, and as soon as the first is finished, the workmen go over to the opposite side when the second charge is ready for boiling. This furnace combines many of the advantages of that of Springer, but is rather more extravagant in fuel. The average results obtained with 9 cwt. charges were 13½ heats in 5·81 tons in 12 hours, with 103·4 per cent. of pig iron and 59·2 per cent. of coal.

The last furnace described is that of Pietzka, which has been introduced at Witkowitz in Bohemia, and Schweschat in Austria. This has two beds like that of Springer, but is not regenerative, being heated by a grate fire with forced draught and heated air, while the exhaust flame passes round a stack boiler in the ordinary way. The bottom plates of the furnace are carried upon longitudinal girders, which are supported by a central ram placed below, so that the whole working part of both beds between the fire and flue bridges can be lowered clear of the roof and turned half round in the horizontal plane. In this way the first charge on the bed at the flue end, which has been melting down during the puddling of that at the fire-place end, is brought into the working position as soon as the latter is finished. With 10 and 11 cwt. charges 6·1 tons were obtained per turn at Witkowitz, and 6·4 tons at Schweschat for 106·6 per cent. of metal and 66·5 per cent. of coal at the former, and 105·4 per cent. and 55·8 per cent. at the latter place. In August 1887, the consumption of coal was as low as 48·9 per cent., which the author considers to be the most economical results yet attained in a grate-fired puddling furnace, as about one-half of that quantity, 27 per cent., was consumed in raising steam, leaving only 28·84 per cent. for the work of puddling proper.

Barrel Chlorination. A Thies, Rep. of the State Mineralogist, California, 1888. Sacramento, 1889, 844, through Abstr. Papers Inst. Civil Eng. 48, iv. 77.

THE author describes the method of barrel chlorination as conducted at the Phoenix mines, North Carolina, and the Haile gold mine, South Carolina. After working for two years with the original Mears process, he found that the results were quite as good without pressure, as with the highest pressure. He has, therefore, remodelled the chlorinator by closing up the hollow trunnion, removing the goose-neck and acid chamber, and substituting a lead valve, connected with the inner lead lining, in such a way that the pressure of free chlorine can be ascertained at any moment. The capacity of the chlorinator is from 1 to 1½ ton of roasted ore. For the Phoenix ores, 40 lb. of chloride of lime, and 50 lb. of commercial sulphuric acid are used per ton of roasted ore. It is found best, however, to add half this charge first, to rotate for three or four hours, and then to add the other half. The Phoenix ore contains a considerable quantity of copper pyrites. At the Haile mine, where the ore is a pure iron sulphide, there are used but 10 lb. of chloride of lime to 15 lb. of acid, and 4 tons of roasted ore are treated in two chlorinators during 10 hours. With the barrel process, 94 per cent. of the assay value of the ore is extracted. The cost of chlorination by this process depends on the number of tons treated per day. Two men can easily treat 4 tons in 10 hours, the cost being as follows:—

	£ s. d.
40 lb. chloride of lime	0 4 10
60 lb. sulphuric acid	0 4 10
Two labourers	0 7 4
One chlorinator	0 8 0
Motive power	0 2 0
Total	1 7 0

or 6s. 9d. per ton. Adding to this 5d. for sulphuric acid for making ferrous sulphate, and 10d. for repairs and wear, gives the sum of 8s. per ton for chlorination, or 18s. 7d. for roasting and chlorinising 1 ton of roasted ore, representing $1\frac{1}{2}$ ton of raw iron pyrites. In less than seven hours from the time the ore is in the chlorinator, the solutions are ready for precipitation and the tailings clean. The wear on the inner lead lining of the chlorinators is inappreciable. Indeed, a chlorinator in use at the Phoenix mine for five years shows no sign of wear.

Supply and Use of Nickel and its Alloys with Steel. Eng. and Min. Journal, 48, 336.

THE most interesting paper and the most instructive excursion of the recent meeting of the American Institute of Mining Engineers at Ottawa related to the Sudbury, Ontario, copper-nickel deposits. The paper was read by Dr. E. D. Peters, manager of the Canadian Copper Company at Sudbury, and it covered an exhaustive description of the deposits, which were originally thought to be of such importance as a source of copper supply that apprehension was felt in some quarters that they would affect the price of the metal. Such, so far at least, has not been the case, though the workings have proved immense bodies of nickel-bearing pyrrhotite, with occasional pockets of copper pyrites. In places this bed has been proved to be 100 feet thick, and its limits have not yet been ascertained. The three mines in the district belonging to the Canadian Copper Company are not uniform in character, and vary considerably in the amount of nickel contained in the ore. The Stobie mine, which possesses the largest bodies of ore, and is worked by open cast, as much as 500 tons being thrown down by one blast recently, is low in nickel, but is valuable from its iron contents, after roasting, as a flux for the ores containing a higher percentage of nickel and copper, but more mixed with gangue.

Mining on this system means cheap production, and we can quite believe that Dr. Peters is correct in his estimate that he can produce from this mine 80 tons a day, at 30 to 35 cents a ton. In the Copper Cliff mine the ore occurs in irregular masses, but is very rich in nickel, and large bodies are developed, carrying from 8 to 10 per cent. in that metal. The Evans mine also has a large body of pyrrhotite, but is more highly nickeliferous than the Stobie. This mine produces about 60 tons of first-class ore a day.

The roasting and smelting arrangements, as might be expected under Dr. Peters' management, are models of ingenuity and efficiency, and the result is that about 40 tons of matte are produced a day, averaging about 27 per cent. of copper and 15 to 18 per cent. of nickel. The furnace work is worth recording, one smelter averaging for months of continuous work 125 tons of ore for 24 hours, and having gone as high as 156 tons. Fuel seems to be the only disadvantage, Connellsville coke being used at the somewhat high cost of about 7.25 dols. a ton, but against this is to be set the judicious handling of the ore and its fluxing qualities, which enables the fuel to carry a burden of 8 to 1.

The result of these operations at Sudbury will be an enormous increase in the world's supply of nickel. The supply hitherto has been principally from the mines of the French company in New Caledonia, and this supply has been regulated to a great extent by the demand, at about 1,000 tons a year, maintaining the price at what the company considered a profitable basis, or rather as high a figure as it could without decreasing consumption, for it has never shown very great profits. The Sudbury production already exceeds the world's consumption, and Dr. Peters has no doubt that he can produce 2,000 tons of nickel a year.

The important question is, will there be a market for this increased supply of the metal even at considerably lower prices than those at present ruling? Mr. James Riley, in a paper before the Iron and Steel Institute on tests made by him of alloys of nickel and steel, furnishes data which convince him that there will be such a market (see this Journal, 1889, 547). It appears that in France a patent has been taken out for these alloys, and Mr. Riley visited the works

at which the process was carried on, and continued his tests at his own works in Scotland with most remarkable and satisfactory results. His data, as usual, are clear, and the results are conclusive, although, as he says himself, several series of tests, involving a very large number of separate experiments, are necessary to a full investigation. We have not space to give in detail here the actual tests carried out, but some of the conclusions arrived at will be sufficient for our steel makers to appreciate the importance of the subject.

The alloy can be made in any good open-hearth furnace working at a fairly good heat. The charge can be made in as short a time as an ordinary "scrap" charge of steel, say about seven hours. Its working demands no extraordinary care, in fact not so much as is required in working many other kinds of charges, the composition being easily and definitely controlled. If the charge is properly worked nearly all the nickel will be found in the steel—almost none is lost in the slag, in this respect being widely different from charges of chrome steel. Any scrap produced in the subsequent operations of hammering, rolling, shearing, &c. can be remelted in making another charge without loss of nickel.

The addition of 4.7 per cent. of nickel raises the elastic limit from 16 up to 28 tons, and breaking strain from 30 up to 40 tons per square inch, without impairing the elongation or contraction of area to any noticeable extent. With only 3 per cent. of nickel somewhat similar results are found, combined with an increase in the carbon to 0.35 per cent.

The hardness increases as the nickel is increased, until about 20 per cent. is reached, when a change takes place, and successive additions of nickel tend to make the steel softer and more ductile. In the hardening and tempering tests Riley shows the possibility of very largely raising the strength and elastic limit, and the hardness of these alloys, but he is not yet prepared, from lack of time, to say to what extent. He has, however, gone up to 95.6 tons breaking strain and 54 tons elastic limit. With regard to torsion tests, it is not necessary to have a steel high in nickel, as those containing only 1 per cent. gave the best results.

In the very important matter of corrodibility, the steels rich in nickel are practically non-corrodible, and those poor in nickel are much better than other steels. The theory of the inventors, from which many metallurgists dissent, is that steel is composed of crystals of metallic iron, cemented together by carbide of iron, and the extra strength given is by the nickel alloying with this carbide of iron to form a stronger "cement," that the space between the crystals of iron is thus more completely filled, and the cohesion between them rendered much more powerful.

The applications and uses of such an alloy are boundless. Its vast increase of strength and elasticity over ordinary steel, its non-corrodibility and hardness alone, open up for it a field in engineering that will render possible what was previously nearly impossible from the masses requisite to attain the object. For example, it seems to bring quite within the bounds of practicability a cantilever bridge over the North River between New York and Jersey City that shall excel even the Forth bridge, with its 1,710 ft. spans and 150 ft. elevation, as a work of engineering skill and beauty. It is only necessary to remember the difference between 30 tons and 95 tons breaking strain, and 17 tons and 54 tons elastic limit.

Some Notes on the Rarer Elements found in the Leadville Sulphurets. F. L. Bartlett. Eng. and Min. Journal, 48, 342.

IN working some low grade sulphurets from the Iron Silver mine, of Leadville, by my new process for the manufacture of pigments, I have made a peculiar discovery, which I believe will interest many. By my process I have been able to eliminate the following list of the rarer elements:—Selenium, cadmium, thallium, gallium, and, possibly, indium and some others. In addition to these, and in connexion with them, I also find mercury, antimony, arsenic, and one unknown substance. It seems to me that the finding of mercury in these ores is new, at least I am not aware that this metal has ever before been found in the Leadville ores.

In order to make the matter plain, it becomes necessary to explain the method of extraction. This, as will be seen, is quite different from anything before attempted. The ores in question were the heavy zinc sulphurets, containing some 35 per cent. of zinc, 6 per cent. of lead, with very little rock. The novelty of the method consists in treating the ores, without previous roasting, to a partial distillation, the fume coming off being cooled and collected in cloth bags. This fume is mostly zinc and lead, but, as can be easily understood, contains many other elements, in fact, must contain about all the volatile matter in the ore, whatever its nature. It will be also understood, that not having been previously roasted, the fume must contain any mercury that may have been in the ore, however slight in quantity, also that the rarer elements closely allied to sulphur will be there. The fume thus collected is subjected to a refining process, which further condenses the rare elements. This refining process consists in subjecting the fume to a red heat in closed tubes, the fume being constantly stirred while under the influence of the heat, the object being to drive off any and all of the lighter elements as sulphur, arsenic, antimony, &c., which might interfere with the colour and quality of the pigment. It follows that if the fume from this last operation be condensed and collected, that this will be the double refined essence of the light volatile elements contained in the original ore.

The amount obtained from a ton of ore in this condensed form is, of course, very small, being, I should say, not more than 2 lb. This condensed material is a mixture of various colours, but when well mixed takes a dull red colour. It has an acid reaction from the presence of sulphuric acid, and has a garlicky odour.

It dissolves in boiling nitric acid, leaving a residue of lead sulphate, and a gummy substance of a peculiar nature which I have not yet been able to determine. This gum does not appear to have come from the fuel used in the original ore treatment; in fact, it is wholly unlike tarry matter, and is incombustible—that is, will not burn—but can be volatilised at a high heat. I have not had time as yet to determine if it is an organic substance or not; of course it is possible that it comes from the fuel. In separating the elements previously mentioned, I have followed the methods outlined by Fresenius. Selenium, cadmium, thallium, mercury, and arsenic are quickly and easily obtained. Indium, as before stated, I am not sure about, and my tests on gallium have not been all that I could desire; still I am quite sure that they are there.

In addition to these elements enumerated, there are certainly others which I am not able to determine, and in working the stuff one is constantly getting precipitates where not expected.

The amount of mercury in the fume varies; it runs from 2 to 10 per cent. The cadmium also varies a good deal, as does the other elements, depending on the manner in which the fume has been collected. All the fume contains more or less zinc and lead, and sometimes free sulphur.

To say the least, this material is an interesting compound, and to anyone who has the time it will well repay one for working upon it.

The writer hopes to be able to make this material a source of extraction, in some quantity, of the elements selenium and cadmium, possibly some others.

In regard to the presence of mercury, I would say that no fuel or other ore has been used with the Leadville ore from which the mercury could by any possibility have come. As a matter of fact, the ore was worked alone, and the fuel was the same as was used before any mercury was found, thus proving that it must have come from the Leadville ore alone.

The writer will be glad to send samples of this compound to anyone having a desire to make an analysis of it. As an assistance to its determination, I will say that the following elements will be sure to be found. How many others may be present I will not attempt to say. Zinc oxide, sulphide, sulphate, and sulphite, lead sulphate, lead sulphide, free sulphur and sulphuric acid (usually), cadmium, selenium, thallium, indium (?), gallium, arsenic, antimony, carbon, and mercury.

PATENTS.

The Production of Alloys of Copper with Iron or Steel and another Metal. L. Q. Brin, Paris, France. Eng. Pat. 13,881, September 6, 1888. 6d.

ALUMINUM iron is melted and to it is added, in any desired proportion, copper or aluminium bronze, for the production of the triple alloy. To avoid loss of metal by oxidation it is desirable to perform the operation in an atmosphere of aluminium chloride, or to use a mixture yielding the same.—A. W.

Process for Alloying Iron and Steel directly with Aluminium in the Blast Furnace. L. Q. Brin, Paris, France. Eng. Pat. 14,287, October 4, 1888. 6d.

THIS is a claim for the direct production of aluminium cast iron by charging layers of a mixture of an aluminous compound and salt, into the blast furnace in which the ordinary process of iron extraction is taking place. The patentee's method of charging the blast furnace is illustrated by a drawing.—A. W.

Improvements in and relating to the Manufacture of Lead from its Ores and Compounds. C. H. T. Havemann, Paris, France. Eng. Pat. 14,331, October 5, 1888. 6d. (Compare this Journal 1889, 197.)

THE patent is based on the fact that lead sulphide is reduced to the metallic state by fusion with caustic soda or sodium carbonate. The former is preferable because a portion of the sulphur is said to be expelled as H_2S instead of forming sodium sulphide, and thus less alkali is required; moreover, the use of sodium carbonate causes the formation of a "double compound of lead and sodium" unless about 10 per cent. of iron be added.

The process is carried out by fusing the lead ore (e.g., galena) with about 25 per cent. of caustic soda, and running off the lead and slag in the ordinary way; the latter is then regenerated by treatment with water and carbonic anhydride or sodium bicarbonate, thereby forming normal sodium carbonate and sulphuretted hydrogen; the liquor is then causticised and run directly on to a fresh charge of ore.

It is claimed that a quantity of lead equal to the assay value of the ore (i.e., about 6 per cent. more than is got by the methods at present used) is obtained.—B. B.

Improvements in Furnaces and Apparatus for Heating Pots and Crucibles. W. G. Foster, Streatham Common. Eng. Pat. 14,391, October 6, 1888. 8d.

See under VII., page 884.

Method of Plating Metals with Aluminium and other Metals, such as Platinum, Gold, and Silver. L. Q. Brin, Paris, France, and A. Brin, London. Eng. Pat. 15,506, October 29, 1888. 4d.

THE metal to be coated is covered with a paste of an aluminium-yielding flux consisting of clay, salt, fluorspar and borax, and is dried in a kiln (this Journal, 1889, 199, 399, and 548). It is then heated to a higher temperature to reduce the flux and melt the plating metal. If the flux does not contain the plating metal, the latter, as a fine dust, is sprinkled over the heated flux-coated metal and the whole is re-fired. Thus the object alloys superficially with the aluminium, and the coating metal is flashed over the alloy so produced.

—A. W.

Improved Methods to alloy Metallic Aluminium with any other Metal. L. Q. Brin, Paris, France, and A. Brin, London. Eng. Pat. 15,507, October 29, 1888. 4d.

THE metal to be alloyed with the aluminium is melted with the aluminium-yielding flux of the previous patent, and metallic aluminium in small pieces coated with the same flux

is added. By this method of procedure it is maintained that an alloy is produced "which is perfectly homogeneous and free from inequality of mixture due to difference of specific gravity," and that loss of aluminium by vaporisation is avoided.—A. W.

Improvements in the Manufacture or Production of Silicium Copper. W. Feld and G. von Knorre, Charlottenburg, Germany. Eng. Pat. 15,572, October 29, 1888. 6d.

COPPER, or its equivalent of oxide, is heated with fossil meal and a substance capable of yielding chlorine or fluorine, whereby chloride or fluoride of silicon is produced, and is acted on by the copper with the production of silicium copper and free chlorine. 150 parts of copper, 50 parts of fossil meal, and 30 parts of salt are made into a paste with tar. The mixture is made into cakes, carbonised by heating to a dull red, and is then smelted with a flux of quartz and lime. Copper containing 8 per cent. of silicon is obtained. Fluorspar may be used instead of the common salt, but is not so advantageous, as the resulting metal contains only 7 per cent. of silicon.—A. W.

Improvements in Preparing Iron and Steel Sheets or Plates previously to Galvanising them (that is, Coating them with Spelter). Davies Bros. and Co., Limited, and E. A. Davies, Wolverhampton. Eng. Pat. 16,489, November 14, 1888. 4d.

IN the ordinary process of galvanising, in which the sheets to be coated are pickled, washed, and passed to the galvanising baths, a comparatively rough coat is obtained, due, in the opinion of the patentees, to the pickling, which acts irregularly on the plates, pitting them to some extent. In order to obviate this it is now proposed to pass the washed plates between cold rolls, run under water or sprinkled by it, by which means irregularities are removed without the plates suffering oxidation. They are then dipped in the ordinary manner. Besides obtaining a smoother surface, a saving of zinc is said to be effected.—B. B.

A Manufacture of Steel alloyed with Copper. H. Schneider, Le Creusot, France. Eng. Pat. 16,569, November 14, 1888. 4d.

THE patentee claims the manufacture of alloys of steel and copper by any method, in any proportions, and containing any quantities of carbon, manganese, and silicon, the alloys being suitable for ordnance armour plates and other military purposes.—A. W.

Improvements in the Manufacture of Iron and Steel, and of Alloys of Iron. W. C. Roberts-Austen, Chilworth, E. J. Ball, and A. Wingham, London. Eng. Pat. 16,671, November 16, 1888. 4d.

THE patentees claim to purify iron, steel, and alloys of iron, particularly from sulphur, by treating the molten metal with a mixture of sodium hydrate or carbonate or lime with any suitable cyanide or ferrocyanide; the lime may be replaced by fluorspar. In the case of pig iron the metal is treated "in a refinery which should be lined with basic material," with a mixture of 5 parts of sodium carbonate, 4 parts of lime, and 1 part of cyanide or ferrocyanide of potassium, in quantity equal to 3–5 times the amount of sulphur to be removed, the fused metal and purifying composition being intimately mixed together.

For steel made by the Bessemer process, the composition is added, together with the ferro-manganese, at the end of the blow after the slag has been poured off, the converter rocked to agitate the charge, and the whole poured in the course of a few minutes. As an incidental advantage, it is claimed that considerably less ferro-manganese than usual is needed. In the open-hearth process the mixture is preferably placed in the ladle and the charge run in upon it, as if added in the furnace the alkaline salts which are volatilised "attack the silica work of the roof and ports."—B. B.

Improvements in Apparatus for the Treatment of Zinc. L. H. Cahaigne, Paris, France. Eng. Pat. 17,324, November 28, 1888. 1s. 3d.

THE apparatus is for purifying zinc by distillation. Four retorts set in two rows, one above the other, are contained in a furnace, and all open into a common condensing chamber. A similar furnace, fitted with the same number of retorts, is placed opposite the first, and its retorts open into the same condenser.

Each retort is provided with a syphon at about the middle point of its height, through which melted zinc can be introduced without permitting access of air, and with a syphon at its lowest part for the withdrawal of non-volatile impurities. The condenser has also a syphon-exit for the distilled metal.

The furnace gases after heating the retorts pass under the condenser in order to keep the zinc in it fused, and their effect may, if necessary, be supplemented by that of gases led direct from the furnace without first passing round the retorts.

In starting the distillation from any given retort, powdered charcoal is first placed in it in order to replace the air by a reducing gas.—B. B.

Improvements in the Treatment of Copper Precipitates. G. Gatheral, Hebburn-on-Tyne. Eng. Pat. 560, January 11, 1889. 4d.

TO purify copper precipitate containing arsenic, it is mixed with a convenient quantity of iron or copper pyrites and calcined in a closed furnace. The arsenic is given off as arsenious acid, which may be condensed. Afterwards the whole is calcined in the open furnace, and the copper extracted by any convenient method.—A. W.

A New or Improved Compound for Use in Welding, Tempering, and otherwise Treating Metals. C. U. Fisher, London. From H. F. Lord, Wyoming, N.J., U.S.A. Eng. Pat. 11,686, July 23, 1889. 4d.

SIXTEEN parts by weight of borax are heated to drive off most of the water of crystallisation, one part of sal-ammoniac, one part of "carbonate of iron," and four parts of plaster of Paris are added, the whole mixed and heated gently "until it is dry." It is then cooled, ground, and packed for sale. It is used for welding steel, and is alleged to restore the good quality of the metal if it has been previously overheated or "burnt." The proportions may be varied.—B. B.

An Improved Process for Treating Iron, Steel, and other Metals, to Prevent Oxidation thereof while in a Heated State. H. H. Lake, London. From G. W. Cummins and J. H. Coleman, New York, U.S.A. Eng. Pat. 13,138, August 20, 1889. 8d.

THE annealing of easily oxidisable metals is usually conducted in air-tight vessels, in spite of which the surface of the articles treated is in some degree acted on by the residual air present. The patentees substitute a reducing or indifferent atmosphere, effecting their purpose in various ways, of which the following is a type:—A cylindrical cast-iron retort is set horizontally in a furnace, raised to incandescence, and filled with coke or charcoal. The products at first evolved (hydrocarbons, water, &c.) are led away to waste, a blast of air is then driven in at one end of the retort, and the gases evolved again run to waste for a short time. When a mixture almost wholly composed of nitrogen, carbon monoxide, and carbon dioxide is being produced, connection with the waste pipe is closed, and the gases led into a worm, where they are cooled, and any water still present condensed. Thence they pass into a drying chamber fitted with shelves laden with fused calcium chloride or pumice soaked in sulphuric acid, and on into the annealing pot. If not immediately required they may be stored in a gas-holder between the worm and the drying-chamber.

A steady stream is maintained through the annealing pot during the whole operation, and the articles, when withdrawn,

are found to be clean and bright and adapted for plating with non-oxidisable metals, or galvanising.

In order that the production of the gas may be continuous, it is found convenient to have two retorts in each furnace, and charge and start one while the other is under blast. The usual composition of the gas employed is nitrogen 68 per cent., carbon monoxide 27—33 per cent., and carbon dioxide from a trace to 4 per cent.—B. B.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

The Thomson Electric Welding Process. W. C. Fish.
Paper read before the Iron and Steel Institute.

THIS paper contains a summary of the history and technique of the method invented by Professor Elihu Thomson (see this Journal, 1889, 288) for the purpose of joining two pieces of metal by the aid of the heat produced by electricity passing through them. The plant for the purpose comprises (1) apparatus for the production of a suitable current, with means for quickly regulating the current; (2) clamps, which are relatively moveable, for holding the pieces of metal so that the pieces can be pressed together. The clamps are connected with the source of electricity, which may be a secondary battery, a dynamo of extremely low armature resistance, or an alternating-current dynamo provided with a transformer. The last method in practice presents many conveniences over the others. The circuit of the transformer, in which the strong welding current is produced, usually consists of a single turn of thick copper bar. The different fluxes employed are similar to those used in the ordinary methods of welding and brazing. In some cases the pieces are slightly rounded at the ends before welding, in order to increase the localisation of heat, to ensure the thorough fluxing of the metals and the expulsion from the weld when pressure is applied of the impurities due to the flux and other causes. As in the old process, the temperature of the welding heat is of importance. In determining the correct temperature, the operator is aided, in addition to the colour of the metal, by the resistance to compression which the pieces exert when the clamps are forced together. The pressure applied generally produces at the weld an enlargement. This can, in some cases, be reduced whilst the metal is still hot, by hammering. Judicious hammering at the weld, particularly with the harder grades of cast steel, is often advantageous, on account of its refining tendency. In welding copper and brass, where there is but a limited range of temperature within which the welds can be made, the necessary pressure can be produced by an adjustable spring, and when the proper temperature is reached, the current can be automatically switched off. As to the tensile strength of welds, the following figures are quoted:—

Materials.	Breaking Strength in Lbs. per Square Inch.	Position of Fracture.
Wrought iron.....	53,119	1·7 in. from weld.
Cast steel.....	81,000	At weld.
Bessemer steel.....	50,584	"
Copper (hard drawn)	31,530	"
" "	32,480	½ in. from weld.
Brass	40,820	At weld.
"	47,730	½ in. from weld.
Steel and German silver....	49,410	At weld.
Cast steel and wrought iron	52,139	3 in. from weld.
Brass and wrought iron....	33,550	At weld.

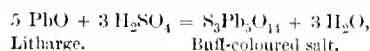
Speaking generally, the tensile strength at the weld is 90 per cent. of the unwelded metal. Only an approximate estimate is furnished of the energy spent in making the welds. In the case of iron and steel, the data shown below is given:—

Ampères per Square Inch required.	Time of Weld.	Product.
3,500	40 seconds	380,000
12,000	30 "	360,000
15,000	20 "	300,000

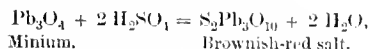
In the last case, the actual power applied at the belt of the dynamo was calculated as about 27 horse-power, the power required for the bar itself (which was of iron one-half inch in diameter) being 5·36 horse-power. There is no danger to the operator, who need not have special electrical knowledge. The advantages claimed for the process are:—(1.) The possibility of welding precious metals and alloys without introducing impurities. (2.) Economy, rapidity of work and convenience and cleanliness compared with the forge fire. (3.) The ease with which irregular shapes can be welded. (4.) The localisation of heat to the weld. Amongst the numerous miscellaneous applications of the process may be named: (1), the welding of wire in the construction of long lengths; (2), the welding of wire ropes and cables; (3), the welding of tires, hoops, bands, and similar endless work, especially links; (4), manufacture of pipes of various metals; (5), general construction and repair work, especially the manufacture of tools where different grades of steel are united; (6), numerous applications in shaping, forging, brazing, local tempering and annealing; (7), finally may be mentioned the possibility of electric riveting. This is accomplished by electrical heating of the rivet when in position to the proper temperature.—W. W. H. G.

Chemistry of Secondary Batteries. E. Frankland. Proc. Roy. Soc. 46, 306.

THE author shows that the processes of charging and discharging a secondary battery consist essentially in the decomposition and formation, respectively, of a sulphate of lead which is not the ordinary white sulphate. By the action of dilute sulphuric acid in excess on litharge and minium respectively (these being the two oxides of lead most frequently used in secondary batteries) he obtains from litharge a buff-coloured salt, according to the equation—



and from minium a brownish-red salt—



He considers that these two coloured salts form the active material of secondary batteries, and gives equations representing the reactions which occur during the charging and recharging of the battery. He points out that only half as much red salt is required on the negative plate as on the positive plate.—W. W. H. G.

An Experimental Theory of Lead Accumulators. G. Roux. L'Électricien, 1889, 411, through Abstr. Papers Inst. Civil Eng. 48, iv, 84.

THE author has endeavoured to determine the true reactions on the positive and negative plates of a lead accumulator, by ascertaining the amount of sulphuric acid absorbed by the plates during discharge, and deducing therefrom the chemical operation involved.

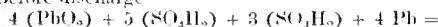
The experiments were made on cells of the Julien type in the following manner:—The negative plate was placed in a porous cell filled with acid of known strength, the positive plate being outside the porous cell also in acid of known strength.

The plates were slowly charged till gas was just disengaged; the acid was now changed, and fresh acid introduced for the discharge, which was continued till the electro-motive force began to fall. The ampère-hours were obtained from the integral curve of current and time. The amount of acid absorbed was then found from the known original volumes and strengths by triturating the resulting liquid with a solution of caustic potash of known strength. The results of a large number of experiments give the following as the weight of normal sulphuric acid absorbed per ampère-hour:—

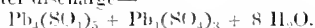
Negative Plate.	Positive Plate.	Both Plates.
Gm.	Grms.	Grms.
1.410	2.293	3.705

The following equation satisfies these results:—

Before discharge—



After discharge—



The experiments therefore point to a sulphating of both plates during the discharge, with a production of water.

The experiments were conducted during the discharge only, because the acid liberated during the charge, in the substance of the plates, takes a long time to disseminate itself in the liquid, whilst the acid is absorbed from the liquid very readily during the charge. (See preceding abstract and Proc. Roy. Soc. 46, 306.)

Electric Conductivity of Saline Solutions. Reciprocal Displacement of Acids. P. Chrontschoff. *Compt. Rend.* 108, 1100–1102.

FROM the results of these electro-chemical researches as displayed in a table, the author concludes (1) that acetic acid is completely displaced by hydrochloric acid; (2) that tartaric acid, combined with soda, is almost entirely displaced by sulphuric acid; (3) that acetic and tartaric acids divide the base; (4) oxalic acid added to sodium acetate divides the base; (5) with $\text{K}_2\text{SO}_4 + 2 \text{HCl}$ the observed conductivity is near the mean of the formula $\text{H}_2\text{SO}_4 + 2 \text{KCl}$, a result not accordant with existing theories.—J. M. H. M.

The Consumption of Energy in Electro-Metallurgical Processes. H. Pontbrière. *La Lumière Électrique* 33, 1889, 251, through *Abstr. Papers Inst. Civil Eng.* 48, iv, 85.

THE author here draws a comparison between the energy consumed in the following modes of treatment:—(1.) Electrolysis with a soluble anode, represented by the Marchese process at Casarza, near Genoa, and at Pont-Saint-Martin in the Aosta valley. (2.) Electrolysis with an insoluble anode. (3.) Thermo-electrolysis, represented by the extraction of aluminium from the molten fluoride by the Kleiner process at Tyldesley, Lancashire, the Bernard and Minet process at Creil, near Paris, and the extraction of magnesium from its chloride, at Humelington, near Bremen, by the Granelt process. (4.) Electro-thermal treatment, represented by the manufacture of enpro- and ferro-aluminium by the Cowles electric furnace, at Lockport, U.S.A., and at Milton, near Stoke-on-Trent, and also by the Heroult electric crucible at Neuhausen, Switzerland. The author treats the question under three heads:—(a.) Energy consumed, or chemical yield; (b.) yield of the ore; (c.) purity of the metal produced.

(a.) *In process* (1).—Two tons of copper were produced in 24 hours from anodes of copper matte, with a composition, in round numbers, of 55 per cent. copper, 38 per cent. iron, and 27 per cent. sulphur. The work produced by the dynamo was 1,963,600 watt-seconds = 1,860 units* of heat per lb. of copper, which, admitting 80 per cent. electrical

efficiency for the dynamo, is equal to 2,330 units actually used. Breaking and screening the ore, and production of steam for lixiviation, use 0.32 lb. of coal per lb. of copper, or $0.32 \times 11,120 = 3,560$ units of heat, so that the total consumption is $2,330 + 3,560 = 5,890$ units of heat per lb. of copper. Considering that the matte is composed in about equal proportions of Cu_2S and CuS , which are to be reduced, about 280 units of heat are theoretically required per lb. of copper, the CuSO_4 in solution is partly electrolysed; also a good deal of $\text{Fe}_2(\text{SO}_4)_3$ is changed to FeSO_4 , so that only about 70 per cent. of the current is of actual use in precipitating the copper. The result is that about 450 units of heat may be reckoned as the energy theoretically required per lb. of copper, so that the bath alone uses $\frac{1,860}{450} =$ about four times the theoretical energy, and the total consumption $\frac{5,890}{450} = 13$ times the theoretical energy required. Allowing that the ordinary treatment of sulphides with 30 per cent. of copper by heat alone requires at least 3 lb. of coal, or 32,400 units of heat per lb. of copper, the energy used is about $\frac{32,400}{450} = 70$ times the theoretical energy required.

(2.) It can easily be shown that the treatment of sulphates of copper by this process requires at least double the energy used for the ores by process (1.).

(3.) On the Kleiner process, 0.0067 lb. of aluminium is produced per electrical HP. per hour, or 381,060 units of heat per lb. of aluminium; the Minet process gives 0.0447 lb. of aluminium per electrical HP., or 54,450 units of heat used per lb. of metal, the large difference being due to the fact that in the Kleiner process the same material is treated several times. The theoretical energy cannot be exactly stated, but the Minet process is about as efficient as the Cowles, while the Kleiner is about six to seven times less efficient.

(4.) The Cowles furnace at Lockport produced 0.03 lb. of aluminium per electrical HP.-hour, and used 4 lb. of charcoal and carbon electrode per lb. of aluminium produced. The first is equivalent to 87,950 units of heat, and the 4 lb. of carbon, burnt into CO , give $4 \times 4,469 = 17,850$, in all 105,800 heat-units per lb. of aluminium. At Milton the result was 63,420 heat-units per lb. At Neuhausen, by the Heroult process, the result was 39,850 units of heat per lb. of aluminium. The heat of formation of Al_2O_3 is about 12,850 units per lb. So that at Lockport $\frac{105,800}{12,850} = 8.2$ times the theoretical energy was used; at Milton $\frac{63,420}{12,850} =$

4.9 times; at Neuhausen $\frac{39,850}{12,850} = 3.1$ times. The author states that there is no reason why the Cowles continuous furnace should not be as efficient as the Heroult process, and then gives particulars of the Deville process, which uses about 45.6 times the theoretical energy required; and he remarks that the energy used with the Catalan furnace in reducing iron ores is about 5.9 times the theoretical energy, and that this is about double of that required with the blast-furnace.

(b.) *Yield of the Ore.*—By the Marchese process, about 92 per cent. of the metal is obtained; by the Kleiner, about the same; in the Cowles furnace, and in the Heroult process, about 66 per cent.

(c.) *Purity of the Metal produced.*—99.7 per cent. of pure copper is guaranteed by the Marchese process; the aluminium obtained by Messrs. Bernard and Minet is almost pure; by the Cowles or the Heroult process the aluminium always contains at least 10 to 15 per cent. of silicon.

In conclusion, the author states that from the point of view of energy used, the electro-metallurgical processes are superior to the ordinary ones, with the exception of process (2.); but for purity of the metal produced process (4.) is much inferior to the other three. He therefore classes them as follows in order of merit:—Thermo-electrolysis, electrolysis with a soluble anode, electro-thermal processes, leaving out altogether electrolysis with an insoluble anode, as being too wasteful.

* The unit of heat employed is the pound-degree Fahrenheit.

PATENTS.

Improvements in and Connected with Electrical Furnaces. R. E. B. Crompton, Chelmsford. Eng. Pat. 13,687, September 22, 1888. 8d.

THE temperature of the furnaces is raised to that of low incandescence by gas-jets, suitably arranged and burning with a non-oxidising flame, before the electric current is switched on, thus reducing the size of the electric plant required for a given number of furnaces.—B. T.

Improvements in Plates or Electrodes for Secondary Batteries. T. J. Hanford, London. From L. Duncan, Baltimore, U.S.A. Eng. Pat. 15,433, October 26, 1888. 8d.

THE lead plates, plain or otherwise, are made anodes in an alkaline solution of a lead salt, such as caustic soda saturated with litharge. By employing a weak current and keeping the liquid well agitated, a strongly adherent and dense oxide of lead is deposited, which is impervious to accumulator acid, and therefore protects the lead support from local action, &c. By now heating the solution and depositing rapidly, a porous coating of oxide is obtained, which serves as the active material: the ordinary methods of pasting and forming may, however, be employed. The protection given by the first coating to the lead support enables the latter to be made lighter and thinner; or other materials than lead may be employed, though these are preferably first coated with lead.—E. T.

Pocket or Portable Secondary Batteries or Accumulators. E. Rousseau, London. Eng. Pat. 15,877, November 3, 1888. 8d.

THE containing cells of these accumulators are made of glass or ebonite; if of the former material, the connecting wires are of platinum, fused into the glass; if the case be of ebonite, they are vulcanised in place. In either case, they are fused into the lead supports of the electrodes and leave the cell below the level of the electrolyte, and preferably at the bottom of the cell, where they are best protected from the gases evolved. The active material is packed between the lead support and a perforated or porous partition or cylinder of celluloid, the latter protecting the cell against disintegration. The lead supports are protected from electrolytic action by the active material, and elsewhere either by proximity to the containing cell, or by an impervious varnish.

Electrolytic gases have first to pass by one or more small apertures into a chamber where they can deposit moisture, and thence escape by another small hole to the atmosphere. The tops of the cells may be closed by an india-rubber bung, cemented into the mouth of the cell and perforated for the vent arrangement. As many cells as are required are packed into a light case and held in position by some such composition as a mixture of resin and pitch. The object is a more durable and lighter cell.—E. T.

Improvements in Electro-Plated Goods and in the Process of Manufacturing the Same. F. A. Oetzmann, London. Eng. Pat. 16,954, November 21, 1888. 4d.

THE parts of electro-plated goods which are most liable to wear are covered with a thicker coat of the deposited metal than the other parts. This extra thickness is preferably put on first, the remainder of the article being protected by a suitable varnish.—B. T.

Improvements in or relating to Dry Piles for Electrical Purposes. G. C. Dymond, London. From L. Moortbarmers, Antwerp, Belgium. Eng. Pat. 17,238, November 27, 1888. 6d.

THE cell is essentially a Leclanché cell, the containing case being of zinc and forming the positive plate, the porous cell

being replaced by a linen bag, and the electrolyte being formed into a paste with chalk or barium sulphate. The linen bag is bound with string to bring its contents into better contact.—E. T.

Improvements in Cells for Secondary Batteries. M. B. Hollies and J. Warner, London. Eng. Pat. 17,537, December 1, 1888. 8d.

THE inventors state that by enclosing their cells and preventing the escape of gases they get greater efficiency, and they describe methods of carrying this into effect.

A cover is fastened down, with a suitable luting, to the top of the cells, or a vessel containing them and capable of withstanding the pressure. This cover is held down by bolts passing through lugs on the vessel, or by metal straps passing round it and holding down the cover by nuts or cottars. In another method, the vessels are circular and have projections which rise above and overhang their tops. The covers are provided with wedge-shaped lugs, which, by rotation of the cover, wedge in under the overhanging projections and so keep the cover down.

The cover may be provided with a safety-valve and pressure-gauge, and have stuffing-boxes through which the connectors pass to the plates.—E. T.

Improvements in the Manufacture of Filaments for Incandescent Electric Lamps. H. H. Lake, London. From J. B. Tibbits, New York, U.S.A. Eng. Pat. 6104, April 9, 1889. 8d.

IN this method a carbon filament is prepared in the ordinary way and soaked in a saturated solution of tungsten trioxide dissolved in any of the fixed alkalis, it is then made incandescent by a current of electricity in an atmosphere of pure dry hydrogen, the result being that metallic tungsten is deposited upon it, which makes it much tougher and more durable. The hydrogen is perfectly obtained by distilling a pure hydrocarbon, such as naphthalene, in a retort and passing the vapour into a chamber containing a coil electrically heated, whereby carbon is deposited and hydrogen liberated.—B. T.

Improvements in Electric Accumulators or Storage Batteries. E. N. Reynier, Paris, France. Eng. Pat. 11,471, July 17, 1889. 8d.

THE active material of accumulator plates is constantly expanding or contracting during the processes of discharging and charging, but the supports do not alter correspondingly, and the result is gradual disintegration. He therefore places porous plates in the spaces between the electrodes, or protects all their faces by thin porous partitions, and employs separating combs or grids of insulating material to keep them apart. The containing case is made of flexible material and the whole is kept compressed by strong springs between pressure plates placed at the two ends of the cell. Instead of employing separate pressure plates and springs for each cell, a whole series of cells may be compressed at once by one set of springs, suitable means being taken to support the cells in the middle of the series. By thus imparting an "artificial elasticity," the inventor hopes to obviate the above-mentioned defect of disintegration.—E. T.

Improvements in Generating Electricity or Magnetism by the Application of Heat. P. M. Justice, London. From E. G. Acheson, Pittsburgh, U.S.A. Eng. Pat. 12,145, July 31, 1889. 8d.

HEAT is applied in a suitable manner to the magnetic mass of an alternate current transformer, and the secondary current is found to be materially increased, or a part of the secondary circuit of a transformer is arranged in inductive relation to a thermo-couple, producing an increase in the electrical output of the couple; or any number of thermo-couples and coils carrying an alternating current may be arranged round a magnetic core with the same effect.—B. T.

A Galvanic Battery Solution. W. P. Kookogey, Brooklyn, U.S.A. Eng. Pat. 12,402, August 6, 1889. 4*d*.

This is an improvement on Eng. Pat. 4667 of 1887, to secure a solution of chromium, sulphuric acid and water as a depolariser. By this improvement the bichromate of sodium, instead of that of potassium, is employed. Three parts of the bichromate are added to 10 of water, and 14 by weight of sulphuric acid added, when, after standing, sodium sulphate is precipitated and the solution is ready for use. The proportions may be slightly varied. Chrome alum, which is detrimental to the working of the battery, is not formed with this solution.—E. T.

A Plate for Secondary Batteries. W. P. Kookogey, Brooklyn, U.S.A. Eng. Pat. 12,731, August 13, 1889. 8*d*.

A PLATE of some material, such as ebonite, glass, or paraffined wood, is formed with taper slots through it and is bolted to a thin plate of lead, with the base of the slots

next the lead. The active material is then pressed into these slots, making contact with the lead at the back. A slotted plate may be placed on each side of the lead conductor, thus preventing all buckling of the lead.—B. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Note on the Examination of Fats. W. Thörner. Zeits. f. angew. Chem. 1889, 309.

THE following table of results is given of a chemical and physical examination of fats and tallow made in the Osnabrück "Control-station." The animal fats were melted out in the laboratory, and all the samples examined were remelted and filtered before testing:—

	Mutton Tallow.	Beef Suet.	Pig's Lard.	Palm Oil.	Palm-nut Oil.	Mixture of Beef Suet and Palm-nut Oil, 1:1.
Melting point of fat.....	55°0	48°0	37°5	25°0	28°0	29°0
Melting point of fatty acids.....	49°0	43°0	29°0	46°0	15°0	20°0
Solidifying point of fats.....	41°0	35°0	28°0	38°0	26°0	28°5
Specific gravity at 100°.....	0·8580	0·8585	0·8605	0·8605	0·8665	0·8650
Ash	0·1	0·04	0·03	0·03	..	..
Volatile fatty acids in terms n/10 alk...	0·4 cc.	0·4 cc.	0·4 cc.	0·22 cc.	2·3 cc.	2·0 cc.
Iodine absorption for fats	32·7	41·8	50·5	53·9	11·9	27·2
Iodine absorption for fatty acids	29·2	37·7	42·4	43·8	16·3	26·6
Saponification equivalent	195·2	201·3	195·2	201·3	231·0	214·2

The author has also determined the refractive index of several kinds of oils and fats by means of a new refractometer invented by Pulfrich, which he highly recommends. The following are the results obtained at a temperature of 60°.

	Refractive Index at 60°.
Water	1·3287
Mutton tallow.....	1·4504
Beef suet.....	1·4527
Lard	1·4539
Palm oil (raw)	1·4501
Palm-nut oil.....	1·4435
Mixture of 1 part of beef suet and 1 part of palm-nut oil	1·4468
Cotton-seed oil	1·4570
Olive oil.....	1·4548
Butter fat (clarified)	1·4477

—H. S. P.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Japanese Lacquer and Wakasa Ware. Board of Trade Journal, VII. 589.

At a recent meeting of the Chemical Society at Washington, R. Hitchcock read an interesting paper on Japanese lacquer and Wakasa ware, of which the following is a brief summary, the paper itself being of considerable length:—

Japanese lacquer is the product of a tree (*Rhus vernicifera*) which grows throughout the main island of Japan. It

attains a large size, and will live for 40 years, but only comparatively young trees are valued for the production of lacquer. Having yielded for several years they are cut down, the lacquer extracted from their branches, and young trees take their places. The best lacquer comes from Yoshino, in Yamato. The lacquer exudes from horizontal cuts in the bark, in the form of a rather viscid emulsion, and may be collected from April to the end of October. In the spring it is more watery than in the later months. It exudes slowly, and is collected by means of a pointed, spoon-like instrument, and transferred to a wooden receptacle or tube of bamboo. Several cuts are made in each tree, the last as high as a man can reach. Having thus prepared a dozen or more trees in rapid succession, the collector begins to collect the juice from the cuts in regular order, beginning with the one first cut. Having finished the collecting, he takes other groups of trees, and after about four days returns to the first, where, after removing the accumulated yield, he cuts again into the same trees, and repeats the same process 15 or 20 times. Thus the work may go on for 80 to 100 days.

As the sap first exudes, it is a greyish white, thick, or viscous fluid, which quickly turns yellow, and afterwards black, where it is in contact with the air. The sap thus collected is *ki-urushi*, *urushi* being the general name for lacquer. An inferior kind is obtained from the branches when the trees are cut down. The branches are soaked in water for several months, then taken up and slightly warmed, when a small quantity of sap exudes. This is *Seshime urushi*. The lacquer is strained through cotton cloth to free it from bits of wood and dirt, first being thoroughly stirred to break up lumps and make a uniform mixture. The product thus purified is known as *Seshime urushi*; but this name, which has already been used to designate the lacquer from the branches, has now a different meaning, and is applied to the cheaper kinds of raw lacquer, such as are used for the first coats in lacquering. These lacquers

have usually lost some of their water by stirring in shallow receptacles exposed to the sun. They have undergone no further preparation.

Many varieties are prepared for special purposes, ranging in price from one or two to six or seven dollars per kilogramme. These differ in quality and colour. There is a famous black lacquer prepared by the addition of iron, which forms a chemical combination to be mentioned further on; while red, green, yellow, and other colours are imparted by the addition of various pigments, as cinnabar for red, orpiment and indigo together for green, orpiment for yellow, &c. Certain lacquers have a small proportion of drying oil (perilla oil) added to them.

The most important and abundant constituent of lacquer is urushic acid, which occurs in the form of minute spherules. The acid is obtained by evaporating the alcoholic solution to a syrupy liquid. The evaporation must be carried on over a water-bath. If too much heat be applied a tough, black, rubber-like substance is obtained, which only strong nitric acid would affect in the slightest degree. Although the drying, or rather the hardening properties of lacquer, are doubtless due to the oxidation of urushic acid, the product extracted by alcohol possesses no drying qualities. This fact was first observed by Professor Rein, in 1874. More recently Professors Korschelt and Yoshida have found that a peculiar albuminoid of lacquer affects the drying by a diastatic or fermentative action. The fact seems to be that the lacquer hardens only when the albuminous substance is present. If heated above 60° C., or above the temperature at which albumen coagulates, the lacquer will not dry. Besides urushic acid and the albuminoid, raw lacquer contains a gum resembling gum arabic, which doubtless imparts some useful properties to the lacquer, and a volatile acid, to which Professor Rein ascribes the poisonous effects of lacquer.

A portion of the raw lacquer, about 16 lb., is poured into a large circular wooden vessel, and vigorously stirred with a long-handled tool for five or six hours while the heat of a small charcoal furnace is ingeniously thrown upon the surface to evaporate the water. During the stirring certain ingredients may be added from time to time. The *roiro*, the fine black lacquer already mentioned, is made by adding iron at this stage. In Tokio a soluble salt of iron is used, but the Osaka manufacturer objects to that, asserting that it injures the quality of the lacquer. The material used in Osaka is the fine iron dust collected from the grinding of knives. This is added in quantities of about a teaspoonful of powder mixed with water at a time, until the desired colour is obtained. When the work is finished the lacquer is poured into a vessel to settle and is afterwards drawn off from the sediment.

The wood generally used for lacquer work is the light, easily worked *hinoki*, a coniferous wood. It is prepared to receive the lacquer in various ways. For inferior work it is first covered with paper, but in the finer qualities paper is not used. These operations apply to the manufacture of that variety of lacquer known as Wakasa lacquer. The wood is first carefully smoothed, and the corners of the boxes strengthened by gluing pieces of cotton or hemp cloth around them with raw lacquer. All joints and imperfections are then filled with *tsugi urushi*, which fills like putty. This is a dark-coloured mixture composed of rice-flour made into a paste with water, and mixed with *Seshime urushi*. It soon hardens, so that it can scarcely be cut with a knife. Sometimes finely cut hemp is used with it. The work is then covered with a mixture of *Seshime urushi*, and a coarse powder of a yellowish colour. The mixture is soft, of a yellowish-brown colour, changing to black by exposure to the air, and is called *jinoko*. The article is left for a few days in the open air to allow some of the water to evaporate, after which it is placed in a moist-air closet to harden. In this way a very hard gritty surface is obtained, affording an excellent ground for the succeeding coat. This process is not applied in making inferior goods.

The next process consists in covering the entire box with two coats of lacquer containing a fine powder, which is a kind of ochre much used in Japan for cleaning and polishing. This is likewise evenly spread. Three coats of this are applied over the joints. The object of this process is to secure an even, smooth-grained surface for subsequent

work. The surface is finally rubbed down with a kind of stone. The parts that are not to receive any decoration are now ready for the finishing applications of lacquer. The other parts are next covered with a black lacquer. Two coats of black lacquer are now applied. The first is *roiro* put on with a broad brush. This dries with a brilliant reflecting surface. When quite hard the second application is made, and in this, while still soft, the designs are impressed.

In the Wakasa lacquer there is no painting or drawing, but the figures are produced in a very curious manner. The white decoration is applied by dropping egg-shell powder in patches here and there. This is done very skilfully by the hand. The other designs are made by pressing various forms of leaves into the soft surface. Thus, the radiating or wheel-like pattern is produced by so arranging the needle-like leaves of the pine, the more complex leaf-pattern with the leaves of an ever-green, while many other effects are made by scattering over the surface husks of rice, and these mingled with very short pine needles. The mother-of-pearl from shells is also used. The designs become more or less modified by the subsequent operations. The lacquer retains the impressions thus produced, when, after the leaves, &c., have been embedded about a day, everything except the egg-shell powder and mother-of-pearl is removed. The article is then put in the moist closet until it is thoroughly hardened, which may require 10 days or a fortnight. The egg-shell is in little heaps, the leaf impressions are beneath the general surface. It is now necessary to fill up all depressions and once more secure an even surface. The first step is to rub down the most conspicuous projections until there is much less irregularity of surface, but even after several successive coats of lacquer there will remain some elevations and depressions. The next application is a transparent lacquer coloured yellow with arsenic sulphide. This is spread as evenly as possible. The object is to afford a yellow ground for the gold which is to follow. A thin coat of *shiu-ai-urushi* is spread over this, and the whole completely covered with gold leaf. Then successive coats of the same lacquer, which is of a transparent red, are applied until the surface is quite even. The surface then appears entirely black, beneath which all the gold and decorations are concealed.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

The Australian Wattle as a Tanning Material. United States Consular Reports, July 1889, p. 253.

ASSISTANT Commissioner Merry, writing from Melbourne, strongly recommends his Government to encourage the planting of the Australian wattle in Texas, New Mexico, and Arizona to replace the rapidly vanishing oaks of the United States, which are, moreover, of too slow a growth to be cultivated for tanning purposes. The wattle belongs to the family of acacias, and is cultivated largely in New South Wales and Victoria. The two varieties most cultivated are the black wattle and broad-leaved wattle, both of which are indigenous to an exceedingly dry climate and poor soil, and attain their growth in about six years. In moist localities they attain a greater diameter of trunk, but their bark yields less tannic acid than that grown in dry situations. The black wattle (*Acacia decurrens*) yields most tannic acid, and is therefore preferred by the trade in England, where its market value fluctuates from 7*l.* 10*s.* to 8*l.* 8*s.* per ton, according to the supply in the market. Mr. Merry states that hides can be readily tanned in a bath of liquor made from black wattle in 47 days, whereas in liquor made from Santa Cruz oak (the best found in all the Pacific States) the time required is from 75 to 80 days. The black

wattle contains from 30 to 32 per cent. of tannic acid, and the following table of percentages will show its relative value:—

	Per Cent.
Black wattle.....	30—32
Broad-leaf wattle.....	26—28
Santa Cruz oak	16—18
Siskey or mountain oak	14—16
Sacramento Valley oak.....	10—12

The broad-leaved wattle (*Acacia pycanthea*) is a larger and handsomer tree than the black wattle, and can withstand more frost, but yields rather less tannic acid.—C. G. C.

XV.—AGRICULTURE, MANURES, Etc.

On the Solubility of Thomas Phosphates poor in Phosphoric Acid. E. Jensch. Zeits. f. angew. Chem. 1889, 299—304.

THE author maintains that poor basic slags, containing from 15 to 16 per cent. of phosphoric acid, are valuable manures in opposition to views expressed by Hofeleiss (Landwirth, 1889, 107), and by Stutzer-Bonn in an essay in the Zeits. d. l. V. für Rheinpreussen (Landwirthsch. Post, 1889, No. 9).

The author in the first place takes the solubility, of the phosphoric acid contained in the slags, in citric acid as a measure of their value as manures, and shows that the phosphoric acid in poor slags is as soluble in this medium as that contained in rich slags, and concludes that the phosphoric acid in both kinds of slags is combined as calcium tetraphosphate, and not as tribasic phosphate, which is difficultly soluble in citric acid. At the same time he has made comparative experiments in various slags with regard to the solubility of their phosphoric acid in tartaric acid, acetic acid and oxalic acid, and in neutral ammonium citrate; he has also tested the solubility of the calcium silicate in the same solvents. The experiments were made upon slags from various works and of different ages, and,

for the sake of comparison, the solubility of Podolian phosphorite and of Somme phosphates was determined. One grm. of each sample was treated for about 12 hours at 50°—70° C. with 150 cc. of the solvent (strength 1:20); 100 cc. of water were then added, the whole boiled, the undissolved residue then filtered off, heated to redness and the phosphoric acid in it estimated in the usual way. A complete analysis of this residue in each case was also made. From the differences between the original analyses of the slags and the analyses of the residues the quantity of each constituent dissolved by the acid was calculated.

The following samples were operated on:—

A.—THOMAS SLAGS.

a. Ground Slags.

1. Stahlwerk Friedenshütte, Morgenroth, Upper Silesia	1885	
2. Do.	1887	
3. Do.	1889	
4. Do.	1889	
5. Königshütte	1886	
6. Witkowitz-Mähren	1886	
7. Sample sent by a farmer	1888	
8. Teplitz	1887	{ Sample taken from waggons.
9. Rheinland	1888	{ Sample from boat-load sent to Breslau.
10. England	1889	{ Obtained direct from works.
11. Scotland	1889	

b. Crushed Raw Slag-Crystal.

12. } Friedenshütte	1888	{ Blue needles.
13. }		{ Brown plates.
14. Kladno-Böhmen	1887	{ Large tabular crystals.

B.—MINERAL PHOSPHATES.

15. Derashnia-Podolia	1886
16. Somme district	1888

TABLE I.—ANALYSES OF SLAGS, &c.

—	Thomas Slags.														Mineral Phosphates.	
	Ground Slags.											Crystals.				
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
P ₂ O ₅	18'21	19'64	18'03	16'26	13'23	16'86	12'41	20'32	16'28	14'83	15'18	36'40	24'81	27'10	38'20	35'29
CaO	54'17	56'03	49'16	48'83	40'04	49'45	39'71	48'07	42'25	44'02	48'63	60'10	62'62	60'81	48'67	50'22
MgO	3'88	3'11	2'46	3'52	1'10	1'26	0'34	0'25	0'44	4'17	3'21	..	..	0'96	..	3'20
FeO	13'04	11'71	13'70	12'10	20'66	9'88	19'02	15'76	17'37	26'06	18'39	0'68	0'10	6'25	..	..
Fe ₂ O ₃ .....					..	5'96	..	..	..			..	1'03	1'72	2'46	
Al ₂ O ₃	2'20	1'70	2'25	3'49	1'11	2'17	2'88	3'76	..	3'58	0'11	0'54	0'44	..	..	..
MnO	3'65	3'20	4'22	0'73	0'96	2'93	3'81	3'44	4'54							
S	0'40	0'32	?	..	0'44	0'61	0'02	0'34	..	0'52	0'44	..	..	..	..	..
SO ₃	0'18	..	0'28	0'44	0'10	0'10	0'51	0'51	0'46	0'11	..	0'01	..	..	..	..
SiO ₂	4'41	5'03	10'04	14'15	22'41	10'08	20'77	6'94	19'49	8'98	9'39	2'24	12'14	3'58	2'18	3'61
CO ₂ .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4'33	2'97
Organic matter	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5'67	1'40
	100'14	98'74	100'14	99'32	100'05	99'30	99'47	99'39	100'83	99'69	98'82	99'54	100'34	100'79	99'77	99'15

Table I. gives the analyses of these samples, and Table II. the percentage of P₂O₅ dissolved by the organic acids.

From these tables it is seen that the solubility of the phosphoric acid contained in poor phosphates is practically the same as in rich; in the richer slags which are used

without hesitation in agriculture the amount of insoluble P₂O₅ varies from 0·02—0·13 per cent., while in the poorer slags it amounts to no more than from 0·04—0·14 per cent. The solubility in oxalic acid shows a similar correspondence, viz., in rich slags the P₂O₅ in the residue is from 0·09—0·26

TABLE II.— P_2O_5 SOLUBLE IN ORGANIC ACIDS.

—	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
Total P_2O_5 in sample.....	18.21	19.64	18.03	16.26	13.23	16.86	12.41	20.32	16.28	14.83	15.18	36.40	24.81	27.10	38.20	35.29
a. Sol. in citric acid.....	18.08	19.60	17.98	16.24	13.15	16.78	12.32	20.30	16.22	14.80	15.04	36.39	24.77	27.08	0.16	0.22
b. „ tartaric acid.....	3.96	4.27	3.91	3.84	2.22	3.63	3.02	6.41	2.87	2.45	2.23	6.49	5.06	5.97	0.02	0.03
c. „ acetic acid.....	5.33	6.21	4.11	4.37	2.46	3.88	3.10	8.12	3.07	2.06	2.64	18.80	17.32	9.17	..	Trace
d. „ oxalic acid.....	18.11	19.52	17.94	16.05	13.06	16.70	12.23	20.06	16.20	14.73	15.06	36.37	24.80	27.03	Trace	..
e. „ neutral amm-citrate..	3.78	3.24	4.09	3.66	1.88	4.01	2.97	3.14	2.90	2.65	3.02	16.72	16.24	5.83	..	..
Percentage of total P_2O_5 remaining in residue..	a.	0.71	0.20	0.27	0.12	0.60	0.48	0.73	0.10	0.31	0.20	0.02	0.03	0.16	0.07	99.58
	b.	78.25	78.26	77.76	76.38	83.22	78.47	75.66	68.90	82.37	83.48	85.19	82.17	79.60	77.97	99.95
	c.	70.73	68.88	77.20	73.12	81.41	76.39	75.02	60.04	81.14	86.10	82.49	48.35	30.19	66.16	..
	d.	0.55	0.61	0.50	1.28	1.28	0.95	1.45	1.28	0.49	0.68	0.69	0.08	0.04	0.25	..
	e.	79.24	83.53	77.31	77.48	85.79	76.21	76.07	84.56	81.57	82.13	80.10	54.07	34.54	78.49	..

per cent., and in the poorer slags from 0.08—0.21 per cent. In the case of the slag crystals the results are even more satisfactory. The solvent action of the other organic compounds experimented with is less complete, but here also a nearly equal relative solubility is shown by the different phosphates. Taking the solubility of their phosphates in citric acid as a gauge of the value of slags as manures, it is at least clear that the poorer slags, without exception, are usable, and the objection to their use is probably to be ascribed to a prejudice which experience will remove.

The author points out that the calcium silicates in basic slags are easily soluble in organic acids, thus differing from mineral phosphates, and he holds that the composition of the silicates in basic slags may be taken as a measure of their applicability as manures. The more basic the silicates the more soluble phosphoric acid is found—or, the more silicon there is in the silicates, the more phosphoric acid is found insoluble in organic acids. He considers the presence of a large excess of free lime of but little importance as affecting the solubility of the phosphates. Magnesia must be taken into account in appraising Thomas phosphates, as magnesium tetraphosphate is more soluble in organic acids than the corresponding calcium salt.

A table is also given showing approximately the composition of calcium silicates contained in the various samples mentioned above, and another table showing the ratio of the phosphoric acid (P_2O_5) to the lime in the silicates.

—H. S. P.

Effect of Phosphatic and Nitrogenous Manuring on Sugar-Beet. F. G. Budweiss. Wiener. landw. Presse, **38**, 1888, 665—666.

RESULTS obtained from numerous experiments with sugar-beet, show that “full” dressings of Chili saltpetre or phosphatic manure give rise to increased yields, whereas

“very heavy” manuring gives rise, in the case of phosphates, to no noteworthy improvement over the “full” dressing, and with nitrates to even detrimental results, so that the results are then lower than those yielded by the unmanured crop. The tables in the paper also illustrate the effect of manuring on the various portions of the plant, phosphates develop the roots, nitrate the leaves; hence where the former prevail the bulk of the root reaches as high as 60 per cent. of the whole plant, whereas when nitrate is in the ascendancy the root forms only 45 to 50 per cent. of the whole weight of the plant. A plant with 60 per cent. of root, 6 per cent. of head, and 34 per cent. of leaf, is regarded by the author as a normal plant.—D. A. L.

Manurial Experiments in the Field and in Pots.

P. Budrin. Biol. Centr. **18**, 375—379.

THE author has conducted numerous experiments in small and large plots in the field, also in pots as employed by Wagner of Darmstadt.

The small plot experiments were made for the purpose of comparing the action of Chili saltpetre and ammonium sulphate. The soil was a diluvial loam poor in humus and contained 0.5603—0.0849 per cent. of N, 0.0304—0.0607 of P_2O_5 , 0.18 of CaO; the beds were 45.5 square metres in extent and 161 in number. The manuring per hectare was 150 to 180 kilos. of Chili saltpetre, 120—180 kilos. of ammonium sulphate, 180—440 kilos. of phosphate or potash manures. The plants grown were potatoes, winter rye, winter wheat, barley, oats, field-beans, flax, and sugar-beet in triplicate or on more than three beds, whilst single beds of summer wheat, summer rye, winter and summer rape, carrots, and clover were also grown. The following table contains the mean results obtained from the more reliable experiments with grain, potatoes, and beans, the mean yield of the unmanured beds being taken at 100:—

—	Chili Saltpetre.								Mean Result with Nitrate N.	
	Alone.		With P ₂ O ₅ and K ₂ O.		And P ₂ O ₅ .		And K ₂ O.			
			Straw.	Corn.	Straw.	Corn.	Straw.	Corn.	Straw.	Corn.
Winter cereals...	..	..	131.1	128.9	128.8	123.3	115.4	111.1	125.3	120.9
Summer cereals..	..	..	134.5	127.5	130.9	124.9	126.3	122.2	131.2	125.5
Field beans .....	..	..	119.7	119.0	112.4	112.0	104.2	115.1	112.0	113.6
—	Starch.	Tubers.	Starch.	Tubers.	Starch.	Tubers.	Starch.	Tubers.	Starch.	Tubers.
Potatoes	Per Cent. 18.2	121.6	Per Cent. 18.0	124.2	Per Cent. 19.5	120.7	Per Cent. 17.5	106.3	Per Cent. 18.4	117.4

—	Ammonium Sulphate.								Mean Result with Ammoniacal N.	
	Alone.		With P ₂ O ₅ and K ₂ O.		And P ₂ O ₅ .		And K ₂ O.			
			Straw.	Corn.	Straw.	Corn.	Straw.	Corn.	Straw.	Corn.
Winter cereals...	..	..	131.9	131.4	125.1	117.5	121.4	116.8	125.0	120.1
Summer cereals...	..	..	144.2	142.5	137.6	138.7	137.0	130.5	137.3	137.0
Field beans.....	..	..	128.5	126.3	106.9	108.7	103.9	104.5	113.1	113.2
—	Starch.	Tubers.	Starch.	Tubers.	Starch.	Tubers.	Starch.	Tubers.	Starch.	Tubers.
Potatoes.....	Per Cent. 18.0	130.1	Per Cent. 17.9	131.2	Per Cent. 18.7	127.1	Per Cent. 17.9	118.1	Per Cent. 18.2	125.1

The results with the grain crops and nitrate and ammonium sulphate alone were not sufficiently numerous to be included in the above table, whilst corresponding experiments with beans were not conducted. By the application of Chili saltpetre and ammonium sulphate the following increments were obtained per kilo. of nitrogen. With grain crops the saltpetre is found better, with potatoes the ammonium sulphate.

Crop Plant.	Crop Increments Obtained.			
	With Chili Saltpetre.		With Ammonium Sulphate.	
	Straw.	Corn.	Straw.	Corn.
Winter rye.....	55	Kilos. 10.2	47.7	Kilos. 8.2
Winter wheat.....	41	8.6	35.7	7.8
Barley.....	45	11.2	41.5	9.9
Oats.....	81	27.0	74.0	24.5
Potatoes.....	Tubers. 115		Tubers. 119	

The manures were sown immediately before the plants. Taking the increase produced by one part of saltpetre nitrogen as 100, the mean increase obtained with ammoniacal nitrogen in a great many experiments would be for cereals:—Total crop, 89.0; corn, 89.5; for potatoes:—129.5.

The field experiments on the large scale were made on a low-lying, alluvial soil, poor in humus, subject to flooding by the Vistula and very fertile. The soil contained per cent. 0.1106 of N, 0.0844 of P_2O_5 , 0.6 of CaO , and was cultivated in a four-course Norfolk rotation (winter wheat, roots, barley, and clover or vetches). The field was divided into four plots; one always received complete artificial manure; another, nitrogen and phosphoric acid; the third, phosphoric acid and potash; the fourth, nitrogen and potash. The following results have been obtained so far. Phosphoric acid produced a moderately good result with roots and cereals; nitrogen exerted a feeble or even injurious action (excessive development of straw to the detriment of the corn) on wheat and barley, and a moderately beneficial effect on root crops, as the following numbers (per hectare) show:—

Sugar-Beet.	Manuring.			
	K_2O , P_2O_5 , and N.		P_2O_5 and N.	
	Double Centners.	Sugar.	Double Centners.	Sugar.
1885	373.5	Per Cent. 14.40	432.5	Per Cent. 16.7
1886	304.2	15.50	261.9	16.0

(continued.)

(continued.)

Sugar-Beet.	Manuring.			
	P_2O_5 and K_2O .		K_2O and N.	
	Double Centners.	Sugar.	Double Centners.	Sugar.
1885	330.3	Per Cent. 15.1	387.0	Per Cent. 15.2
1886	238.8	17.2	240.6	17.2

In the wet year 1885, one kilo. of nitrogen produced an increase of 232 kilos. of sugar-beet, whereas in dry 1886, the increase was 307 kilos.

The author's pot experiments were made with millet, summer wheat, flax, and oats; the loams above described with or without sand; also pure sand were employed as soils. The manuring exerted only a very slight action on the pots filled with loam, either alone or mixed with sand, therefore the author only communicates the results obtained with oats in pure sand. The pots were 32 centimetres high by 24 in diameter. The manuring and results are shown in the following table. In the original the mean length of the plants, the number of seeds per vessel, and a numerical comparison between the unmanured and other pots are also given:—

Manuring.	Total Yield.	Corn.
Unmanured.....	Grms. 14.20	Grms. 4.71
Eight grms. of lupin-flour.....	45.16	21.32
Two grms. of Chili saltpetre.....	47.55	19.86
Two grms. of ammonium sulphate...	42.35	20.20
Chili saltpetre + superphosphate + kainite.....	56.76	22.30
Unmanured.....	13.93	5.83
Sixteen grms. of lupin-flour.....	5.70	1.38
Ammonium sulphate and kainite....	61.85	24.64
Chili saltpetre + superphosphate....	52.23	20.29
Amm.-sulphate + superphosphate...	24.43	9.98

Leaving out the last experiment, which was injured by a fall, and the bad result obtained with 16 grms. of lupin-meal, a kilo. of nitrogen yielded the following increased yields of oats in kilos.:—(For Table, see next page.)

The results with lupin-flour are important, inasmuch as in Russian Poland nitrogen in that form costs half as much as nitrogen as Chili saltpetre. The injurious action of the large quantity of lupin-flour noted in the above table is also observed with many other plants, wheat, rye, buck-

Manuring.	Nitrogen as					
	Saltpetre.		Ammon-Sulph.		Lupin-flour.	
	Total Crop.	Corn.	Total Crop.	Corn.	Total Crop.	Corn.
The nitrogenous manure alone	104.5	45.6	70.6	37.3	69.0	35.6
Along with phosphatic manure.....	122.2	46.9	..	..	..	..
Complete artificial manure.....	133.3	53.2	119.3	48.4	..	..

wheat, flax, &c. But it is only observed when the lupin-flour is sowed on perfectly barren soil and immediately before the plant. For instance, oat plants sowed in the pots after the completion of the above experiment did not suffer, nor did summer wheat and millet which received a heavy dressing of lupin-flour immediately before sowing, but on a loamy soil. Lupin seed or flour would hence be perfectly harmless on ordinary cultivated soil, especially if sowed betimes.—D. A. L.

Comparative Manurial Experiments with Rye. G. Thoms. *Bied. Centr.* **18**, 420—421.

SEVEN experimental cultivations were made, manuring with phosphates as well as stable manure; five showed a profit and only two a loss. Superphosphate was used in six of the experiments and Thomas slag-powder for the seventh. In seven other experiments the manuring consisted of stable manure, superphosphate, and kainite, with the result that only two yielded a profit, whilst five registered a loss. These results indicate that for rye manured with stable manure, the judicious application of superphosphate will yield a profit; whereas the employment of kainite should not be indulged in extensively until the necessity for it has been proved by experiment.—D. A. L.

Peat-Litter Manure. C. Giannetti. *Le Stazioni Speriment. Agrar. Ital.* **1889**, **16**, 1—12. J. H. Vogel. *J. f. Landw.* **1888**, **36**, 455—473.

GIANNETTI obtained the following results with a peat from Ferrara, which was in an almost pulverulent condition and sufficiently dry, although it contained 24.55 per cent. of moisture. The peat was used for 12 days as litter for a cow; it was then examined:—In the first experiment, after three days, when fermentation had already commenced; in the second experiment, after 21 days vigorous fermentation; and in the third experiment, after being mixed with drainage. 200 kilos of peat made 1,300 kilos. of peat-litter manure and then deodorised 150 kilos. of drainage. The following analytical data are given, the numbers being per 1,000:—

	Moisture at 120°.	In the Dry Material.			
		Organic Matter.	N.	K ₂ O.	P ₂ O ₅ .
Original peat	244.5	821.8	29.97	0.75	5.21
Peat manure, I.	641.2	773.7	53.53	9.28	6.15
" " II.	639.6	763.6	58.40	9.44	7.38
" " III.	672.6	861.9	37.72	7.27	10.48

The dampest sample lost 0.7 per cent. of its weight of ammonia by drying at 100°. As the peat-litter is evidently a good absorbent and produces a good manure, it is, moreover, more economical than straw, and costs a third the price, therefore the author recommends its use strongly.

Vogel's experiments were made with peat and human urine. The value of the manure is indicated by the following numbers:—

	Original Peat.	The Manure.
Dry matter	78.29	15.63
Total nitrogen	0.78	0.63
(Ammoniacal nitrogen	0.08	0.20)
Ash	1.90	1.43
Total phosphoric acid.....	0.07	0.15
(Soluble phosphoric acid.....	Trace	0.17)

Two lots, each 10 kilos., of the moist peat manure, were placed in casks, one intimately mixed with 100 grms. of lime, the other without lime. After four months the latter had lost 33.72 per cent. of nitrogen, the former 31.66 per cent., and in neither was any nitric acid detected; but the proportion of organic nitrogen had increased from 34.70 per cent. to 40.04 in the lot with the lime, and to 42.36 in the other lot; which increase is attributed to retrogression of ammoniacal nitrogen. In two experiments, 2 kilos. of peat were saturated daily for 11 days, with 16 kilos. of sheep urine, in one case being mixed with 1 kilo. of the mixture, in the second case with 2.6 kilos.; whilst in a third experiment, 1 kilo. of peat was treated on three different days with sheep urine, and mixed with 1.5 kilos. of the mixture, of which finally another $\frac{1}{3}$ kilo. was added, and the whole spread over a surface of 0.45 square metre, where it remained for 10 days. Lots 1 and 2 were left 14 days in a trough; all three were then examined, with the following result:—

	Weight of Peat Manure.			Nitrogen added as Urine.		
	Theory.	Found.	Lost.	Total.	Found.	Lost in the Air.
1st lot	19.00	16.87	2.13	123.84	123.11	2.73
2nd lot	20.60	19.29	1.40	120.36	116.14	3.51
3rd lot	14.32	13.13	1.19	86.44	79.14	8.45

These results are regarded as excellent, and show the utility of using such a mixture for preventing dissipation of nitrogen from such manures.—D. A. L.

The Chemical Composition of the Aqueous Solutions drawn to the Surface Layers of Field Soils by Capillarity. L. Sostegni. *Stazioni Speriment. Agrar. Ital.* **16**, 1889, 48—49.

SOIL was placed in two zinc cylinders in the same position as it previously held in the ground; the lower part of the cylinders stood in distilled water, whilst packets of filter paper, perfectly free from mineral matter, were placed on the top. The packets were changed every 24 or 48 hours, when the absorption became very small. As soon as the water had reached the surface of the soil in the cylinders the water supply was removed from beneath them. The papers were ultimately washed and the solutions analysed. The mineral matter in the solutions varied between 1.34 and 3.97 per cent., the quantity brought to one square metre of surface in 24 hours being between 1.88 to 3.50 grms. Carbonates, sulphates, chlorine compounds, and nitrates are present in the order given.—D. A. L.

Loss of Nitrogen during Nitrification, and the Gain of Nitrogen in Soils destitute of Vegetation. B. Tacke. *Landw. Jahrbücher*, **1889**, **18**, 439—462.

It is pointed out that results obtained in all previous experiments, showing loss of nitrogen during nitrification,

are open to the objection that the substance undergoing nitrification has never been exposed to an uninterrupted access of air, and consequently the loss of nitrogen might be attributed to reduction of the nitrates already formed. The author has, therefore, made two series of experiments to investigate this point. In one series, the gases evolved during nitrification were examined, in the other series the quantity of nitrogen in the material employed was determined both before and after the experiments. The former series yielded no definite results, but the results of the latter are as given below, and were obtained in the following manner:—Garden or lupin soil was allowed to nitrify in the presence of an abundant supply of air, the latter being first purified from nitrogenous compounds by passing through sulphuric acid and potash, the air, after contact with the nitrifying substance, passed through sulphuric acid, to stop any ammonia, and then into the external air, as any other gaseous form of nitrogen would be considered as lost. The current of air was sustained by a pump. The soils were kept moist by a special arrangement; in some cases they were impregnated with ammonium chloride. The estimations of nitrogen were made in the following manner:—Firstly, to avoid errors due

to sampling a quantity of soil, 100 or 200 grms. was taken, and divided into halves, one half being used for the experiment, the other being reserved for the analyses, which were made as soon as possible. It was found that the small amount of nitric acid—the maximum was 0.003 per cent.—present in the original soil did not interfere with the estimation by Kjeldahl's method, and was of itself unimportant, as the amount produced during the experiments was considerably greater. The soil was, therefore, digested to whiteness with mixed sulphuric and phosphoric acids, oxidised with permanganate, diluted, and part of the filtrate and washings used for estimating the ammonia, which was collected in standard sulphuric acid, and titrated back with baryta water, using litmus as indicator. After an experiment, the soil was extracted with water, and the nitrogen left in the residue estimated in the above manner. For total soluble nitrogen, part of the solution was reduced by Kreusler's method, and then treated by Kjeldahl's method; for the nitric acid, another portion of the solution was evaporated to dryness with milk of lime, the residue dissolved in water, and the nitric acid reduced to and estimated as ammonia. The results are as follows:—

No. of Experiment.	Days Duration.	Material Employed.	Total Nitrogen at Commencement.	Nitrogen added as Ammonium Chloride.	Total Nitrogen after Experiment.	Per Cent. Total Nitrogen present as Nitric Nitrogen.	Gain or Loss of Nitrogen in Percentages of Total Nitrogen.
1	32	50 grms. garden soil	0.2673	0.1819	0.2719	9.24	+ 1.72
2	81	" " "	0.2673	0.1819	0.2942	11.41	+ 10.06
3	77	" " "	0.2219	0.1212	0.2309	33.53	+ 4.06
4	70	" " "	0.2219	0.1212	0.2310	27.40	+ 4.10
5	77	" " "	0.2219	0.1212	0.2263	49.09	+ 2.43
6	132	100 grms. " "	0.2405	0.1212	0.2162	36.51	- 10.10
7	132	" " "	0.2371	0.1212	0.2186	33.87	- 7.80
8	120	" " "	0.1162	..	0.1076	6.54	- 7.40
9	120	" lupin "	0.0909	..	0.0854	6.49	- 6.05
10	132	" garden "	0.1249	..	0.1185	4.96	- 5.12
11	132	" lupin "	0.0911	..	0.0826	6.81	- 9.33
12	67	" garden "	0.1239	..	0.1340	6.38	+ 8.23
13	67	" lupin "	0.0915	..	0.0846	10.93	- 7.54

In some cases, the loss or gain scarcely exceeded error of experiment, but in others the numbers obtained were far beyond this. In no case could nitrous acid be detected in the soils, a result ascribed by the author to a perfect aëration of the soil. The author explains his results on the assumption that two opposing operations were at work in these soils: the one, loss of nitrogen by nitrification, the other, acquisition of nitrogen, in the manner suggested by Berthelot. In support of this, he points out that the conditions of moisture (20 per cent.) in experiments 6 to 11 were such as, according to Déhérain, are favourable for nitrification; but, according to Berthelot, are deleterious to nitrogen-fixing. It thus appears that the two operations go on simultaneously, and the result obtained depends upon the conditions being favourable to the one or the other. The author is of opinion that these results show, firstly, that nitrification, even in presence of an abundant supply of air, is accompanied by loss of nitrogen; secondly, that, as suggested by Berthelot, soils containing micro-organisms can fix free nitrogen from the air.—D. A. L.

Mammalian Experiments with Different Phosphates and Chili Saltpetre on Sugar-Beet. Küthe. Königsberger land. u. forstw. Zeit. 24, 1888, 27.

The author has conducted a series of five experiments in duplicate, and gives a table showing the mean results, from which it appears that increases in both crop and percentage

of sugar were obtained by the use of artificial manure, Chili saltpetre alone yielding the best result, the same quantity of Chili saltpetre, mixed with various phosphates, showing in each case smaller increases over the unmanured. The author, however, has found that Thomas slag is almost equal in effect to half its weight of superphosphate, and that the most favourable manure for sugar-beet is a mixture of Chili saltpetre Thomas slag and superphosphate.—D. A. L.

Top-Dressing Beets with Chili Saltpetre. J. Morávek. Oesterr. landw. Wochenblatt, 1889, 11—12.

A SERIES of experiments were made on a sugar-beet field; one plot remained unmanured; on a second plot phosphates and nitrate were sown broadcast, the former before the seed and turned into a depth of 20 centimetres, the latter immediately after the seed, and without harrowing. The third plot received the same quantities of the same manures, but they were mixed together and sown in the rows. In the fourth plot the phosphate alone was sown in the rows. In the fifth experiment the same quantities of manure were given as in the second and third, but the nitrate was applied as a top-dressing. The beneficial results obtained followed the above order of the experiments, the result from the fifth being the best. In another experiment the same quantity of superphosphate and nitrogen were applied, the latter in the form of ammonium sulphate, with a result about equal to that obtained with the phosphate alone (the fourth above).

Tables of results are given, but there is no reference either to the character of the soil or to the meteorological conditions which prevailed during the experiments.—D. A. L.

The Influence of Gypsum and Clay in Retaining in Open Soil Nitrogen, in Absorbing Atmospheric Nitrogen, and in Nitrification. M. Péchard. *Compt. Rend.* **109**, 445—447.

ORGANIC matter in a fermenting condition was added to a siliceous sandy soil which was kept almost dry for 18 months. At the end of that period there was a considerable loss of nitrogen, and the amount of ammonia and nitric acid remaining was also very small. The addition of a little gypsum reduced the loss of nitrogen from 70 parts per 100 to 58, and when the soil was at the same time kept moist a still greater amount of the nitric acid was found to be present. The ammonia was retained as the sulphate. In any small quantity sodium chloride does not seem to be harmful, but in larger proportion it acts prejudicially. With clay and coarse sand both the nitric acid and the ammonia increased in amount, but with fine sand there was a diminution in the nitric acid. In a mixture of clay and gypsum the loss of nitrogen was much reduced, and with fine sand there was an actual increase of nitrogen as though there had been absorption from the air. The loss of ammonia and nitric acid had also much diminished. Gypsum seems very useful in dry lands poor in calcareous and clayey matter. Its high nitrifying power also renders it very valuable for leguminous crops especially lucerne. Cereals also are benefited by its use. The author points out that agricultural experts have long recommended that gypsum should be added to phosphatic manures to cause them to approximate more closely to the more efficient superphosphates.—S. G. R.

Thomas Slag Fertiliser. United States Consular Reports, August 1889, 509.

PROFESSOR Dr. Wagner, of Darmstadt, has been experimenting on the best methods of employing Thomas slag as a manure. The results obtained are as follows:—The plants experimented with were wheat, barley, and flax, and the manures compared were superphosphate, Thomas slag in various degrees of fineness, "unopened" Peru guano, boiled bone-meal, and powdered coprolites. It was found that in order to obtain the effect which 1 kilo. of phosphoric acid in the form of dissolved superphosphate produced on the first crop after manuring, 2 kilos. of phosphoric acid in the form of slag, 3 kilos. in the form of guano, and 10 kilos. in the form of bone-meal were required. Wagner therefore deduces that so far as the first crop was concerned the Thomas slag was the cheapest, because 2 kilos. of it cost only 40 pfennigs as against 54 to 60 pfennigs for 1 kilo. of phosphoric acid as dissolved superphosphate.

As regards after-effect, in the second year the superiority of Thomas slag was still more marked. Wagner therefore recommends the use of Thomas slag, but insists that it must be derived from a reliable source, that it should contain at least 75 per cent. of fine meal, and that the proportion of fine meal and phosphoric should be ascertained by analysis on a sample of each consignment.—C. G. C.

XVI.—SUGAR, STARCH, GUM, Etc.

The Simultaneous Estimation of Saccharose and Raffinose in Commercial Products. L. Lindet. *Compt. Rend.* **109**, 115—117.

THE method most commonly used for this purpose is that in which the polarisation before and after inversion with hydrochloric acid is noted. The results obtained are not reliable because the rotatory power of inverted raffinose varies considerably with the time of heating and amount of acid

employed in the inversion. The author gives the following method. The sugar solution containing from 10—20 grms. of sugar per 100 cc. is heated in a flask on the boiling water-bath. 20 grms. per 100 cc. of zinc dust are next introduced, and then 20 cc. of strong hydrochloric acid, previously diluted with an equal bulk of water, are gradually added to every 100 cc. of sugar solution. Under these conditions the acid is almost immediately saturated, but has time enough to previously invert the sugars. The quantity of acid may be increased to 40 cc., and the time of heating prolonged to an hour and thirty minutes without affecting the result. Oxide or carbonate of zinc may be used instead of zinc; metallic zinc is, however, to be preferred, because it does not saturate the acid so quickly as the oxide or carbonate; besides which the nascent hydrogen, to a great extent decolourises the solution. The author finds the rotatory power of inverted raffinose to be + 53° at 20° C.; for inverted cane sugar the number is - 20° 1' at 20° C.

The saccharose and raffinose are calculated by means of the following formula, where p and p' represent the weights of the sugar and raffinose respectively, ρ and ρ' the polarisation before and after inversion, α and α' , the rotatory power of cane sugar (67° 3'), and of raffinose (103° 6'), β and β' the rotatory power of invert sugar (- 20° 1') and of inverted raffinose (+ 53°):—

$$p + p' = \rho \frac{N}{\left(\frac{\rho}{p + p'} \alpha + \frac{\rho'}{p + p'} \alpha' \right) l};$$

$$p + p' = - \rho' \frac{N}{\left(- \frac{\rho}{p + p'} \beta + \frac{\rho'}{p + p'} \beta' \right) l}.$$

$$p = p' \frac{\rho \beta' + \rho' \alpha'}{\rho \beta - \rho' \alpha'}.$$

By transposing the value of p in one of the above equations, the value of p' , and therefore of p , is obtained.—H. T. P.

Improvements in the Manufacture of Starch, Dextrin, Glucose, &c. *Dingl. Polyt. J.* **272**, 522—527.

AN interesting paper was read before the "Vereins der Stärke-Interessenten Deutschlands," by Saare, on the "Difference in Quality of Moist Starches." The chief impurities found are fibre, sand, and remains of the pulp water. The water varied from 47·5 to 52 per cent., the average being 48·5 per cent. The impurities ranged from 0·1 to 1·5 per cent., average 0·5 per cent. Sand averaged 0·22 per cent. Fibre was found from 0·01 to 0·3 per cent., average, 0·15 per cent. The impurities soluble in water varied from 0·08 to 0·2 per cent., mean, 0·12 per cent. To prevent the introduction of sand into the finished starch, the portion which settles in the washing tank next to the axis of the stirring apparatus should be removed and not mixed with the rest of the starch. Fibre gets into the finished starch owing to imperfect arrangement of the sieves. Pulp water remains in the starch owing to bad washing. Spoilt and sound potatoes of the same origin were also examined. In the case of spoilt potatoes a considerable loss (34—40 per cent.) takes place during the preliminary washing, besides which a large quantity of slime forms on the sieves, and a dark pulp water, which ferments later on, is obtained. The starch settles very loosely, and after draining contains 67 to 70·5 per cent. of water, whilst starch from sound potatoes contains an average of 48·5 per cent. water. The addition of 1 gm. of sulphuric acid per litre of water causes the starch to separate somewhat cleaner. Calcium bisulphite has a similar, but superior, effect. The fineness of the sieve mesh has also some influence on the purity of the starch obtained. As regards the pulpy mass remaining after the starch has been washed out, not more than 5 per cent. of the starch remaining in it should be removable by washing, and not more than 50—60 per cent. of the dry, completely washed pulp should consist of chemically bound starch.

—H. T. P.

PATENTS.

Improvements in Refining Sugar and Apparatus therefor. A. Baumgarth, Lünenburg, Germany. Eng. Pat. 17,339, November 28, 1888. 8d.

For the purification of sugar in the centrifugal machine, instead of washing the crystals by means of pouring cold water from a can, or by steam jet as is sometimes done, the author uses a very fine spray of cold water produced by a jet apparatus on the injector principle. The agent in producing the fine spray is in this instance, however, compressed air instead of steam. Using this jet at a distance of 1 metre, a centrifugal loaded with 150 lb. of sugar can be treated in $1\frac{1}{2}$ to 2 minutes with 4 lb. of water, "whilst according to the old process it required three times the quantity of water, and at least five times as long a period." A drawing is given of the jet apparatus.—A. J. K.

Improvements in Bagasse Furnaces. W. Fairweather, Glasgow. From The Babcock and Wilcox Company, New York, U.S.A. Eng. Pat. 12,393, August 6, 1889. 8d.

In combination with a bagasse furnace are used auxiliary furnaces directly under the boiler to be fired with wood or other dry fuel, and fitted like the bagasse furnace with side tuyères and passages to admit a forced cold or hot air blast. They may also be worked with a natural draught, and may be worked independently or in connexion with the bagasse furnace. The waste heat from the furnace gases between the boiler and the chimney is used for heating the air for the blast. The object of the invention is to provide means whereby steam may be generated quickly at any time without depending upon the slower process of firing the green bagasse, the combustion of the latter being dependent, in part at least, upon a hot forced draught. The particular arrangement of the compound furnace is fully described with reference to drawings.—A. J. K.

XVII.—BREWING, WINES, SPIRITS, Etc.

Syrman Vermouth Wine. M. Petrowitsch. Zeits. Anal. Chem. 28, 455—456.

This wine is prepared in Syrmia (Slavonia) by digesting ripe grapes with red wine. The same grapes may be employed 2—3 times. Below are given the analyses of a sample of Vermouth wine, and of a sample of red wine similar to that employed in its preparation. The results are expressed in grammes per 100 cc.:—

	Vermouth.	Red Wine.
Specific gravity at 15° C.....	1·037	0·9920
Alcohol	5·75	9·76
Extract	12·49	2·44
Mineral matter	0·27	0·22
Free acid	0·58	0·49
{ Volatile acids	0·10	0·05
{ Fixed acids	0·46	0·42
Tartaric acid	0·2832	0·1704
Glycerol .....	.. ..	0·78
Sugar	10·46	Present.
Line	0·0222	0·0215
Magnesia	0·0252	.. ..
Phosphoric acid	0·0537	0·0486
Sulphuric acid	0·0378	.. ..

The high percentage of volatile acids may be ascribed to the mustard-flour which is added to the grapes.—H. T. P.

Rectification of Alcohol. E. Sorel. Compt. Rend. 108, 1128—1131, 1204—1207 and 1317—1320.

An attempt to explain, on mathematical principles, the fact that the stronger the alcohol delivered from the analyser of a spirit still, the more free it is from impurities of higher boiling point and the greater the quantity of good quality alcohol obtained in the first fraction.—J. M. H. M.

Copper in Wine. Zecchini and Ravizza. Le Stazioni Speriment Agrar. Ital. 16, 1889, 73.

AUTHORS find that where vines have been treated with copper preparations, the grapes in 1886 harvest contained 0·0055 grm. of metallic copper per kilo., whilst the wine contained traces to 0·1 milligramme of copper per litre. (See also this Journal, 1889, 406.)—D. A. L.

Honey Fermentation. Chemist and Druggist.

M. GASTINE, after experimenting with hydromel and other fermented honey preparations, has come to the conclusion that the reason why fermentation so often fails is that honey is too pure to afford to yeast cells the mineral substances necessary to their development. He has found that on adding to honey solutions less than 0·5 per cent. of a mixture composed of ammonia, potash, and calcium phosphates, tartrates and sulphates, when yeast is introduced under the ordinary conditions, complete and rapid fermentation is readily obtained. The proportion of the various salts is not very different from that found in ordinary grape-must, only their quantity, as compared to the total liquid, is a great deal smaller; which explains at the same time why the making of hydromel will succeed so well in old wine tuns and fail in new vessels.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A)—CHEMISTRY OF FOOD.

A New Artificial Coffee. E. Fricke. Zeits. f. angew. Chem. 1889, 310—311.

The sample examined by the author differed from that described by J. König (Zeits. f. angew. Chem. 1888, 680) in appearance and composition. In appearance it was not nearly so much like real coffee. An analysis gave the following results on the dried sample:—

	Per Cent.
Crude proteins.....	17·90
Fat.....	2·03
Ash.....	2·27
Woody fibre	10·83
Caffene.....	0·94
Sugar.....	1·90
Non-nitrogenous extract	61·04
Matter soluble in water.....	24·85

The microscopical examination showed the presence of lupin seeds and of cells of the outer skin of some kind of grain, together with hairs probably derived from wheat grains. The presence of caffeine does not suffice to make this artificial coffee a substitute for coffee, as the value of coffee is quite independent of its contents of caffeine, and is more particularly dependent on its aroma. The bitter principle in lupin seeds is known to be injurious to man, and even if means were taken to destroy this by fermentation or steaming, it could scarcely be done with such certainty as to render the lupin seeds safe for admixture.—H. S. P.

PATENTS.

An Improved Method of Treating Rice and other Grain for Removing the Outer Skins or Coverings thereof. W. Shedlock, London. Eng. Pat. 15,499, October 27, 1888. 8d.

For the purpose of removing the outer skins or coverings from rice and other grain, the grain is usually submitted to a process of mechanical rubbing, known as the "attrition process." The object of this invention is to facilitate the above process by the simultaneous action of suitable gases such as, for instance, superheated or dry steam. Apparatus suitable for carrying on the improved process is described in the specification with reference to drawings.—A. J. K.

Improvements in the Preparation of Grain for Food. H. Hart and F. C. Hawtin, London. Eng. Pat. 17,129, November 24, 1888. 4d.

The object of the invention is to prepare a food in which the bran is entirely reduced to powder. The grain is first ground or crushed, then mixed with cold water to form a dough, rolled into thin sheets, and baked. By this process the gluten of the wheat binds the whole into a hard and brittle cake, which is then broken up and ground to a fine powder.—A. J. K.

(B)—SANITARY CHEMISTRY.

The Influence of Ventilation on the Micro-Organisms in Suspension in the Atmosphere. R. Stern. Zeit. für Hygiene, 1889, 44, through Abstr. Papers Inst. Civil Eng. 48, iv. 35.

NOTWITHSTANDING the numerous investigations that have been made to determine the numbers of germs present in the air of dwellings, and the effects of disinfectants upon such germs in sick rooms, &c., the author states that no attempts have hitherto been made to ascertain how far it is possible, by means of ordinary ventilation, to expel the micro-organisms from an enclosed space, and to disinfect the air by this simple means. To endeavour to elucidate this question, the author, on the suggestion of Professor Flügge, undertook a series of experiments at the Breslau Hygienic Institute. These experiments were directed to ascertain, further, the effect of steam upon germs floating in the atmosphere, and to test how far it might be possible, by means of air-currents due to ventilation, to remove germs from floors, carpets, and clothing. The room used for the tests was situated on the third floor of the house; it had two doors and two windows, and contained 85.41 cubic metres. The arrangements made to seal the openings and to admit and exhaust the air are described, and the mode of generating the air-currents by gas-jets and water-sprays is explained. The maximum yield of the ventilation was 2,250 cubic metres per hour, equivalent to a renewal of the air in the room 27 times, but the currents could be controlled and reduced to any extent. Experiments were made with very fine dust, specially prepared, and obtained from schools and factories; this dust was impregnated with the spores of the *Bacillus megatherium*, because this bacterium, on account of its unusual size, can readily be distinguished from others under the microscope. Other experiments were made with the spores of *Aspergillus niger* alone. The dust was disseminated through the chamber by means of a spray-producer and a Japanese fan. The spores were collected on a sand filter on the plan proposed by Petri, and cultivated on a mixture of agar-agar and gelatin. Tables of the various results are appended, and the author sums up the experience gained as follows:—

(1.) In still air the germs sink rapidly to the ground; when school-room dust is used, the atmosphere, even in the course of one hour and a half, becomes nearly germ-free. When still finer particles are used (such as the finest wool-fibre, rag-dust, and mildew spores), a longer time is of course required.

(2.) With ordinary ventilation, corresponding to a renewal of the air from once to thrice in the hour, the air does not apparently become free from germs more rapidly than it

would do by simple deposition alone (there is one slight exception in the case of a descending current in the winter time).

(3.) A more rapid rate of air-renewal, but such as is scarcely practicable without giving rise to draughts, gradually increases the influence of the ventilation on the suspended germs. The lowest limit at which such an effect begins to take place would seem, from the experiments, to be such a rate as would renew the air from six times to seven times in the hour.

(4.) A rapid and complete removal of the germs from the atmosphere of dwellings can only be effected by a violent draught.

(5.) No considerable number of germs can be detached from the surface of floors, carpets, furniture, clothing, &c., even by causing the room to be traversed by strong draughts.

(6.) The generation of steam does not effect the speedy and complete deposition of suspended germs, and it only hastens the same to a slight extent.

The Physical Action of Precipitants upon Micro-Organisms present in Water. B. Krüger. Zeits. für Hygiene, 1889, 86, through Abstr. Papers Inst. Civil Eng. 48, iv. 36.

THE fact that the germs believed to be the active agents in producing certain diseases are capable of existing for some time in water has caused the bacteriological examination of rivers, streams, and lakes to assume new interest and importance, more especially, too, because it is from these sources that the water-supply of numerous towns is derived. Investigations have shown that more bacteria are usually present in rivers than in lakes. Cramer found, as the mean of 50 experiments between October 1884 and January 1885, that 168 germs per cubic centimetre were present in the Lake of Zurich; in the water of the Lake of Lucerne, on one occasion, only 8 germs were found, and on another, 51 in the cubic centimetre, while in a like quantity of the water of the Lake of Geneva, as the mean of 10 tests, 38 bacteria were found to be present. The figures are far different in the case of lakes into which rivers flowing past populous towns discharge themselves; thus, according to Frank, the contents of the water in Lake Havel, between Potsdam and Spandau, varied at different seasons from 10,600 micro-organisms per cubic centimetre in January to 326,000 in August. From a glacier-stream Schmelek obtained from 4 to 6 bacteria per cubic centimetre; Rosenberg found, as the mean of nine tests of the water of the main above Würzburg, 662 germs in February and 823 germs per cubic centimetre in March; and the Rhine contains, between May and December, an average of 20,000 bacteria per cubic centimetre. The author discusses the various sources from which these germs are derived, the rainfall, the soil, &c. The sewage of towns is a most fertile cause of the presence of micro-organisms in river-water, many examples of which are given. The germs, after their introduction into the water, may multiply considerably, in accordance with the temperature, supply of food-stuffs, &c. Instances are given in support of this fact, and the converse also holds good; when temperature falls, or when the nutritive matters are altered in character or reduced in quantity, the germs diminish in numbers. The rapidity with which micro-organisms disappear in lakes may possibly be due to the effect of direct sunlight, the influence of which may be unfavourable; but the tendency to deposition or precipitation is of greater moment, and may perhaps play an important part in the self-purifying power of water.

The results of experiments by Bolton, Hüppe, and Frankland, in support of this settling power of micro-organisms, are discussed, and the author, finding that none of the recorded observations were entirely conclusive, decided to undertake a series of tests in order to ascertain what effect in carrying down the germs would be produced by the precipitation of matters, which neither in themselves furnished nutriment to bacteria nor had any chemical action on the water.

For these experiments he employed tall glass cylinders 21 centimetres in diameter, and 57 centimetres in height, with a content of 20 litres. The jars stood in a cellar with a temperature varying from 10° to 13° C. in summer,

and from 7° to 10° C. in winter. The water employed in all cases was service water drawn from the tap, and contained from 20 to 40 bacteria per cubic centimetre. This water was impregnated with from 50 to 120 cubic centimetres of a liquid containing a bacillus-culture of a species found in the service water. This is fully described, as also all the precautions taken in its preparation and admixture with the test liquids. The substances used as precipitants were sterilised, reduced to a fine powder in a mortar, and passed through a sieve with 900 meshes per square centimetre. The precipitants employed were clay, carbonate of lime, infusorial earth, alumina, brick-dust, charcoal, coke, and sand. Tables are given of the results with each substance, and of the number of germs near the surface, at the middle, and at the bottom of each vessel when filled with treated and untreated water. The conclusions arrived at by the author are that finely divided, chemically inert substances, when introduced into water, take down with them to the bottom the greater part of the bacteria present. The action is the more intense the slower, within certain limits, that the deposition takes place, and the greater the quantity of the precipitant employed.

In order to test the difference between the above inert substances and those capable of exerting a chemical action on the water, another series of experiments was conducted with magnesia, hard wood ash, lime, and lime and raw sulphate of alumina. Here again the results are set forth in a tabulated form, and the author's conclusion is as follows:—

“Although, as will be seen from the experiments, there is no doubt that large numbers of bacteria are carried down by substances sinking through water, this action is far more considerable when, in addition to the merely physical deposition, a chemical precipitation supervenes. In the purification of water, therefore, preference should be given to chemical treatment, and inert substances should merely be regarded as mechanical aids to the precipitation.”

Lead Poisoning by Water. Ironmonger.

IN connexion with the occurrence of lead poisoning by means of water at Sheffield, Chesterfield, and other places in England, it is of interest to note a similar state of things at Dessau, Germany, together with the effects of the remedies employed at that town. The water at Dessau previous to its distribution was absolutely free from lead, yet as many as 92 cases of lead poisoning took place, and an investigation demonstrated that the illnesses were owing to the lead taken up by the town water in the course of its distribution. The general average of a large number of analyses of the water as first drawn from the pipes showed 4.463 milligrammes of oxide of lead per litre. This quantity of lead could only be acquired in one of the following ways:—(a) Owing to the composition of the metal used for the pipes; (b) owing to certain effects of weather; (c) owing to galvanic action; or (d) owing to the composition of the water itself. Carefully conducted experiments were made in order to determine the real cause of the mischief. It was proved that when metallic tin was introduced into a lead pipe more lead was invariably dissolved, from which alleged fact it is argued by the German investigator that tin-lined lead piping is “dangerous.” But it was found finally that the mischief arose from the freedom from hardness of the water itself—a conclusion, it will be remembered, which was reached also at Sheffield. The total hardness of the water was only 2.5° to 2.8° of the German scale, each degree being equivalent to 10 grms. of lime per cubic metre. When the hardness of the water was increased to 5° or 6° by agitating the water with finely-powdered limestone it no longer dissolved lead, but the reaction was proved by subsequent experiments to be due, not to the greater degree of hardness, but to the removal of the carbonic acid gas, the absence of which rendered the water incapable of dissolving lead. Various experiments were made in order to get rid of the gas, and finally an apparatus was arranged to mix the powdered limestone and the water automatically. The apparatus treats about $\frac{1}{25}$ part of the water-supply with about 200 cubic centimetres of the powder every two minutes, and the water

so treated then mixes with the rest of the supply. This arrangement is said to have effected a complete removal of the mischief, and lead in solution has almost entirely disappeared from the water-supply of Dessau.

(C)—DISINFECTANTS.

The Disinfecting Properties of Creosote. C. Fränkel. Zeit. für Hygiene, 1889, 521, through Abstr. Papers Inst. Civ. Eng. 48, iv, 39.

LAPLACE had first shown that the disinfecting power of solutions of corrosive sublimate and phenol is very considerably increased by the addition of acid, and he demonstrated the fact that the so-called 25 per cent. carbolic acid, which is inert and comparatively useless for disinfecting purposes owing to its insolubility, is, when treated with sulphuric acid, converted into a powerful disinfectant, soluble in water and watery fluids. The author had occasion to repeat the experiments of Laplace, and used for this purpose a mixture of equal weights of raw (25 per cent.) carbolic acid and pure concentrated sulphuric acid, slowly added to one another with due precautions, to avoid excessive heating. In first making the mixture without these precautions, great heat was evolved, but when care was taken to cool the vessel, and to add the sulphuric acid slowly, a sulphocarbolic acid was produced, which was tested separately to that which had become heated. Both samples were tested as 5, 4, 2, and 1 per cent. solutions, and, for the purpose of comparison, similar solutions of pure crystallised phenol and of concentrated sulphuric acid were examined in a similar way. The test objects were anthrax spores dried on to silk threads, and the cultures took place at blood-heat in prepared bouillon. The results are set forth in a table, and show the marked superiority of the mixture prepared cold to that which was allowed to become heated. The general results differ in many respects from those obtained by Laplace, and the author considers that this may be due to the nature of the anthrax spores used, for it is now known that certain varieties of these spores have much greater powers of resistance than others; and a mode of testing the powers of endurance of such spores is proposed, namely, by the period they can resist a 5 per cent. solution of pure crystallised phenol. Those spores which can survive a 20 to 40 days' exposure to such a solution to be classed as “highly resisting”; those withstanding an exposure of from 10 to 20 days as “moderately resisting”; and those destroyed in less than 10 days as “weakly resisting.” The reason of the superior action of the cold preparation of the acid mixture is discussed, and is considered to be due to certain highly poisonous compounds described by the author.

Experiments on the Practical Disinfection of Excrementitious Substances. S. von Gerlőczy. Deutsch. Vierteljahrsschr. für öffentl. Gesundheitspflege, 1889, 433, through Abstr. Papers Inst. Civ. Eng. 48, iv, 40.

THESE experiments were carried out in the course of the past year at the Pesth Hygienic Institute, in order to test the real values of the various substances employed as disinfectants, concerning which much difference of opinion had been expressed. The author divided the matters to be disinfected and deodorised into five groups, viz.:—(1), night-soil from cess-pits; (2), liquids from sewers; (3), solid contents of street gulleys; (4), dry road scrapings; and (5), fresh excreta of patients suffering from acute diarrhoea and typhoid fever. The disinfectants used were:—(1), corrosive sublimate; (2), iron sulphate; (3), zinc sulphate; (4), copper sulphate (for comparison); (5), crystallised carbolic acid; (6), raw carbolic acid (two descriptions of which are obtainable, that employed by the author, known as 50 to 60 per cent. solution, actually contained 18.7 per cent. of carbolic acid); (7), carbolised lime, commercially known as 5 per cent., but yielding on analysis 2.1875 grms. of carbolic acid per 100 grms.; (8), creolin; (9), α -oxynaphtholic acid. On the score of their extreme cheapness, the author used also—(10), raw concentrated sulphuric acid; (11), freshly slaked lime; (12), boiling water; (13), hot and cold solutions of wood-ash lye (specific

gravity of the lye 1.037, equivalent to 4 per cent. of carbonate of potash); (14). solution of common salt, containing 26.1 per cent. of salt. Specimens of the disinfected materials were withdrawn on a platinum needle, and introduced into warm fluid peptone-gelatin. The cultivation took place both at ordinary temperatures, and also at a temperature of from 35° to 37° C.

The specimens were examined at intervals of 24 hours, 48 hours, and from three to four days after treatment.

Group I.—*Night-soil*.—Samples for experiment were obtained from a night-soil removal contractor; 100 grms. were placed in a glass vessel, and treated with weighed quantities of each of the disinfectants enumerated, in various proportions. The results are set forth in detail, and they show that a practical disinfection of night-soil is all but impossible, as even 2.5 per cent. of corrosive sublimate is insufficient to render it germ-free; this quantity would entail a cost of 150 gulden per cubic metre (9*l.* 11*s.* 1*d.* per cubic yard). Complete sterilisation resulted from the use of a 4 per cent. solution of copper sulphate, and it would appear from this that with this material 1 cubic metre of night-soil could be disinfected at a cost of 12 gulden (1*l.*). For the purpose of deodorisation, the use of raw carbolic acid may be regarded as successful.

Group II.—*Sewage Water*.—Was treated with the foregoing disinfectants in a similar way, full details of the experiments being given. Here again the author draws attention to the extraordinary value of copper sulphate, a solution of 1 per mille sufficed to destroy all germs, and rendered the liquid clear and inodorous.

Group III.—*Sudge from Gulleys*.—The series of experiments recorded shows the extreme difficulty of disinfecting thoroughly this substance. For deodorisation, carbolised lime in moderate quantities sufficed, but the author recommends the use of raw carbolic acid diluted to 1 per mille.

Group IV.—*Street Sweepings, &c.*—Owing to the last cholera outbreak in Pesth the authorities ordered that carbolised lime should be freely used in the dwelling-houses, and they caused it to be strewn along the roads, against walls, under doors, and over gully-holes. The author therefore carried out special experiments to test the value of this treatment, and to ascertain how far it might be possible to practically disinfect road sweepings. Treated with the foregoing disinfectants it became manifest that complete disinfection was out of the question. Even where thoroughly soaked with solutions of corrosive sublimate, copper sulphate, &c., the road dust was far from sterile, nor did experiments with respect to the strewing of carbolised lime yield satisfactory results. The advantages of this mode of disinfection are illusory.

Group V.—*Disinfection of Excreta*.—In certain cases it becomes of the utmost importance to thoroughly and rapidly sterilise the dejections of patients. The excreta used for these experiments were in all cases diluted with three times their weight of water. All the various disinfectants were tried in different proportions, and the results of the experiments are recorded. The conclusions arrived at by the author are:—That a strong solution of copper sulphate should be used, at least 1 gm. of the disinfectant being added to 100 cubic centimetres of excreta; but still better results arise from the employment of thrice their weight of boiling lye (2 parts of water to 1 part of wood-ashes). Milk of lime (1 part of slaked lime in 20 parts of water), used in the proportion of $\frac{1}{2}$ to $\frac{1}{10}$ of the weight of the excreta, likewise disinfects cheaply and well.

XIX.—PAPER, PASTEBOARD, Etc.

The Behaviour of Wood and Cellulose at High Temperatures in Presence of Water. H. Tauss. *Dingl. Polyt. J.* **273**, 276—285.

THE materials used in these experiments were pure Swedish filter-paper and fine chips of beech and pine woods. The extractions at the ordinary pressure were performed in glass vessels, those at increased pressures in a Möncke's digester. The extracts obtained were always more or less yellow in colour, turning brown on exposure to air, and deposited on evaporation a black, resinous precipitate, soluble in alkalis. This precipitate was filtered off and the solution further examined. The solutions contained more or less solid matter and all reduced Fehling's solution. They yielded a small extract to ether, which gave a colour reaction with phloroglucol and hydrochloric acid. The cellulose extracts all gave a red colouration with phloroglucol, similar to that given by dextrose. The wood extracts yielded a blueish-violet colouration.

1. *Extraction of Wood and Cellulose at the Normal Pressure*.—20 grms. of cellulose were boiled with 1 litre of distilled water and yielded only traces of extract; however, the concentrated solution distinctly reduced Fehling's solution. Phloroglucol and hydrochloric acid gave a red colour.

20 grms. of beech, boiled three times, each time with 1,000 cc. of water, for three hours, gave:—

Solid Matter.	1.	2.	3.	Total.
On 20 grms.	0.76	0.44	0.25	1.45
On 100 grms.	3.80	2.20	1.25	7.25

Containing sugar reckoned as dextrose:—

—	1.	2.	3.	Total.
On 20 grms.	0.313	0.140	0.02	0.473
On 100 grms.	1.565	0.700	0.100	2.365

Phloroglucol gave a red colouration.

20 grms. of pine wood boiled for three hours with 1,000 cc. of water gave:—

Dry Residue.	1.
For 20 grms.	0.236
For 100 grms.	1.180

Containing sugar—

For 20 grms.	0.035
For 100 grms.	0.175

Reaction with phloroglucol as before.

2. *Extraction at 5 Atmospheres Pressure*.—20 grms. of cellulose, with 1,000 cc. of water, heated three hours:—

Solids.	1.	2.	3.	Total.
On 20 grms.	0.148	0.080	0.049	0.277
On 100 grms.	0.740	0.400	0.245	1.385
Sugar:—				
On 20 grms.	0.021	0.0025	0.0012	0.0247
On 100 grms.	0.105	0.0125	0.0060	0.1235

Phloroglucol and hydrochloric acid gave a red colouration.

20 grms. of beech treated with 1,000 cc. of water for three hours:—

Solids.	1.	2.	3.	Total.
On 20 grms.	4'32	0'800	0'25	5'35
On 100 grms.	21'60	4'00	1'25	26'75
Containing sugar:—				
On 20 grms.	1'971	0'237	0'03	2'238
On 100 grms.	9'85	1'185	0'15	11'190

Under the same conditions 20 grms. of pine wood gave:—

Solids.	1.	2.	3.	Total.
On 20 grms.	3'08	0'613	0'142	3'835
On 100 grms.	15'40	3'065	0'710	19'175
Containing sugar:—				
On 20 grms.	1'60	0'20	0'015	1'815
On 100 grms.	8'00	1'00	0'075	9'075

Both yielded blue or bluish-violet colourations with phloroglucol and hydrochloric acid.

3. *Extraction at 10 Atmospheres.*—10 grms. of cellulose + 1 litre of water heated for three hours gave:—

Solids.	1.	2.	3.	Total.
On 10 grms.	0'944	0'384	0'020	1'348
On 100 grms.	9'44	3'84	0'20	13'48
Containing sugar:—				
On 10 grms.	0'394	0'145	0'010	0'549
On 100 grms.	3'94	1'45	0'10	5'49

Phloroglucol gave the dextrose reaction distinctly.
10 grms. of beech treated as before:—

Solids.	1.	2.	3.	Total.
On 10 grms.	1'368	0'412	0'061	1'841
On 100 grms.	13'68	4'12	0'61	18'41
Containing sugar:—				
On 10 grms.	0'424	0'086	0'021	0'531
On 100 grms.	4'24	0'86	0'21	5'31

10 grms. of pine wood treated same way gave:—

Solids.	1.	2.	3.	Total.
On 10 grms.	1'178	0'312	0'120	1'610
On 100 grms.	11'78	3'12	1'20	16'10
Sugar:—				
On 10 grms.	0'340	0'085	..	0'425
On 100 grms.	3'40	0'85	..	4'25

With phloroglucol and hydrochloric acid, blue-violet colours were obtained.

4. *Extraction at 20 Atmospheres.*—At this pressure cellulose was completely changed, being turned into a jelly-like mass, which on drying could be powdered. Its elementary composition was:—

	Per Cent.
C	42'37
H	6'30
O	51'33
	100'00

The cellulose had been hydrated to hydrocellulose $C_{12}H_{22}O_{11}$. Phloroglucol turned it red.

10 grms. of beech exposed to the same temperature yielded solid matter:—

	Grms.
On 10 grms.	0'326
On 100 grms.	3'26

Containing sugar:—

On 10 grms.	0'14
On 100 grms.	1'408

A formation of hydrocellulose was not observed.

The sugars have been stated as dextrose all through, but it is probable that other sugars are formed. No trace of vanillin could be detected in the extracts. The colour reactions obtained with phloroglucol are very similar to Ihl's carbohydrate reactions (this Journal, 1887, 306; 1888, 511.)
—H. T. P.

PATENT.

A New or Improved Machine for Preparing or Finishing Wood Pulp and other Vegetable Fibres for Making Paper. J. H. Shorrocks, Darwen. Eng. Pat. 15,956, November 5, 1888. 8d.

THE apparatus consists of a cylindrical vessel furnished with angular projections in the form of a screw from end to end. Inside the cylinder a shaft revolves carrying a number of knives which operate between the fixed knives placed on the upper part of the cylinder. At one end the shaft carries a screw to push the pulp forward after having been delivered to the machine from a hopper. Drawings accompany the specification.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Ecgonine and Anhydro-ecgonine. A. Einhorn.
Ber. 22, 1495.

It follows from the optical properties of cocaine that an asymmetrical carbon atom is contained in the pyridine nucleus, and it has been shown that the side chain in cocaine is in the α -position.

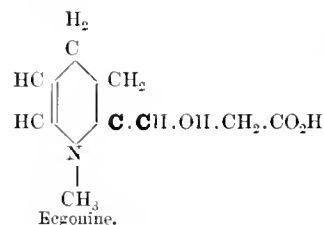
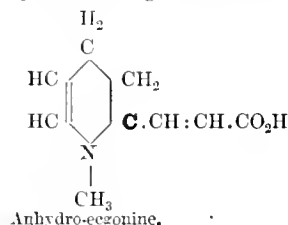
Ecgonine and anhydro-ecgonine in the form of the hydrochlorides, dissolved in water, are optically active and are laevo-rotatory.

The specific rotatory power is—

For ecgonine hydrochloride $(\alpha)_D = 57^\circ$,

For anhydro-ecgonine hydrochloride $(\alpha)_D = 61.5^\circ$.

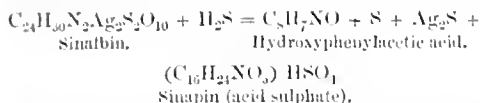
Ecgonine differs from anhydro-ecgonine in containing a second asymmetrical carbon atom, a difference which may be expressed by the following formula:—



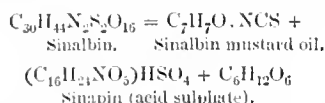
—J. B. C.

Some Derivatives of Parahydroxyphenyl Acetic Acid and the Ethereal Oil of White Mustard. H. Salkowski. Ber. 22, 2137—2144.

Will and Laubenheimer (Ber. 12, 2381) have shown that the nitrile of an acid having the formula $C_8H_7O_3$ is obtained when the precipitate produced by the addition of silver nitrate to the sinabin of white mustard seeds is decomposed by sulphuretted hydrogen, and have suggested that this acid is closely allied to the *p*-hydroxyphenylacetic acid, previously described by the author (Ber. 12, 1138), but do not consider it identical with the same, but as more probably being an *o*-hydroxyphenylacetic acid. Bayer and Fritsch (Ber. 17, 971) have shown that the ortho-acid has quite different properties from those of the acid obtained from sinabin, the formation of the nitrile of which may be represented by the following equation:—



Nor is the acid identical with the *m*-hydroxyphenylacetic acid prepared by the author (Ber. 17, 507), so that it (provided it is an hydroxyphenylacetic acid) must be identical with the para-acid, a fact which is fully borne out by the author's work. The nitrile of parahydroxyphenylacetic acid or *p*-hydroxybenzylamide, $C_8H_7ON \cdot CH_2 \cdot N$, melts at 69° — 70° as does the nitrile obtained as above from sinabin; the solubilities of the two are identical and the measurements of the crystals correspond most closely. As to the acids, that obtained from sinabin melts at 144.5° , that formed synthetically at 148° ; they further resemble one another in their calcium and barium salts, the former of which crystallises with four and the latter with one molecule of water of crystallisation. These facts are sufficient in the author's opinion to confirm the identity of the acid from sinabin with *p*-hydroxyphenylacetic acid. Similarly he looks upon sinabin mustard oil, the product of the action of the ferment myrosin on sinabin according to the following equation—



as *p*-hydroxybenzyl mustard oil, $C_8H_7(OH)(CH_2NCS)$, and he has prepared this substance by the action of carbon bisulphide and mercuric chloride on para-hydroxybenzylamine $C_6H_4(OH)(CH_2NH_2)$. It possesses a burning taste and raises a blister on the skin, but far more slowly than allyl mustard oil does. The characteristic mustard oil smell is only made apparent on warming the oil; it is insoluble in water, soluble in dilute alkalis, and only slightly volatile with steam. This product has not yet been obtained pure.

A number of derivatives of *p*-hydroxyphenylacetic acid are described in the paper.—C. A. K.

Mandragorin. F. B. Ahrens. Ber. 22, 2159—2161.

THE alkaloid extracted from the root of the *Mandragora* by means of alcohol is purified by converting it into the mercuric chloride double salt, decomposing this after recrystallisation, by means of sulphuretted hydrogen and separating the alkaloid by the addition of potassium carbonate to the hydrochloride thus obtained. The base is best extracted by a mixture of chloroform and ether, when, after distilling off the solvent and drying over sulphuric acid, it forms a colorless, transparent vitreous mass, which is very hygroscopic, without smell, and soluble in the ordinary solvents. The hydrochloride forms deliquescent needles. The double salts with the chlorides of gold, platinum and mercury are very characteristic, and have been analysed with a view to the determination of the empirical formula of the alkaloid. This approaches most nearly to $C_{17}H_{23}NO_3$, whence the alkaloid does not appear as an isomer of atropine, $C_{17}H_{23}NO_3$, as formerly suggested by the author (see this Journal, 1889, 814—815); still the

difference in the analytical data required is very small. The two alkaloids referred to in the previous paper appear on further examination to be identical. The gold double salt, $C_{17}H_{23}NO_3 \cdot HCl \cdot AuCl_4$, forms gold-coloured crystals which melt at 153° — 155° ; the platinum double salt, $(C_{17}H_{23}NO_3 \cdot HCl)_2 \cdot PtCl_4$, crystallises from hot water in yellow tables, and melts with decomposition at 193° — 194° ; the mercuric double salt crystallises from water or from alcohol in needles or tables, and melts at 159.5° — 160.5° .

The following reactions are characteristic of the salts of mandragorin:—An aqueous solution of picric acid gives a slightly yellow crystalline precipitate; phospho-tungstic acid a white precipitate, and iodine in potassium iodide an oily periodide. Potassium ferrocyanide gives no reaction, and no colourations are produced by the mineral acids. Introduced into the system or brought directly upon the eye, the simple salts of the new alkaloid produce mydriasis. The *Mandragora* obtained from Sicily and from Venice yielded very little of the alkaloid, whilst that from Trieste was found to be much richer, a fact due either to the plants being of different species or to their being in different stages of growth when examined.—C. A. K.

The Oils of Wintergreen and Birch. H. Trimble and H. J. M. Schroeter. American Journal of Pharmacy, August 1889.

I. PREVIOUS investigators have found oil of wintergreen to consist of methyl salicylate and a hydrocarbon, called gaultherilene; and oil of birch to be composed of methyl salicylate alone.

II. The authors find, in addition to methyl salicylate, in both a hydrocarbon of the formula $C_{15}H_{22}$, and small quantities of benzoic acid and ethyl alcohol. The amount of the hydrocarbon is from 0.3 to 0.447 per cent., and it becomes solid on standing a short time or on cooling. It is probably made up of a solid and liquid portion.

III. The oils are physically and chemically identical. The only difference detected being in the melting point of the hydrocarbons. That from wintergreen melted at from 10° to 15° C., and that from birch at 18° C. This may depend on the time of collecting the plants or on the age of the oils.

IV. A representative sample of artificial oil of wintergreen possessed the physical properties, but not the chemical composition of the natural oils, nor was it pure methyl salicylate.

V. The artificial product, when unmixed with the natural oils, may be identified by the addition of excess of potassium hydrate, when all odour of wintergreen will disappear.

VI. It would be undesirable in the next Pharmacopœia to replace the almost pure natural oils by an impure methyl salicylate of variable and uncertain composition. No reasonable objection can be offered to the designation by the Pharmacopœia, as oil of wintergreen, the product from either of the natural sources.

Some Modes of Producing Ammonio-Chlorides of Mercury. G. Audré. Compt. Rend. 108, 1108—1110.

IF mercuric chloride be precipitated by an equivalent of potassium hydrate, and ammonium chloride be then added, the yellow oxide gradually becomes white, and the precipitate eventually contains the mixture NH_2HgCl (tetramercurammonium chloride of Weyl), NH_2HgCl (mercury chloranide), and $NH_2(Hg_2O)Cl$ (dimercurammonium chloride), the second of these substances being formed by the action of sal-ammoniac on the first, and the third by the action of water on the second. The smaller the excess of sal-ammoniac, the more tetramercurammonium chloride is formed. In boiling solutions the tetramercurammonium chloride is formed, being stable, and mixed with it is the dimercurammonium chloride, $NH_2(Hg_2O)Cl$, into which the chloranide is resolved by heat.—J. M. H. M.

*Modes of Production of Ammonio-Mercuric Chlorides.*G. André. *Compt. Rend.* **108**, 1164—1167.

Action of ammonia on a mixture of mercuric chloride and mercuric oxide.—On adding ammonia to a solution of mercuric chloride partly precipitated by potassium hydrate, and shaking, the yellow precipitate gradually changes to a white one, containing NH_2HgCl and $\text{NH}_2(\text{Hg}_2\text{O})\text{Cl}$.

Action of mercuric chloride on a mixture of potassium hydrate and ammonia.—A precipitate is formed containing NH_2HgCl , NH_2HgCl , and $\text{NH}_2(\text{Hg}_2\text{O})\text{Cl}$. If the ammonia is in excess, no NH_2HgCl is formed.

Action of potassium hydrate on mercury chloramide.—If the precipitate, NH_2HgCl , produced by ammonia in a solution of mercuric chloride, be washed and heated with potassium hydrate, it is gradually converted into NH_2HgCl ; a portion of it is also converted by the action of water into $\text{NH}_2(\text{Hg}_2\text{O})\text{Cl}$. (Compare preceding abstract.)—J. M. H. M.

Chinese Method of Extracting Opium. J. Calvert. *Western Druggist*, **9**, 238.

THE preparation of "chandu," or the aqueous extract of opium which is used for smoking, is carefully kept secret by the Chinese, but the author has been able to observe the process. The opium cake is placed in tepid water in order to soften the covering, which is removed by hand. The cake is then placed in a shallow brass pan, gently heated over a charcoal fire, and as the mass becomes soft it is kneaded with a pestle and spread all over the sides of the pan, the greater part of the water being gradually expelled. The cake is then turned and heated cautiously over a direct flame until the crust becomes sufficiently hard, after which it is roasted on a gridiron over a charcoal fire until completely friable. It is then placed in a copper or brass vessel, covered with tepid water, and allowed to remain until the next day, when the infusion is poured off and the residue extracted twice with tepid water in a similar manner, care being taken to break the crust as little as possible. The infusion is filtered through muslin. Only the first and second infusions are used for the preparation of the extract; the third infusion and the washings being used in the next operation.

The first two infusions are mixed with egg albumen and boiled in a copper vessel, the scum being removed and fresh infusion mixed with albumen being added from time to time until the extract is sufficiently concentrated, when it is removed from the fire and cooled, with continual stirring, in a rapid current of air.

18 lb. of the best Turkish opium yield about 10 lb. of extract. No loss of morphine could be recognised, and hence it would seem that the extractive matter prevents the decomposition of the morphine compounds present in the original opium.—C. H. B.

Oxychlorides of Mercury. K. Thümmel. *Arch. Pharm.* **27**, 589.

By the action of mercuric oxide on mercuric chloride five oxychlorides have been isolated, and only five, all other supposed oxychlorides being found to be mixtures only. Those isolated are:—

Mercuric oxydichloride.....	$\text{HgO} \cdot 2 \text{HgCl}_2$
Mercuric monooxychloride ...	$\text{HgO} \cdot \text{HgCl}_2$
Mercuric dioxychloride	$2 \text{HgO} \cdot \text{HgCl}_2$
Mercuric trioxychloride.....	$3 \text{HgO} \cdot \text{HgCl}_2$
Mercuric tetroxychloride	$4 \text{HgO} \cdot \text{HgCl}_2$

The *oxydichloride* is contained in all mercuric chloride solutions which have been treated with mercuric oxide. The best method of obtaining it is to heat on the water-bath 1 part of oxide and 10 parts of chloride until no further yellow precipitation takes place. The product may then be washed free from chloride.

The *monooxychloride* has not been obtained in a state of purity.

The *dioxychloride* may be obtained red or black. The red modification is obtained by treating mercuric chloride with sodium bicarbonate (1 mol. of chloride to 2 mols. of

bicarbonate). The black modification is formed when the oxide is added to hot solutions of the chloride. The red dioxychloride is transformed, on heating, into the black polymeric form.

The black modification on treatment with caustic soda gives red oxide; the red modification similarly treated gives yellow oxide.

The *trioxychloride* can be got pure by treating freshly precipitated yellow oxide with chloride solution; or by similarly treating red oxide made into a paste. In the former case the product is light yellow; in the latter reddish yellow.

To obtain the *tetroxychloride* shake up an aqueous solution of chloride with red oxide (1 to 6). It is reddish brown to bronze in colour.

All the mercuric oxychlorides heated dry give a sublimate consisting of a mixture of mercuric and mercurous chlorides.

—T. L. B.

New Method for the Preparation of Pharmaceutical Extracts. A. Vée. *J. Pharm. Chim.* [5], **20**, 52.

ALTHOUGH good extracts may be obtained on a small scale by evaporation on the water-bath with certain precautions, yet on the large scale this process cannot be satisfactorily carried out. Evaporation in vacuo has also its disadvantages, such, for instance, as evolution of aromatic substances. The author makes use, therefore, of the system of concentration by freezing. If water containing only a small quantity of substance be frozen, the ice forms in compact masses, which interfere with the agitators and render it necessary to break up the ice in order to obtain the mother-liquor. He finds, however, that if but a relatively small quantity of extractive be used (which need not exceed that of the natural plant juices), the ice formed is so fine that the mother-liquor may be separated directly by means of a centrifugal machine. Hence only the products of the first maceration are taken. If the product is to take later on the form of a syrup, sugar may be added to the liquid about to undergo concentration in this manner. A methyl chloride refrigerator is used, which cools down a calcium chloride solution to -12° to -18°C ., and this circulates round the copper containing-vessels, whose interior is plated with nickel.

Some substances cannot be concentrated in this manner, probably because at lower temperatures they form crystallisable hydrates. Such a body is the hydrocyanic acid in cherries, and also sulphuric acid, which is used as solvent for alkaloids.

The liquids concentrated by the method here described contain about two-thirds their weight of water. This may be removed wholly or in part by means of hygroscopic substances in vacuo. Concentrated sulphuric acid and also burnt lime serve the purpose. Layers not exceeding 1 cm. in depth may be sufficiently dehydrated by this means in two or three days.—T. L. B.

Cocaine in Yellow Fever. United States Consular Reports, July 1889, 313.

CONSUL Vifquain, writing from Colon, states that Dr. James Thornton, resident physician and surgeon of the Panama Railroad Company, has for some time used cocaine with success as an anti-emetic in cases of yellow fever. He has never seen any toxic effects from its use. The mixture contained 10 grains of cocaine hydrochlorate, and was administered every hour. Before the use of cocaine the mortality was from 50 to 55 per cent., but out of 20 cases treated with cocaine only three were fatal.—C. G. C.

The Manufacture of Quinine in India. Board of Trade Journal, VII. 545.

Allen's Indian Mail for 14th October last, with reference to the recent attempts to introduce the manufacture of quinine in India, has the following:—

It is now some little time since the plant and apparatus for the manufacture of quinine were procured and erected at the Naduvatam cinchona plantation, and the public in

general, and planters in particular, would be glad to hear what Messrs. M. A. Lawson and D. Hooper have to say about the working of the new method. These gentlemen have been ready to give every possible information, and in showing the details of the process to all interested in the subject; but a short report, available to the public, would now be acceptable. It has often been questioned whether a factory for the manufacture of quinine could be profitably started in India, and, up to the introduction of the process now in use at Naduvatan, the answer has been in the negative. Now, however, tangible results have been achieved, as the 10 lb. jars of sulphate of quinine, equal in purity to Howard's, which may be seen at the factory, should convince the most sceptical. The next question is, can the drug be produced in paying quantities; or is it—like most of the gold in Wynaad—undeniably there, but too expensive to produce? It has been asserted that Government is manufacturing quinine at a loss compared with the market price, but it must be recollected that Government, when it started the present enterprise, did so more with the view of proving a process than of making a commercial success. It does not follow because the manufacture on an experimental scale does not pay, that it should not do so when properly conducted on a commercial scale. It may seem rather surprising that cinchona planters or others interested have not moved yet in the matter of starting a factory, but there is an explanation of this in the fact that Government will give no guarantee as to its future action, and it is obvious that whilst this is the case, nothing can be done, and private enterprise is completely checked. With large supplies of bark at hand, a genuine factory in working order, which could be enlarged so as to meet any requirements at any time, and a congested market, it is obvious that Government could, whenever it chose, completely rule Indian prices for quinine; and though at present we are assured that there is no intention of interfering with private trade, yet it is distinctly laid down that Government will not fetter itself by promises of any kind. To business men this is very unsatisfactory, and it is to be hoped that the Government will take the matter into reconsideration, and resolve on its future course. There has been great discontent amongst planters, and we do not know that it has in any way lessened, at Government retaining a large interest.

Indian Morphia. Chemist and Druggist.

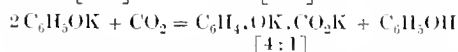
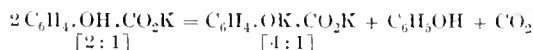
FOR the second time within the past year or two a consignment of morphia from the Indian Government has been offered for sale in Mining Lane this week, and was disposed of at a price a little below the market value of muriate of morphia. The Indian muriate is not pure, being of a light-brown colour and irregularly crystalline, there being hard tufts of agglutinated crystals mixed in fair abundance with the major portion of detached crystals. We find that the sample contains barely 96 per cent. of pure morphine hydrochlorate, and is free from any notable impurity saving the colouring and extractive matters, and a little uncombined morphine. This result agrees closely with that obtained by the authors of *Pharmacographia Indica* from a sample obtained from Ghazipore, their figures being 96.6 per cent. of morphine hydrochlorate, 0.828 per cent. of uncombined morphine, 0.812 per cent. of chloroform extractive, and 0.063 per cent. of ash. The sample in that case was white. Indian morphia is manufactured at the Government laboratories, Ghazipore, from opium which has been confiscated owing to adulteration, and which is consequently unfit for making provision opium and *abkari*—i.e., opium for local consumption. Contraband opium which is not pure is also used for alkaloid making, and the total quantity of all kinds so employed is about 17,000 lb. a year. As the yield of morphia salts from this quantity falls a little short of 300 lb., or 1.7 per cent., it is obvious that the opium employed is very poor stuff. The process of manufacture employed at Ghazipore is practically the same as that recommended in the British Pharmacopœia. The opium is exhausted with water, filtered, evaporated to a syrup, calcium chloride added,

and evaporation continued until on cooling the mixture sets into a mass of morphia crystals. This mass is subjected to pressure and re-solution in order to get rid of the codeia, &c., and finally is dissolved in water, precipitated with ammonia, converted into the hydrochlorate, and crystallised. We presume that it is the product of this stage which has come to Mining Lane, for the muriate as finally turned out is "nearly white," and is so made by a method which is worth mentioning. The morphia manufactured is mostly used for native consumption, and as there is a caste prejudice against anything which has been brought into contact with animal matter, bone-black cannot be used for decolourising. Wood charcoal has to take its place; and experience has shown that charcoal from *Balea frondosa* is most suitable, as it is almost free from saline matter. Two ounces of this are used for each pound of the morphia. In addition to the latter a little over 30 lb. of codeia is manufactured every year. It will be seen from the foregoing that there is no immediate hope of getting any important supplies of morphia from India; moreover the Government has given a distinct promise not to manufacture and sell either morphia or quinine in such quantity as would disturb the market. What they do is to dispose of their surplus stock merely, and any small jobber will be able to buy the whole of that when it appears.

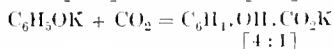
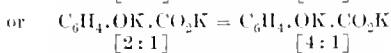
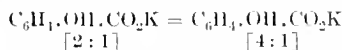
PATENT.

Improvements in the Manufacture or Production of Para-oxibenzoic Acid. J. Y. Johnson, London. From Dr. F. von Heyden (Nachfolger), Radebeul, Germany. Eng. Pat. 17,075, November 23, 1888. 4d.

THE methods hitherto employed for the preparation of *p*-hydroxybenzoic acid have been by heating potassium salicylate to 210° or by passing carbonic acid gas over potassium phenate at 200–220°, when the decompositions represented respectively by the following equations take place—



In both these reactions 1 mol. of phenol is liberated. According to the present invention the above operations are to be performed in closed vessels under pressure at 180 or upwards, when the whole of the product produced consists of a salt of *p*-hydroxybenzoic acid—



The potassium salt is then dissolved in water, and the *p*-hydroxybenzoic acid precipitated by means of a mineral acid.—T. A. L.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Prevention of Frilling. E. Himly. Phot. Arch. 30, 229.

IN order to prevent frilling, which is not uncommon with developers which contain potassium carbonate and especially caustic alkalis, the author coats the edges of the plates, before development, with a solution of india-rubber in benzene.—C. H. B.

Discolouration of Gelatino-Chloride Prints. Stolze. Phot. Wochenblatt, 15, 265.

In the various operations of developing, washing, &c., the gelatin film becomes soft and liable to injury. The use of the ordinary alum bath leads to a precipitation of sulphur and consequent discolouration of the image if all the thio-sulphate has not been removed, and the use of solutions containing much sulphurous acid is unpleasant. The author recommends immersion in a solution of chrome alum which has been carefully neutralised with ammonia.—C. H. B.

Observations on the Use of Coloured Glasses in Photography. Delaurier. Bull. Soc. Chim. [3], 1, 706—707.

LIPPMANN'S experiments to obtain photographs, representing the true value of light, remind the author of some fruitless experiments to obtain photographs in material colours by the action of light, using alternately three glasses, red, yellow, and blue. In these experiments it was observed that light, passing through an orange-tinted glass, produced a very even photogenic action of all subjects to be reproduced. It was found, however, that only the difference of luminous intensity acted and produced true images as to shade and light. When the orange glass was too thick or too thin, or too deep in colour, or too light, the action was naturally imperfect. But when once the right glass is prepared, very good photographs are always obtained. The author claims considerable advantages for his method over Lippmann's, as it is sufficient to put a glass of right colour and thickness either before the objective or before the aperture of the dark chamber.—A. L.

PATENTS.

An Improvement in the Method of, and Materials or Compound employed in Developing Photographic Pictures or Images. W. Oldham, Eton. Eng. Pat. 16,537, November 14, 1888. 4d.

THE ordinary materials used for alkaline development are mixed in the form of dry powders for convenience of transport and storage, and are dissolved in water when required for use. The proportions of the mixture may be varied according to circumstances, but the quinol developer may consist of quinol $3\frac{1}{2}$ parts, sodium sulphite $7\frac{1}{2}$ parts, potassium metasulphite $1\frac{1}{8}$ parts, sodium carbonate 12 parts. It is better to have two powders, one consisting of the sodium carbonate, and the other of the remaining ingredients, the proportions in the packets being those suitable for compounding the developer.—C. H. B.

Improvements in Photographic Negatives and Sensitised Plates for use in Photo-Illustrative Processes. H. Deveril and W. Gallagher, Sydney, New South Wales. Eng. Pat. 9921, June 17, 1889. 4d.

BEFORE or after exposure on the subject to be produced, the sensitive plate is exposed for a short time to a feeble light under a "mater," which is prepared by coating a transparent or translucent substance with opaque matter in such a way that it is transparent only in lines, dots, or grains. Such an image may be transferred from a lithographic stone, or the "mater" may be an ordinary photographic negative of a drawing or any other object which will give a negative of the character required. After the plate has been exposed on the object and under the mater it is developed, and the image is a composite of the image of the object and of the dots, lines, or grains of the mater.

An unvarnished gelatin negative is immersed for 10 to 15 minutes in a saturated solution of potassium dichromate, the excess of liquid blotted off, the plate dried in the dark, and then exposed to bright light until it becomes covered with opaque dots or grains owing to the reduction of the dichromate and combination of the chromic oxide with the gelatin. The plate is then washed and dried, and is used for printing a transfer in the usual way.—C. H. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

Experiments Demonstrating the Mode of Action of Explosives. F. C. G. Müller. Zeits. f. d. Phys. u. Chem. Unterricht, 2, 170.

IN order to show the action which takes place between charcoal and saltpetre, 10 grms. of saltpetre and a piece of wood charcoal 1 gm. in weight are introduced into a large test tube fitted with a doubly bored cork. Through one hole of the cork passes a delivery tube; the other is plugged by means of a piece of glass rod. The saltpetre is now melted and that part of the tube containing the charcoal heated. The gases evolved are collected in a jar of about 2 litres capacity. In about one minute the whole of the carbon has disappeared and about 1.8 litre of gas has been collected. After absorption of the CO_2 by means of caustic potash only nitrogen remains, occupying about two-fifths of the original gas volume in accordance with the following equation:—



By now removing the glass plug and slowly adding water and dilute acid by means of a small funnel, carbonic anhydride is given off from the residue, and may be measured. The quantity of CO_2 obtained falls somewhat short of the theoretical quantity on account of mechanical losses, &c.

The immense gas evolution on explosion may be shown by supporting a tubulated bell-jar, of 1 to $1\frac{1}{2}$ litre capacity, on a tripod stand in a trough of water. The tubulus is fitted with a cork carrying a tube furnished with a stop-cock, and a piece of glass tubing sealed at the upper end and containing in its lower portion a piece of smoldering tinder. On the water inside the jar floats a piece of wood carrying 1 gm. of a mixture consisting of 8 parts of saltpetre, 1 part of sulphur, and 1 part of finely powdered wood charcoal. The air is sucked out of the jar until the wood rises to the tinder, which ignites the powder. The wood is driven down as far as the tripod, but in a few seconds as the gases cool their volume contracts to about 150 cc.

To show the action of nitroglycerol a sheet of lead 2 cm. thick and weighing about 2 lb. is placed on an anvil, and a small hole punched into it about 4 mm. in diameter and 6–8 mm. deep. If then 1 to 2 drops of nitroglycerol be introduced into the hole and the lead then struck directly on the hole with a tolerably heavy hammer, explosion ensues, and a cavity about 15 mm. in diameter is made in the lead.—T. L. B.

PATENTS.

Improvement in Fuses or Igniting Apparatus for Armour-Piercing Shells. A. Noble, Newcastle. Eng. Pat. 15,934, November 3, 1888. 8d.

THIS invention has for its object improvements in fuses or igniting apparatus for armour-piercing shells. The projectile is provided with an arrangement which, on striking the object, crushes a small glass vessel enveloped in lead and containing sulphuric acid. This acid is thus brought in contact with a charge of chlorate of potassium and sugar, which fires the shell. The ignition of this charge may be delayed by thickness of paper interposed between the acid and the chlorate mixture.

It is necessary, in order to clearly understand this invention, to refer to the drawing attached.—C. N. H.

Improvement relating to the Manufacture of Explosives and to Apparatus therefor. H. S. Maxim, Westminster. Eng. Pat. 16,213, November 8, 1888. 8d.

THE object of this invention is to produce a smokeless powder suitable for firearms, &c.

In carrying out this invention gun-cotton is treated with solvents such as acetone or a mixture of acetone and alcohol and ether in a vessel from which the air has been exhausted.

By this means the horny material produced is free from air bubbles, and becomes, after being subjected to a high pressure, very hard. It is then reduced to a granular or other suitable form.

There are 11 claims and two drawings of the apparatus used attached to this specification.—C. N. H.

Improvements in or relating to Percussion Caps or Fuzes.

H. M. Chapman, Waltham Cross. Eng. Pat. 16,997, November 22, 1888. 6d.

THE object of this invention is to effect the ignition of nitro-explosives known as "high explosives" in firearms, ordnance, and the like, without producing "detonation," which, as is well known, has frequently caused the bursting of guns.

In carrying out the invention the use of fulminates are dispensed with, and friction material, giving a longer flash and greater igniting power, substituted.

One of the compositions for charging the caps used with nitro-explosives, is the following:—

Amorphous phosphorus.....	15·90
Potassium carbonate	2·00
Powdered resin	2·00
" cane sugar	2·00
" mercuric oxide	4·00
" peroxide of manganese...	5·20
" magnesium	6·10
" potassium chlorate	10·90
" potassium nitrate.....	51·90
	100·00

but the above mixture is open to variation.—C. N. H.

Improvement in Mining or Blasting Cartridges and in Shells or Explosive Projectiles. P. Giffard, Paris, France. Eng. Pat. 12,089, July 30, 1889. 4d.

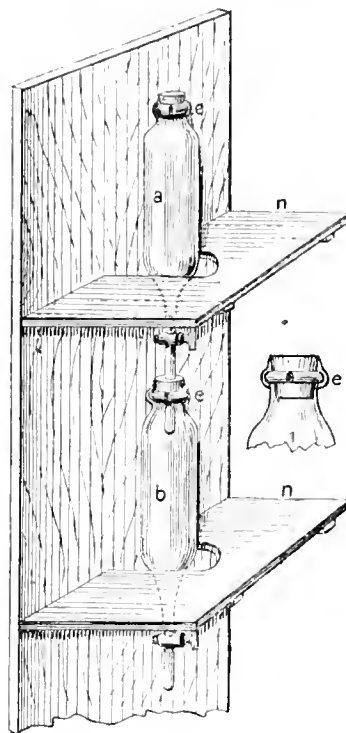
THIS invention relates to mining or blasting cartridges and to shells or explosive projectiles, and consists essentially in charging them with liquefied carbonic acid gas.—C. N. H.

XXIII.—ANALYTICAL CHEMISTRY.

A New Continuous Extractor. A. Ungerer. Zeits. f. angew. Chem. 1889, 304—305.

MOST of the many apparatus for making extracts are inapplicable when it is desired to make extracts of volatile substances or of substances which would be decomposed by distillation or by warming. The annexed figure shows an arrangement by which the most concentrated extracts or tinctures of spices, or perfumes, &c. can be made without evaporation. A number of cylindrical glass vessels, *a, b*, are placed on a suitable stand one above the other, so that the tube of one vessel passes through a cork fitted into the mouth of the vessel below. From 6 to 12 of these vessels may be used one above the other. The stand consists of a board with pairs of projecting pegs placed at such distances that there is room for the cylinders between them. Boards having a horseshoe-shaped piece cut out on one side, are placed on these pegs, and serve to support the cylinders in their places. The material from which the extract is to be obtained is placed in these cylinders, a little asbestos or cotton-wool packing having been first inserted. The solvent is then allowed to run into the top cylinder, either freely or (in order to increase the pressure) through a long tube attached to the top. The liquid permeates the substance in the cylinder and runs through into the cylinder below, and so on to the bottom, where it is drawn off as the strongest

possible tincture. By adjusting the lowest stop-cock, the speed of flow can be properly regulated. The number of vessels and the speed of percolating should be so regulated that the tincture begins to flow from the lowest cylinder just when the contents of the top one have been thoroughly exhausted. As soon as the top cylinder is exhausted it is removed, the whole column of vessels raised up a stage, and a newly-filled vessel is added at the bottom. In this



way the process becomes continuous, and a concentrated extract can be made, except, of course, towards the end of operation. When alcohol, ether, and similar solvents are used, the liquid remaining in the vessels at the end of the operation may be recovered by emptying the cylinders and distilling off the liquid from the spent material, or steam may be blown through the column from the top downwards, when the spirit is driven out, and may be collected below fairly well separated from the condensed water. Samples of the tincture may be taken at various stages by double boring the corks and attaching a tube with a stop-cock, through which a portion of the extract may be drawn as required; or a three-way tap may be used with branch tube instead of the ordinary tap arrangement.—H. S. P.

On an Apparatus for Indicating the Presence of Carbon Monoxide. M. Rasine. Bull. Soc. Chim. [3], 1, 555—558.

THE principle of this apparatus is based on the property of spongy platinum to absorb carbon monoxide with evolution of heat. In the circuit of an electric current two metallic plates are interposed, which, when touching, close the circuit. A bent rod is arranged near these plates, and its extremity is placed at a certain distance but immediately above the end of the upper plate. A combustible thread is attached to the free end of the rod and to the free end of the upper plate. This thread, serving to keep separate the two plates, is surrounded by muslin containing a fragment of cotton-powder dusted over with spongy platinum. Carbon monoxide will burn the thread and establish an electric current and thereby ring a bell put in its circuit.—A. L.

Withdrawal of Test-Liquid from Extraction Apparatus.
J. Hertkorn. Chem. Zeit. **13**, 1117.

In order to remove small quantities of liquid with a view to ascertain when extraction is complete, the extraction tube is provided with a small lateral tubulus about 1 cm. below the level of the liquid. This tubulus is closed by a cork which carries a narrow tube with both ends bent at right angles, and lying in planes at right angles to each other. The bent end of the tube which is inside the extractor is placed vertically, and the open end projects above the level of the liquid. When liquid is to be withdrawn, the tube is turned through 90°, so that the end inside the tube lies horizontally below the level of the liquid, which then flows from the outer end of the tube. When the tube is turned back, sufficient liquid remains in the horizontal portion to prevent escape of vapour.—C. H. B.

Sodium Nitro-Prusside as a Test for Caustic Alkalis and Alkaline Earths. H. Brunner. Schweiz. Wochens. Pharm. **27**, 237.

NITRO-PRUSSIDE produces an intense yellow colouration with caustic soda or caustic potash, also with baryta water and lime water, whilst in the case of carbonates and bicarbonates, no colour reactions are noticeable. If caustic soda be added to an aqueous solution of sodium nitro-prusside until an orange colouration is obtained, and the whole be then shaken with alcohol, a dark yellow oil separates, which on standing solidifies to an orange-coloured

crystalline mass. The aqueous solution of this sodium salt gives coloured precipitates with metallic salts; with acids it gives a green colouration, becoming violet on exposure to the air, with final production of a blue precipitate.—T. L. B.

The Estimation of Nitrogen by Kjeldahl's Method.
F. Martinotti. Zeits. Anal. Chem. **28**, 415—421.

In the analysis of manures free from nitrates the author proceeds as follows:—1 gm. of manure is treated in a flask of 200—250 cc. capacity, with 2 grms. of mercury, and 20 cc. of a mixture of phosphoric anhydride and strong sulphuric acid (200 grms. P_2O_5 + 1,000 grms. H_2SO_4). The flask is heated on gauze to gentle boiling till the contents are clear, the temperature is then raised and the heating continued till the solution is almost colourless. A few crystals of potassium permanganate are then added, and the mixture again heated to boiling and allowed to cool. The contents of the flask are diluted, a sufficiency of caustic potash or soda added, and the ammonia distilled over into semi-normal sulphuric acid. In a table the author gives a number of comparative results obtained by Kjeldahl's and by Will-Varrentrapp's methods. The numbers yielded by Kjeldahl's process are as a rule slightly higher than those obtained by Varrentrapp's method. The author describes Jodlbauer's modification of the Kjeldahl method for the estimation of nitrogen existing as nitrates. In this process raw phenolsulphonic acid and zinc dust are added prior to the heating with acid. The results obtained are not at all satisfactory, as is shown by the following table:—

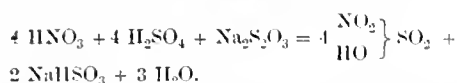
Substance.	No. of Analysis.	Nitrogen.	Method.	Duration of Analysis.	Remarks.
		Per Cent.		Hours.	
Manure	1	1.86	Kjeldahl-Jodlbauer	1½	With addition of sugar. Sugar and tartaric acid added.
	2	1.20	" "	7½	
	3	1.34	" "	7½	
	4	1.97	" "	10	
	5	1.58	" "	10	
	6	1.56	Will-Varrentrapp .....	..
	7	1.58	" " .....	..
	8	1.66	Dumas .....	..
Manure	1	0.56	Kjeldahl-Jodlbauer	6	} Contained only small quantities of nitrates.
	2	0.70	" "	6	
Manure	1	3.78	" "	5½	} Fuming sulphuric acid was used instead of the ordinary mixture.
	2	3.64	" "	5½	
	1	3.22	" "	8	
	2	3.92	" "	8	
	3	2.38	" "	10	
	4	2.38	" "	10	
	5	2.10	" "	4	
	6	1.89	" "	1½	
Manure	7	5.78	Dumas	Without permanganate.
	1	0.77	Kjeldahl-Jodlbauer .....	..
	2	1.15	" " .....	..
Manure	3	0.875	" "	} Without permanganate.
	1	3.50	" "	8	
	2	3.57	" "	8	
	3	1.48	" "	7½	
	4	1.62	" "	7½	
Manure	5	6.14	Dumas	Without permanganate.
	1	2.10	Kjeldahl-Jodlbauer .....	..
	2	1.68	" " .....	..
	1	1.12	" "	6	
Manure	2	0.84	" "	6	Without permanganate.
	3	0.98	" "	6	
	4	1.11	Dumas .....	..
	1	1.63	Kjeldahl-Jodlbauer .....	..
Manure	2	2.08	Dumas	

The low results obtained are chiefly due to the loss of nitric acid fumes during the digestion.

The author recommends a method in which the nitrates are first destroyed by evaporating the substance to dryness with ferrous chloride and hydrochloric acid. The remaining nitrogen is then determined in the usual way. The nitrates are estimated separately by Schlosing's method. The total nitrogen thus obtained agrees very closely with the results yielded by the absolute process.—H. T. P.

The Estimation of Nitrates by the Kjeldahl Method.
O. Foerster. Zeits. Anal. Chem. **28**, 422—427.

In the analysis of bodies containing nitrates by the Kjeldahl method, phenolsulphonic acid is added prior to digestion, in order to fix the nitric acid as a difficultly volatile nitro-compound. A little nitric acid, however, always volatilises so that the results come low. The author completely prevents this loss by the addition of sodium thiosulphate, which fixes the nitric acid as difficultly volatile nitrosylsulphuric acid, the reaction being as follows:—



A number of experiments were made with pure potassium nitrate in the following manner. A weighed portion of potassium nitrate solution was evaporated to dryness in a flask. 30 cc. of phenolsulphonic acid (containing 5—6 per cent. phenol) were then added for every gram. of potassium nitrate taken, and, without warming, the mixture was shaken till solution of the salt was effected. 1 to 2 grms. coarsely powdered sodium thiosulphate were then added at once, followed, when decomposed, by a sufficient quantity (10 cc. for every 15 cc. of phenolsulphonic acid used) of sulphuric acid, and 0.4 to 0.5 gram. mercury, the mixture being heated immediately after these additions. The time of heating required is about 1—1½ hours. Beyond this stage the process is the same as the ordinary Kjeldahl method. The following results were obtained:—

results were obtained, as will be seen from the following table:—

Phenol contained in the Phenol-sulphonic Acid.	KNO ₃ used.	Calculated Quantity of Nitrogen taken.	Nitrogen found.
Per Cent.	Grm.	Grm.	Per Cent. Grm. Per Cent.
4	0.51919	0.07206	13.88 0.07183 13.84
4	0.56084	0.07784	13.88 0.07753 13.82
4	0.48973	0.00797	13.88 0.006790 13.87
5	0.56373	0.07825	13.88 0.07784 13.81
5	0.45937	4.00376	13.88 0.00349 13.82
5	0.54039	0.07501	13.88 0.07454 13.79
6	0.50225	0.06371	13.88 0.06312 13.82
6	0.5224	0.07251	13.88 0.07247 13.87
6	0.50781	0.07048	13.88 0.07061 13.91
6	0.50484	0.07007	13.88 0.07005 13.88
6	0.54512	0.07570	13.88 0.07586 13.91
6	1.02921	0.11285	13.28 0.11230 13.83
6	0.99057	0.13749	13.88 0.13659 13.79
6	0.06162*	0.0085523	13.88 0.0085513 13.88
6	0.04986*	0.0069212	13.88 0.0069573 13.95
6	0.04856*	0.0067404	13.88 0.0067874 13.98
7	0.57174	0.07336	13.88 0.07304 13.82
7	0.46670	0.06478	13.88 0.06459 13.84
7	0.50399	0.06995	13.88 0.06982 13.85
8	0.51114	0.07095	13.88 0.07039 13.77
8	0.52044	0.07224	13.88 0.07185 13.81

* In these analyses a correction was made for the small amount of nitrogen contained in the reagents.

—H. T. P.

KNO ₃ used.	Calculated Quantity of Nitrogen taken.	Nitrogen found.	Loss of Nitrogen.
Grm.	Grm.	Per Cent.	Grm. Per Cent. Mgrm. Per Cent.
1.00407	0.13936	13.88	0.13717 13.66 2.19 0.22
1.01214	0.14049	13.88	0.13831 13.67 2.18 0.21
0.99130	0.13759	13.88	0.13558 13.68 2.01 0.20
0.99411	0.13798	13.88	0.13607 13.69 1.91 0.19
1.00689	0.13892	13.88	0.13703 13.69 1.89 0.19
0.48596	0.06745	13.88	0.06636 13.66 1.09 0.22
0.49071	0.06936	13.88	0.06829 13.67 1.07 0.21
0.49826	0.06916	13.88	0.06810 13.67 1.06 0.21
0.50369	0.06991	13.88	0.06890 13.68 1.01 0.20
0.50077	0.06951	13.88	0.06858 13.70 0.93 0.18
0.50295	0.06931	13.88	0.06895 13.71 0.86 0.17
0.49651	0.06892	13.88	0.06810 13.72 0.82 0.16
0.50425	0.06999	13.88	0.06921 13.73 0.73 0.15
0.49770	0.06908	13.88	0.06835 13.74 0.73 0.14
0.50091	0.06953	13.88	0.06905 13.78 0.48 0.10
0.49549	0.06877	13.88	0.06830 13.79 0.47 0.09
0.50461	0.07004	13.88	0.06994 13.86 0.10 0.02

These small losses of nitrogen were found to be caused by the non-absorption of a trace of ammonia in the receiver. By using a bulb U-tube as receiver, almost theoretical

The Purification of Litmus. O. Foerster. Zeits. Anal. Chem. **28**, 428.

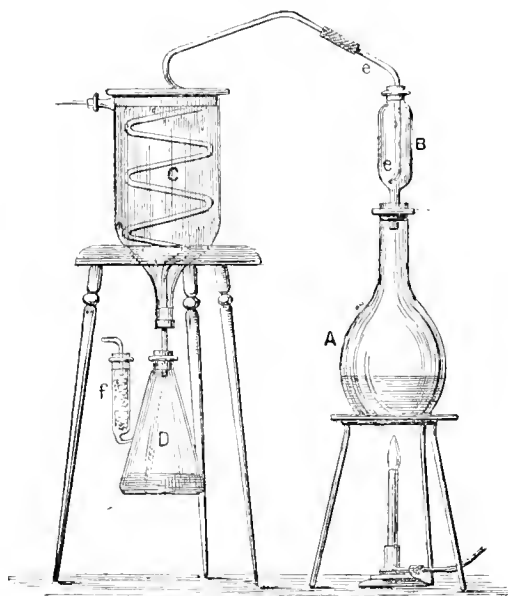
COMMERCIAL litmus of the best quality is extracted with alcohol, and then digested with water and the solution filtered and evaporated. The residue is redissolved in water, filtered, and the filtrate precipitated with absolute alcohol containing a little glacial acetic acid. The precipitate is collected on a filter and washed with alcohol, which removes a violet fluorescent colouring matter. The precipitate is redissolved in water and reprecipitated as before, and this process is repeated a third time. The residue is repeatedly moistened with alcohol, to remove the acetic acid. The precipitate is finally dissolved in water, filtered, precipitated with weak alcoholic ammonia, collected on a filter and washed with alcohol. After drying it is ready for use.

—H. T. P.

The Estimation of Ammonia by Distillation. W. M. Stein and P. W. Schwarz. Zeits. Anal. Chem. **28**, 428—431.

THE authors highly recommend the distillation apparatus, a drawing of which is given below. The steam from the distillation flask A passes into the bulb B, into which is fitted by means of an india-rubber stopper the glass tube c. This tube is slightly contracted at the lower end, and is bent sideways to prevent the entrance of alkali from A. The wall of the tube is pierced with three holes of suitable size. During distillation a little condensed water collects in B, which serves to wash the steam as it bubbles through. Any alkali which may be blown into the tube c, immediately runs

out again, since the side-openings equalise the pressure within the tube. The absorption apparatus consists of an Erlenmeyer flask D, fitted with a side tube *f*, which is filled with fragments of glass. The receiver holds about



250 cc. up to the bottom of the side tube, *i.e.*, sufficient for a distillation. The standard acid is introduced through *f*. The small quantity of acid which adheres to the broken glass suffices to retain any traces of ammonia which escape condensation. The titration is performed in the receiver itself.—H. T. P.

A Source of Error in the Separation of Manganese from much Lime, by means of Ammonium Sulphide. L. Blum. Zeits. Anal. Chem. **28**, 454.

IN the analyses of blast-furnace slags, containing a little manganese in presence of much lime, the author noticed that the highly-concentrated solution of the slag, when mixed with ammonium sulphide, deposited, after long standing (24–48 hours) besides manganese sulphide, a crystalline compound, which caused the results to come high. On closer examination this compound was found to be calcium thiosulphate. In cases where it is necessary to separate a little manganese from an excess of lime, it is therefore advisable to boil the solution with ammonium sulphide and filter at once.—H. T. P.

The Estimation of Carbon in Iron. L. Blum. Zeits. Anal. Chem. **28**, 450–452.

UNDER this heading L. L. de Koninck (this Journal, 1888, 457 and 693) recently published a paper in which he recommends the addition of silver sulphate to the retort containing the carbon residue, prior to combustion with chromic and sulphuric acids, in order to retain any traces of chlorine present in the carbon residue as silver chloride. The author finds this precaution to be quite useless, for the silver chloride first formed is decomposed by the sulphuric acid when heat is applied. A blank combustion was made, a quantity of silver chloride being added to the acid mixture in the retort. After the completion of the experiment, it was found that the potash bulbs had increased in weight by 0.2495 gm. owing to the absorption of the decomposition products of the silver chloride.—H. T. P.

The Precipitation of Magnesia. L. Blum. Zeits. Anal. Chem. **28**, 452–454.

MOHR recommends sodium ammonium phosphate, in preference to sodium phosphate, as a precipitant for magnesia, because, in his experience, precipitation takes place more quickly and more completely when the former salt is employed. The author, however, finds, in opposition to Mohr, that in the case of very dilute solutions of magnesia, the precipitate produced by sodium ammonium phosphate is of an exceedingly fine crystalline nature, requiring several days to settle completely, while if the solution be filtered before it is quite bright, it runs through the filter turbid. On the other hand, when sodium phosphate is employed, the precipitate settles in a few hours, and is easily filtered off. The precipitation is as complete as in the case of sodium ammonium phosphate.—H. T. P.

The Use of Kaolin-Balls and of Salet's Pipette in Gas Analysis by Bunsen's Method. N. Bunge. Zeits. Anal. Chem. **28**, 457–466.

FOR the introduction of liquid reagents into the absorption tube, porous balls of papier-mâché or coke are employed. Gypsum has also been used for the purpose, but balls of all these materials are difficult to make, and they easily break to pieces. The highly recommends bullets made of a mixture of kaolin and soot. The best proportions are—three parts of finely levigated kaolin to one of soot. They are dried at a moderate temperature and ignited till all the carbon is burnt off. The bullets thus obtained have a smooth surface and adhere tightly to the wire. Their porosity depends upon the amount of soot originally used. Balls made of 6 parts of kaolin and 1.2 parts of soot, absorb about 65 per cent. of water, those of 3 parts of kaolin and 1 of soot, take up 71 per cent. of water; and those of 2 of kaolin to 1 of soot absorb 113 per cent. water; but these are very fragile.

A drawback to Bunsen's method is the necessity of transferring gases from one tube to another. This operation requires some skill and the use of large quantities of mercury. This objection may be overcome by employing Doyère's mercury trough and Doyère-Salet's gas pipette. Salet's pipette permits this transference of gas to be performed with great ease. By its use the gas may be treated with reagents in an ordinary tube, the measurements being made in another tube, which thus has no chance of being soiled. The tubes must not, however, exceed 200 mm. in length. Long eudiometers, difficult to handle, can be done away with; for explosions can be made with ease and perfect safety in Salet's pipette, which need only be provided with an extra tap, and two fused-in platinum wires for the purpose.—H. T. P.

On the Volumetric Determination of Zinc. A. Voigt. Zeits. f. angew. Chem. 1889, 307–308.

THE author suggests the following method for volumetric determination of zinc, which is much less tedious than Schaffner's method, now usually adopted, and which gives fairly accurate results, so that it is very suitable for everyday use in zinc works, even if it be not sufficiently exact for buying and selling upon.

The method depends upon the precipitation of the zinc from an ammoniacal solution by a standard solution of potassium ferrocyanide. The sample to be tested (blende, silicate, zinc ashes, &c.) is dissolved in hydrochloric acid, oxidised with a little nitric acid, and from 100 to 150 cc. of water are added. To this solution are then added from 5 to 10 grms. of potassium tartrate, according to the quantity of iron in the sample, so as to keep the iron in solution. Ammonia is then added until the solution is just alkaline, a point which is easily observed by the change of colour of the liquid from yellow to white, and the volume is made up with water to about 250 cc. A standard solution of potassium ferrocyanide is then run in from a graduated burette whilst the mixture is continuously stirred. The end of the precipitations of the zinc is recognised by taking out a drop and mixing it, on a white plate, with a drop of acetic acid; the first formation of Prussian-blue indicates the end of the reaction.

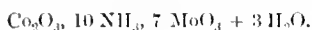
The ferrocyanide solution is standardised by dissolving 46 grms. of the pure commercial salt in water, and allowing the solution to stand for a few days, filtering off any deposit, and making up the volume to a litre. 12.461 grms. of ZnO are then dissolved in hydrochloric acid, and made up to a litre. 10 cc. of this zinc solution are measured off in a pipette, diluted with about 150 cc. water, 5 grms. of potassium tartrate and a few drops of ferric chloride added, and then ammonia added until the liquid is alkaline. The volume is then made up to about 250 cc., as in the case of the samples, and the solution is titrated, making use of a drop of acetic acid on a white plate to bring out the Prussian-blue reaction. 10 cc. of the ferrocyanide solutions should be required for 10 cc. of the zinc solution; or 1 cc. of standard ferrocyanide solutions equals 1 per cent. of zinc.

Manganese interferes with the accuracy of the test, but the presence of lead is of no consequence. A number of determinations are given, and compared with results by the Schaffner method, showing a fairly close agreement.

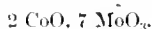
—H. S. P.

Ammonio-cobaltic Molybdate, Tungstate, and Vanadate. The Separation of Cobalt from Nickel and of Cobaltic from Cobaltous Salts. A. Carnot. *Compt. Rend.* **109**, 109—112.

THE differences existing between ammonio-cobaltic salts and the corresponding cobaltous and nickelous salts are, as a rule, not sufficiently marked to permit of a method of separation being based upon them. This advantage is, however, found in the case of ammonio-cobaltic molybdate, tungstate and vanadate. When ammonium molybdate is added to a solution of cobalt, which has been converted into a purpleo-cobaltic salt by the addition of hydrogen peroxide, ammonia, and ammonium chloride, no change takes place. If the solution be now acidified with acetic acid, a voluminous peach-coloured precipitate is formed, which is almost insoluble in water. Dried at 100° C. it retains its colour and has the following composition—



When heated above 100° C. it assumes first a blackish-green and then a greenish-yellow colour, water, ammonia, and oxygen being given off at the same time. The ignited salt takes a lilac tint on cooling. Its composition is—



When heated to a dull red heat this salt is decomposed, black oxide of cobalt and molybdic anhydride being separated. Nickelous and cobaltous salts do not give a precipitate with ammonium molybdate, either in acid or alkaline solution, if sufficiently dilute.

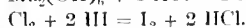
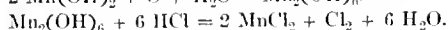
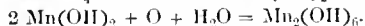
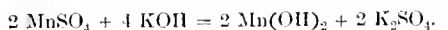
For the separation of nickel and cobalt the author gives the following details. To a hydrochloric or nitric acid solution of the two metals, ammonia and ammonium chloride are added in excess, as well as a little peroxide of hydrogen. After a few minutes the solution is boiled till no more oxygen is disengaged. It is allowed to cool, neutralised with acetic acid and an excess of 3—5 cc. of acetic acid per 100 cc. of solution added. A solution of ammonium molybdate is then run in, as long as a precipitate forms. After settling the supernatant liquor is decanted off and the precipitate transferred to a filter and washed with water containing a little ammonium chloride. When dry the precipitate is removed from the paper as completely as possible and gently ignited. Its weight, multiplied by 0.1332, gives the quantity of protoxide of cobalt, and by 0.1048 the weight of metallic cobalt. When dealing with small quantities of cobalt it is well to redissolve the precipitate in ammonia and reprecipitate by the addition of acetic acid and a few drops of ammonium molybdate. The nickel is separated from the filtrate by boiling with caustic potash to expel the ammonia, and the nickel is obtained quite pure by redissolving the precipitate in acid and reprecipitating with potash and bromine.—H. T. P.

On a New Method for the Volumetric Estimation of Mercury, Silver, and Thallium by means of Iodide of Potassium. A. Carnot. *Compt. Rend.* **109**, 177—179.

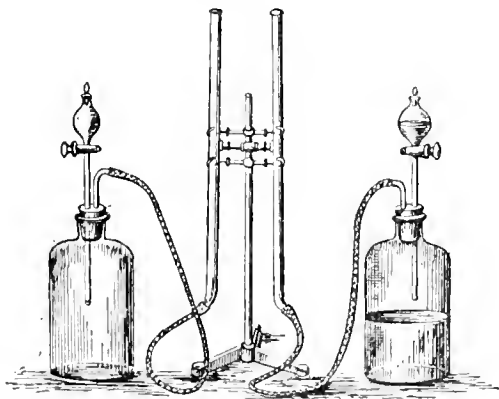
To the solutions to be estimated nitric acid is added and then a little starch solution. A solution of iodide of potassium of known strength is run in, when the insoluble iodides of the metals are thrown down, which as soon as the slightest excess of the iodide solution has been added are decomposed by the nitric acid present, with the liberation of free iodine, which reacts with the starch, giving the characteristic blue colour. The process is not satisfactory in presence of free hydrochloric acid or alkaline chlorides.—S. G. R.

Determination of Oxygen in Water. Max Müller. *Chem. Zeit.* **13**, 1188—1190.

THE author points out the impossibility of ascertaining the quality of water by making a single oxygen determination, as is generally done, by bacteriological examinations, or by determination of the quality of organic matter present. A water may contain quite a large quantity of bacteria and a considerable amount of organic matter without being by any means an injurious water; whilst, on the other hand, many waters containing but small quantities of bacteria and very little organic matter may be totally unfit for use. If the quantity of oxygen in a water be ascertained, when the water is fresh, and again after the water has stood for several days out of contact with air, it is found in the case of good waters that the change in quantity of oxygen is very slight, while bad waters show a very decided falling off, or even total disappearance, of oxygen. The author's method of determining the oxygen is as follows:—A small quantity of pure manganous sulphate is dissolved in the water under examination, and several cc. of concentrated caustic soda or caustic potash solution are added, air being carefully excluded. The manganous hydrate at first thrown down as a white precipitate, is immediately acted on by the free oxygen in the water with formation of one of the higher oxides. By adding now a little concentrated hydrochloric acid containing potassium iodide (air being here also carefully excluded), a quantity of free iodine is obtained corresponding to the free oxygen originally contained in the water. The free iodine may then be titrated with sodium thiosulphate. The whole process may be represented thus:—



Two drawings of a convenient form of apparatus for carrying out the process are represented in the figure.



A bottle of 2 to 3 litres capacity is fitted with a doubly-bored cork, carrying a 25 cc. tap funnel, and a small tube bent once at a right angle. The stem of the tap funnel passes some distance into the bottle, whilst the end of the

other tube is flush with the inner surface of the cork. A rubber tube connects this outlet tube with a wider moveable tube, as shown. The bottle is filled to overflowing with the water under examination, and a crystal of manganous sulphate (about 1 grm.) is then introduced; all air is displaced from the rubber tube by means of water, and the cork is quickly inserted. By raising the side tube and carefully opening the stop-cock of the funnel, all air is displaced from the stem of the funnel. Five cc. of a strong caustic soda solution are now introduced into the tap funnel and drawn into the bottle with the aid of the moveable tube. The precipitate formed is well agitated, and, after the lapse of about half an hour, the funnel may be rinsed with water, and about 15 cc. of hydrochloric acid, with a few crystals of potassium iodide dissolved therein, are added as before. After complete solution of the manganese oxides, the whole contents of the bottle are transferred to a porcelain dish and titrated with sodium thiosulphate solution. By working with several bottles, a number of determinations may be very expeditiously made. If the water contain nitrites, of course a sample must be treated with HCl and KI, and titrated with sodium thiosulphate in order that the necessary subsequent correction may be made.—T. L. B.

The Behaviour of Wood and Cellulose at High Temperatures in Presence of Water. H. Tauss. Dñgl. Polyt. J. 273, 276—285.

See under XIX., page 913.

The Reactions of Oils with Nitrate of Silver. R. Brullé. Compt. Rend. 109, 118—119.

TEN cc. of oil are heated in a porcelain capsule with 0.5 cc. of fuming nitric acid. The mixture is violently agitated till a kind of cream is produced, when 5 cc. of a solution of silver nitrate in 90 per cent alcohol (25 grms. per 1,000 cc.) are added, and the heating continued. As soon as the temperature reaches about 115° C., the silver nitrate is briskly decomposed, with separation of silver. The heating must be continued till the film of silver first formed disappears. If the oil be now examined by transmitted light, by spreading it over the side of the dish, it will be found to have assumed a very characteristic tint, depending on the nature of the oil. The play of colours on the surface, as seen by reflected light, is also very characteristic. If the oil be saponified prior to the above treatment, the colours obtained are quite different. In the following table the colours yielded by different oils are given:—

COLOURS OBTAINED.

Oil Used.	In the Natural State.		Saponified.	
	By Transmitted Light.	By Reflected Light.	By Transmitted Light.	By Reflected Light.
Olive	Olive-green.	Green.	Orange (Orangé de Mars).	Cyprus-green.
Cotton.....	Green.	Asby-green.	Sienna.	Cobalt-violet.
Sesame	Chrome-yellow.	Bright Sèvres blue.	Golden-yellow.	Cobalt-violet.
Earth-nut	Greenish-yellow.	Emerald-green.	Persian lake.	Bright violet.
Poppy	Olive-green.	Bluish-green.	Golden-ochre.	Blue.
Camelina	Persian lake.	Bright blue.	Dark chrome.	Blue.
Linseed.....	Dragon's blood.	Emerald-green.	Black.	Green.
Colza	Persian lake.	Cyprus-green.	* Burnt carmine.	Ultramarine blue.

* On cooling, blue crystalline needles separate on the surface of the liquid.

With a little practice, it is easy to determine the presence of 5 per cent. of a seed oil in olive oil by means of the above test.—H. T. P.

On a Method for detecting Impurities in Alcohols by Potassium Permanganate. P. Cazeneuve. Bull. Soc. Chim. [3], 1, 700—702.

THE author uses as standard a chemically pure alcohol of 93°. The reagent is a solution of potassium permanganate of 1:1000. 10 cc. of the pure alcohol require, at the ordinary temperature of 15°—20° C., 1 cc. of the permanganate solutions to produce a colouration that will last five minutes. If it be decolourised in less time impurities are indicated. To examine dilute spirits, such as brandy, it is best to proceed in the following manner:—500 cc. of the liquor are distilled in the apparatus of Le Bel and Henninger, containing four bulbs. The first 10 cc. are tested in the same way as already specified, and compared with the chemically pure alcohol. This distillate will contain impurities, such as aldehyde, acetone, &c. The distillation is continued until only a few cc. remain, and these are tested as well. Bodies like furfural will be thus discovered.

The author contends that his method is superior to the sulphuric acid method of Bang.

Of course this reaction only proves that the alcohol contains impurities, it does not give information as to their character.—A. L.

The Estimation of the Extract in Wines by the Indirect Method. E. Egger. Zeits. Anal. Chem. 28, 397—404.

THE estimation of the extract of wines is generally performed as follows:—50 cc. of the wine are evaporated in a platinum dish on the water-bath. The residue is heated for 2½ hours in a water-oven and weighed. In the case of sweet wines, less than 50 cc. must be taken, and in no case must the dried residue exceed 1—1.5 grms. in weight. The author condemns the indirect method of estimating extract. By this process the extract is deduced from the density of the wine, freed from alcohol, and diluted to the original bulk. In a table the author gives the extract numbers obtained in the analysis of 150 samples of wine by both methods, the indirect values being deduced from the density by means of the tables constructed for the purpose by Schultze and

Hager. The differences observed between the indirectly and directly obtained results were as follows:—

Difference.	According to Schultze's Tables.	According to Hager's Tables.
Less than 0.1 grm.....	In 71 cases	In 2 cases.
Between 0.1 and 0.2 grm..	„ 61 „	„ 4 „
„ 0.2 and 0.3 „ ..	„ 15 „	„ 19 „
„ 0.3 and 0.4 „ ..	„ 3 „	„ 48 „
„ 0.4 and 0.5 „ ..	„ „	„ 48 „
„ 0.5 and 0.6 „ ..	„ „	„ 25 „
„ 0.6 and 0.7 „ ..	„ „	„ 3 „
„ 0.7 and 0.8 „ ..	„ „	„ 1 „

According to Schultze, the results are in 32 cases higher than the direct numbers, in 122 cases lower than the direct numbers, and in six cases identical with them. By Hager's tables, the results, with one exception, were found lower than the directly determined values. A wine containing less than 1 grm. of solids per 100 cc., after subtracting the free acids from the extract, is to be regarded with suspicion. For this reason at least 26 of the 150 samples examined by the author would be condemned if the extract as found by Hager's tables be accepted as correct.—H. T. P.

The Quantitative Estimation of Galactose. E. Steiger.
Zeits. Anal. Chem. **28**, 444—450.

THE author has constructed a table similar to those used for dextrose, &c., by means of which the quantity of galactose corresponding to a given quantity of copper can be found. The necessary gravimetric sugar estimations were carried out as follows:—60 cc. of Fehling's solution were placed in a beaker of about 300 cc. capacity, diluted with 60 cc. of water, and raised to the boil. 25 cc. of galactose solution were then added, and the mixture boiled for 3—4 minutes. The precipitated cuprous oxide was filtered off on a Soxhlet asbestos filter, washed and reduced in a current of hydrogen. A distinct increase in the quantity of copper was observed when the time of boiling was prolonged to 30 minutes; on the other hand, seven minutes boiling had no appreciable effect on the amount of metal obtained. From the results of these experiments the following table was calculated:—

Yield.		Yield.	
Galactose.	Copper.	Galactose.	Copper.
Mgrm. 250.0	Mgrm. 434.5	Mgrm. 125.0	Mgrm. 232.7
237.5	411.8	112.5	211.1
225.0	393.6	100.0	188.7
212.5	375.0	87.5	165.4
200.0	354.2	75.0	142.4
187.5	335.0	62.5	120.2
175.0	316.4	50.0	94.8
162.5	297.6	37.5	73.1
150.0	277.5	25.0	49.9
137.5	254.9		

—H. T. P.

Combinations of Oxide of Copper with Amalgaceous Substances, Sugars, and Mannites—New Reagents for their Direct Analysis. C. E. Guignet. Compt. Rend. **109**, 528—530.

A SOLUTION of cellulose in cuprammonium hydrate is precipitated by addition of a large quantity of water, and gives a definite compound of cellulose and oxide of copper, which gives up all trace of ammonia by prolonged washing. Amidon or starch readily absorbs cupric oxide and ammonia from cuprammonium hydrate, completely decolourising the blue liquor. The compound produced yields only the merest trace of copper on prolonged washing with water or ammonium hydrate. It is of a deep blue colour, but when heated with water to 40° C. it loses ammonia and turns to a green colour. At 80° C. the compound passes to the condition of a paste and retains anhydrous cupric oxide intimately mixed with the starch. By prolonged digestion of the above with pure ammonium hydrate a liquor is obtained containing soluble starch and cupric oxide in solution. Inulin behaves in an analogous manner. Cuprammonium hydrate does not precipitate any of the sugars, but the case is different with ammoniacal copper sulphate which does not contain excess of ammonia. This compound is produced by gradually adding to caustic ammonia pulverised sulphate of copper dried at 100° C. The mixture is boiled and allowed to cool.

Cane sugar and milk sugar have no effect on ammoniacal cupric sulphate, whilst pure glucose (from honey), galactose, &c., precipitate the reagent after a few minutes. Invert sugar prepared by action of weak sulphuric acid on cane sugar gives no reaction, nor does pure levulose. If, however, glucose be added to invert sugar or levulose the glucose compound is precipitated after several hours, which seems to indicate that invert sugar is a true compound and not a mixture of glucose and levulose. The compound of glucose and copper oxide thus obtained contains no ammonia and is soluble in water or ammonium hydrate. The ammoniacal solution is decolourised on heating without any deposition of cuprous oxide and with the formation of a soluble ammonia salt having the properties of gluconate of ammonia. This fact indicates that in the estimation of glucose by a bitartrate solution of copper we ought not to add ammonium chlorhydrate as is sometimes recommended, for in the presence of free ammonia a little glucose may escape detection.

Mannite and dulcite produce with solutions of ammoniacal cupric sulphate a blue precipitate, soluble in ammonia, to a blue solution which is not altered by boiling. Vegetable acids, gums, pectic bodies, and most other substances contained in decoctions of vegetable materials do not precipitate ammoniacal cupric sulphate, hence this body is a useful reagent for separating the carbohydrates from such decoctions. The authors have obtained well crystallised mannite from the copper precipitate obtained from a decoction of sea-weed (wrack) and from the juice of mountain-ash berries. The copper compound is decomposed by sulphuretted hydrogen, the sulphide of copper removed by filtration and the filtrate evaporated and extracted with weak alcohol.—A. J. K.

The Analysis of Etheral Oils. R. Benedikt and A. Grüssner. Chem. Zeit. **13**, 1087—1088.

A. KREMEL recently observed (Pharm. Post 1888, **21**, 789, 821) that the usual quantitative reactions employed in the analysis of fats may also perform important service in the analysis of etheral oils. He has accordingly estimated the acid-, ester-, saponification- and iodine values of a large number of etheral oils.

It is also possible to obtain valuable evidences in the identification, valuation, and discrimination of purity of the etheral oils as well as recognition of impurities, by examining these oils by the method devised by Zeisel for the estimation of methoxyl in organic compounds, since a whole series of oils contain substances in admixture, possessing the constitution of methyl- and ethyl-ethers of phenols or acids, and, therefore, on boiling with hydriodic acid, furnish alkyl-iodides. The authors propose to express

the amount of alkyl radicles separated by hydriodic acid by the "methyl-number," which indicates therefore how many milligrammes of methyl I grm. of the substance loses on being boiled with hydriodic acid. In this case ethyl, propyl and isopropyl are considered to be replaced by their equivalents of methyl, effected according to Zeisel's method by calculating into methyl the amounts of silver iodide obtained, in each case. Thus, 0.2963 grm. of oil of cloves gave 0.3737 grm. of AgI. This multiplied by 15, the weight of the radicle methyl, and divided by the mol. weight of AgI = 235, gives 0.02385 grm., the weight of methyl equivalent to the silver precipitate, or calculated for 1 grm. of clove oil = 0.0805 grm. Hence this oil of cloves possesses the methyl-number 80.5. The apparatus used has been already described in this Journal, 1889, 735, with the method adopted, and so now it is only necessary to give some account of the methyl-numbers of the ethereal oils. The samples of oils examined were just the same as those examined as to other quantitative reactions by Kreml. Though a tabulated list of

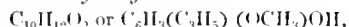
methyl-numbers is subjoined, still many more samples must be tested before it is possible to estimate the limits between which the numbers vary. In the cases of a large number of oils there is no methyl-number, whilst with others only traces of silver iodide precipitates were obtained. These are indicated in the table by cyphers. Of course only oils free from alcohol can be tested by the method, and on the other hand, when once the methyl-numbers of the oils are known, the amounts of alcohol present can be estimated in them. Absolute alcohol possesses the methyl-number 326. The presence of oils containing sulphur is indicated by a black precipitate in the silver solution. In such a case the mere weight of the washed silver precipitate yields no result of value. Oils containing ethers of higher alcohols, such as butyl-, amyl-, and hexyl-alcohol, are recognisable in that the liquid above the silver precipitate will not become clear even after heating the oil for many hours with hydriodic acid, since small quantities of alkyl-iodides are continually distilling over.

No.	No. in Kreml's Table.	Name.	Methyl-Number.	Remarks.
1	1	Ol. Absinthii.....	0	Hänsel's patent oil.
2	2	Ol. Amygdalar. amar.....	0	From bitter almonds.
3	6	Ol. Amygdalar. amar.....	0	Artificial.
4	10	Ol. Angelicæ	0	Hänsel's patent oil.
5	12	Ol. Anisi.....	82.8	Schimmel and Co., Leipsic.
6	18	Ol. Anisi stellati	79.8	Hänsel's patent oil.
7	22	Ol. Aurant. florum	0	French orange-blossom oil.
8	21	Ol. Aurant. corticum.....	6.9	Hänsel's patent oil.
9	26	Ol. Bergamottæ	0	Oil of M and O.
10	28	Ol. Bergamottæ	6.6	Hänsel's patent oil.
11	..	Ol. Betulini	22.4	Birchwood tar oil (M and O).
12	35	Ol. Calami	24.2	Oil of calamus; Hänsel's patent oil.
13	45	Ol. Carvi.....	0	Meadow cumin oil (M and O).
14	46	Ol. Carvi.....	8.3	Cumin oil of M and O.
15	47	Ol. Carvi.....	0	Hänsel's patent oil.
16	42	Ol. Carvi.....	6.6	Cumin oil, extra strong.
17	36	Ol. Caryophyllorum.....	88.8	"Eugenol" (Sch. and Co.).
18	39	Ol. Caryophyllorum.....	86.9	Hänsel's patent oil.
19	40	Ol. Caryophyllorum.....	73.8	Clove oil of M and O ("Nelkenstichöl").
20	50	Ol. Cassiæ florum.....	6.7	Hänsel's patent oil.
21	51	Ol. Cassiæ foliorum	73.2	Cinnamon-leaf oil of M and O.
22	55	Ol. Cinnamomi	25.7	Ceylon oil of cinnamon of M and O.
23	59	Ol. Citri cort.....	0	Hänsel's patent oil of M and O.
24	58	Ol. Citri cort.....	23.6	M and O.
25	61	Ol. Copaivæ	0	Para Copaiva Balsam oil.
26	63	Ol. Coriandri.....	0	Hänsel's patent oil.
27	64	Ol. Cubebæ	0	M and O.
28	65	Ol. Elemi	12.1	Sch. and Co.
29	67	Ol. Eucalypti	0	From Eucalyptus globulus, Sch. and Co.
30	69	Ol. Fœniculi.....	65.7	Hänsel's patent oil.
31	73	Ol. Gaultheriæ artefact	89.4	Artificial Wintergreen oil of Sch. and Co.
32	79	Ol. Geranii.....	0	Spanish oil of M and O.
33	77	Ol. Geranii	0	French oil of M and O.
34	76	Ol. Geranii	0	African oil of M and O.
35	80	Ol. Juniper	0	Juniper berry oil of Hänsel.

No.	No. in Kramel's Table.	Name.	Methyl-Number.	Remarks.
36	81	Ol. Juniperi	0	Juniper berry oil of M and O.
37	86	Ol. Laurocerasi	13.8	Cherry laurel oil, free from prussic acid, of M and O.
38	85	Ol. Laurocerasi	0	Rectified by M and O.
39	93	Ol. Lavandula	0	Quintessence of Sch. and Co.
40	87	Ol. Lavandula	2.4	Hänsel's patent oil.
41	97	Ol. Menthae crisp	0	Balm mint oil; Hänsel's patent oil.
42	101	Ol. Menthae pip	0	Peppermint oil, Hänsel's.
43	107	Ol. Menthae pip	0	Japanese oil, liquid.
44	105	Ol. Menthae pip	0	Superfine, Sch. and Co.
45	109	Ol. Olibani	9.1	Frankincense oil, Sch. and Co.
46	110	Ol. Petroselinii	92.2	Oil of parsley from seeds, Sch. and Co.
47	111	Ol. Pini pumid	0	"Tatschenkieferol," Hänsel's patent oil.
48	116	Ol. Pulegii	0	"Poleyol," Sch. and Co.
49	120	Ol. Rosmarini	0	Hänsel's patent oil.
50	124	Ol. Sabinae	0	Juniper oil of M and O.
51	125	Ol. Salviae	0	Oil of sage, Sch. and Co.
52	126	Ol. Santali	0	East Indian sandalwood oil, Sch. and Co.
53	128	Ol. Santali	0	West Indian sandalwood oil, M and O.
54	133	Ol. Terebinthinae	0	French oil of turpentine, Sch. and Co.
55	136	Ol. Terebinthinae	0	Austrian oil of turpentine.
56	137	Ol. Terebinthinae	0	American oil of turpentine, Sch. and Co.
57	141	Ol. Valeriana	0	Valerian oil, Sch. and Co.

The methyl-number gives direct indication of the value of some oils. For example, from the methyl-number can be calculated—

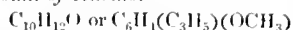
1. The Amount of Eugenol—



in oil of cloves, oil of cinnamon leaf, oil of cinnamon root, and in Ceylon oil of cinnamon. Thus there are contained in the following from the table already given:—

No.	Name.	Methyl-Number.	Eugenol.
			Per cent.
13	Ol. Caryophyllorum (Eugenol of Sch. and Co.)	88.8	97.0
14	Ol. Caryophyllorum (Hänsel's patent)	86.9	94.0
15	" " (Clove oil)	73.8	80.6
20	Cassia flor. (Hänsel's oil)	6.7	7.3
21	" foliorum (Cinnamon leaf oil).	73.2	80.0
22	Cinnamomi (Ceylon oil of cinnamon).	25.7	28.1

2. The Amount of Anethol—



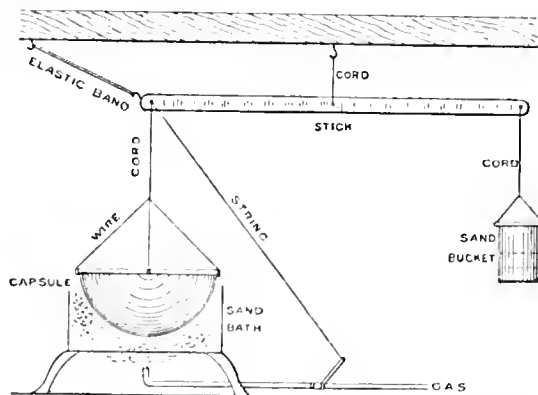
in oil of anise, oil of star anise, and oil of fennel.

No.	Name.	Methyl-Number.	Eugenol.
			Per cent.
5	Ol. Anisi (Sch. and Co.)	82.8	81.7
6	" (Hänsel's patent oil)	79.8	78.7
7	Ol. Foeniculi (Hänsel's patent oil) ...	65.7	64.8

3. The Amount of Apiol, $C_{12}H_{14}O_3$, in oil of parsley. For this the methyl-number of pure apiol must first be determined.

Automatic Evaporating Apparatus. F. E. Ray. Pharmaceutical Record.

THE author describes an apparatus, which he has designed, for checking evaporation when it has reached a desired point. It is represented in the following illustration, which speaks for itself:—



The evaporating dish is counterpoised by sand placed in the bucket; then the weight to which the liquid is desired to be evaporated is counterpoised by an additional quantity of sand. The elastic band and the string to the gas tap are then arranged and heat applied. When the liquid has evaporated to the desired weight the falling of the sand bucket causes the closing of the gas tap, and the elastic band swings the dish away from the sand bath.

PATENT.

Improvements in the Means of Determining the Percentage of Fat in Milk. N. G. K. HUSBERG, Arboza, Sweden. Eng. Pat. 16,697, November 17, 1888. 6d.

THIS is an apparatus for the above purpose, and consists in a syringe-shaped instrument in which the milk and the chemicals (ether and alcohol) are mixed and the fat separated. The syringe is connected with a fine tube, into which the separated fat is forced and measured. Drawings accompany the specification and illustrate the construction of the instrument.—W. M.

New Books.

THE YEAR BOOK OF COMMERCE. Edited by K. B. MURRAY. Cassel and Co., London.

THE new Year Book of Commerce is an 8vo. volume, price 5s. It is compiled under the authority of the London Chamber of Commerce, is projected on the most useful lines, and contains a multitude of statistics arranged so as to be easily accessible and to carry their lessons at once to the reader. The tables of international trade contain in themselves a lesson, and inculcate a further lesson in the art of studying statistics profitably. Amongst other things, it is shown that the United Kingdom takes thirty-two per cent. of the entire exports of Russia, a circumstance worthy of consideration when our political attitude towards Russia comes under discussion. On the other hand, of Russian imports only 23 per cent. are drawn from the United Kingdom, and here Germany leads us. Thus, though we may not have less to lose than Russia through war, we should not be unmindful that Germany heads us in the supply of manufactured articles to Russia, and that we cannot afford to risk an inward trade from Russia amounting in 1887 to some 19 millions sterling, especially as so much of it is represented by food, wood, and other elementary products upon which life itself depends.

Again, though proximity has much to do with the volume of the trade transacted between two countries, in many cases it would be fallacious to conclude that a near neighbour is likely to be a good customer. Thus, Norway is closer to us than Sweden, yet we take only 7 per cent. of Norway's exports and 47 per cent. of Sweden's. Also, Germany takes only 35 per cent. of Denmark's exports, whilst we take 50 per cent. France is the country which most cultivates its immediate neighbours, and is far ahead of us and of Germany both as a buyer from, and seller to, Belgium, Spain, and Italy.

Germany is a seller rather than a buyer, so far as Europe goes, and in every case, save that of Belgium and that of Italy, it sends a greater percentage of the goods imported than it takes of the goods exported by the various countries. We occupy the converse position, with the exception of Italy. We take only 8 per cent. of what Italy has to sell, but send 19 per cent. of what she requires to buy.

There might be room here for our importers to cultivate Italy a little. Between the quinquennial periods, 1871—75 and 1875—80, the falling off in Italian exports to us was 15 per cent.; between 1875—80 and 1881—85 it was 19 per cent., but comparing 1887 with 1886 there was a growth of 11 per cent. At the same time, Italy was materially increasing the percentage of British goods in her importation, and though the onus of extending the export trade should lie with Italy, it is not certain that importers here might not legitimately, and with benefit to themselves, try to discover if there are no products now obtained elsewhere which might not be got as good and more cheaply from Italy.

DIE FARBEN INDUSTRIE. Viertel Jahrsbericht über die Leistungen auf dem Gebiete des Steinkohlentheers, der Chemie der aromatischen Verbindungen, der Künstlichen Farbstoffe, der Färberei, Bleicherei, des Zengdruckes und der Appretur. Im Verein mit fachkundigen Mitarbeitern herausgegeben von E. BERNSTEIN, Erstes Heft, October bis Dezember 1888. Berlin: Mayer and Müller, Markgrafenstr. 51. London: H. Grevel and Co., 33 King Street.

LARGE 8vo. pamphlet in paper cover. The price of the four numbers, Hefte 2 to 5, for 1889, is 2s.

The manner in which this subject is treated in this new quarterly journal, is made clear by a glance at the sub-divisional headings, which are as follows:—I. COAL TAR. II. AROMATIC COMPOUNDS. A. GENERAL. 1. Physical. 2. Physiological. 3. Theoretical. B. SPECIAL. Benzene Group. Diphenyl Group. Phenylated Fatty Hydrocarbons. Indol Group. Quinoline Group. Naphthalene Group. Phenanthrene Group. Anthracene Group. III. MORDANTS and DYE-STUFFS. IV. BLEACHING, DYEING, CALICO PRINTING and FINISHING. 1. General. 2. Preparatory operations. 3. Dyeing, printing, finishing. The present number (No. 1) commences with editorial preface, in which the necessity for such a collective quarterly periodical is claimed, considering the numerous discoveries of suggestive character, new colours or compounds possessing marked physiological influence, patents taken out by the physiologist, colour chemist, dyer, and calico printer, now being continually placed before the world.

The number contains 104 pages of text, and no pains appear to be spared to do the fullest possible justice to the theoretical as well as the practical side of the entire subject.

CHEMIKER-KALENDAR, 1890. Ein Hilfsbuch für Chemiker, Physiker, Mineralogen, Industrielle, Pharmaceuten, Hüttenmänner, u.s.w., mit einer Beilage. Von Dr. RUDOLF BIEDERMANN. Elfter Jahrgang. Verlag von Julius Springer, Monbijou-Platz, 3, Berlin. N. H. Grevel and Co., 33, King Street, Covent Garden, London.

SMALL 8vo. volume, in pocket-book form, price 3s., containing: Table of Contents; Chronological Table of important Occurrences and Discoveries during the Christian era, relating to Chemical and Physical Science; Calendar, with blank pages for notes; Table of more-frequently used Atomic Weights. After the Calendar follow some 28 pages of blank ruled paper for memoranda, &c. Next is a complete series of Tables supplying every want of the chemist which tabulated matter can supply. A good example of an amount of useful and valuable information condensed into a small space is to be found in the little chapter on the Investigation of Clays by Mechanical and Chemical means, and also of Fire Clays, the chapters mostly tabulated, on the detection and testing of the Coal-tar and Natural Colours, are also models of their kind. The work closes with a few pages ruled for the record of names and addresses, fly-leaves at the end supplying the German Post Office Regulations, and a complete railway map of the German Empire. The text fills 315 pages, a small volume in paper cover forming an Appendix to the Calendar—the "Beilage" referred to in the heading. In this are to be found tabulated matter for physicists, and at the end an Appendix, giving information as to the Professors and Dozenten in the various Polytechnic Schools and Universities, and to the subjects taught in those Institutions. A tabulated list is added of the prices of the various kinds and sizes of the more important articles of chemical apparatus.

HANDBOOK OF CHEMICAL TECHNOLOGY. Compiled and edited in association with several scientific men and specialists by Dr. P. BOLLEY, late Professor of Chemical Technology in the Swiss Polytechnikum in Zürich. Subsequently continued by Dr. K. BIENBAUM, Hofrath and Professor of Chemistry in the Polytechnikum of Karlsruhe. First volume of Group III. THE CHEMICAL TECHNOLOGY OF FUELS. By Dr. FERDINAND FISCHER. Brunswick: Friedrich Vieweg und Sohn. London: H. Grevel & Co., 33, King Street, Covent Garden.

THIS important work on the Chemical Technology of Fuel is contained in two volumes, Part I. and Part II., of which

Part I. was issued in 1880, and Part II. in 1887. They are of 8vo. size, enclosed in paper covers, and the price is 13s. The work is fully illustrated with 281 finely executed wood engravings, Part I. with 119 and Part II. with 135.

Part I. (1880) contains 160 pages of subject-matter, whilst Part II. (1887) contains 245. The whole work is devoted to methods of investigation, and these are headed as follows:—Measurements of Heat; Measurements of Light; Investigations of Fuels; Investigation of Atmospheric Air; Investigation of Fuel Gases; Investigation of Illuminating Gas. Under the investigation of Fuel is to be found a very complete and full description of the various calorimeters which have been devised; under that of Atmospheric Air, descriptions of the methods for estimating ozone, carbonic acid, carbonic oxide, sulphuretted hydrogen, sulphurous acid, and ammonia; whilst under Fuel Gases and their investigation are given data for judging of furnace efficiencies, for calculating the losses of heat through the gaseous products of combustion and for instituting a research as to evaporation efficiency.

MINES. Summaries of the Statistical Information contained in the Reports of Her Majesty's Inspectors of Mines under the provisions of the Coal Mines Regulation Act, 1887; the Metalliferous Mines Regulation Acts, 1872 and 1875; and the Slate Mines (Gunpowder) Act, 1882. Also List of Inspectors and Inspection Districts, Forms of Returns, and Particulars of Examination Boards and of Examinations. (C.—5780.) Price 9½d.

In the introduction which precedes these summaries it is stated that under the Coal Mines Regulation Act, 1887, every inspector of a district, and under the Metalliferous Mines Regulation Act, 1872, every inspector is required to make an annual report to a Secretary of State, and these reports have to be laid before both Houses of Parliament.

In these reports the statistics of persons employed in and about the mines are prepared, and an account of minerals wrought under the Coal Mines Act is also given. A separate volume, entitled "The Mineral Statistics of the United Kingdom," is also prepared by the Inspectors of Mines. From the summaries there given it appears that:—

The number of persons employed in and about all the mines in the United Kingdom of Great Britain and Ireland, together with the Isle of Man, and inclusive of those employed on private branch railways and tramways, and in washing and coking coal on premises adjacent to or belonging to the mines (this latter information being an addition to previous summaries), amounted to 592,656, of whom 5,680 were females above ground.

The number of persons employed in and about all the mines, exclusive of those employed on private branch railways and tramways, and in washing and coking coal, was 578,417, of whom 5,357 were females, the aggregate increase being 10,391.

The total number of fatal accidents was 885, and the total number of deaths occasioned thereby 960, being an increase of 4 in the number of fatal accidents, and a decrease of 91 in the number of lives lost, compared with the totals of the preceding year. The summary shows also the ratio of fatal accidents and deaths to persons employed, the death-rate per 1,000 being 1·660 as compared with the higher ratio of 1·850 of the year 1887.

The quantities and kinds of mineral wrought in the different districts in 1888 amounted to 182,660,163 tons, of which 169,935,219 was coal and 8,635,032 ironstone, the rest being fire-clay, oil shale, and other minerals, being a total increase of 9,610,368 tons compared with the preceding year, the increase of coal being 7,815,407, and of ironstone 1,065,114 tons.

The occupation of persons employed in and about mines under the present and former Coal Mines Acts is now more than twice as safe as it was at the commencement of the inspection, the average ratio for the first 10 years ending 1860 being one death in every 245 persons employed, for the 10 years ending 1870 one death in 300, for the 10 years ending 1880 one death in 425, whilst for the present year it is one in 602, a much more favourable ratio.

The ratios of accidents and deaths to the number of persons employed and tons of mineral wrought in each of the districts were, in 1888:—222,185 tons of mineral wrought for every fatal accident, and 205,698 tons for every death, as compared with the lesser quantities, 208,494 and 173,919 tons respectively in the preceding year.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

RUSSIA.

Classification of Articles in Customs Tariff.

Note.—Pond = 36 lb. avoirdupois. Gold rouble = 3s. 2d.

A despatch, dated the 24th October last, has been received at the Foreign Office from Sir R. B. D. Morier, Her Majesty's Ambassador at St. Petersburg, enclosing a translation by Mr. Consul Michell, of a recent notification of the Customs Department making the following classifications of articles in the Russian Customs Tariff:—

Zinc sheets, nickel plated, to be admitted under section 102, point 2, of the Customs tariff. Duty at 85 copecks gold per pond.

Magnesite in powder, to be cleared under section 135. Duty at 15 copecks gold per pond.

Azotic acid salt of barium and strontium, to be cleared under section 140, as chemical salts not specially mentioned in the tariff. Duty at 2 r. 40 copecks gold per pond.—*Board of Trade Journal.*

Customs Tariff.

The Russian Customs tariff for drugs and chemicals is about to be revised in a manner which will render the importation of certain articles almost impossible. On this occasion the move appears to be made especially with the idea of injuring Germany. The duty on ether, collodium, salicylic acid, and chloroform is to be raised from 6 roubles to 15 roubles; on sulphuric acid, from 22 copecks to 30 copecks; on tartar-emetic, from 26 copecks to 4 roubles (about 400 per cent.); stearin and similar tars from 1·20 to 2 roubles; borax and boracic acid, from 11 copecks to 240 copecks per pond. These are but a few examples of an increase which extends over the whole of the drug and chemical branches. The pond is equal to 36 lb., and the gold rouble (in which duties are payable) to 3s. 2d.—*Chemist and Druggist.*

Revised Customs Tariff.

The revised Russian Customs tariff, under which the duties on many articles, especially certain classes of machine-tools, dyestuffs, tanning materials, colonial goods, glass and earthenware, chemicals, and pharmaceutical preparations, are to be increased to such an extent as to amount to virtual prohibition of importation, will probably come into force at the close of the first quarter of 1890. A new feature in the tariff is the adoption of a scheme by which the present duties are preserved for a number of articles, with the proviso that they will be applicable to the lowest class of goods only, while for goods of better manufacture and superior quality the duties will be doubled or even trebled. It was at first thought that the new Customs law would be aimed specially against Germany, but, according to this particular "shoddy" clause, it would certainly seem as if Germany is to be exceptionally favoured, at the expense of such countries as Great Britain and France.—*Ibid.*

ITALY.

Prohibition of the Importation of Saccharine.

A communication, dated 8th October last, has been received from the Foreign Office, forwarding the following translation of an Italian decree, dated the 29th September last, by which the importation and production of saccharine and saccharine products in the kingdom of Italy are prohibited.

Art. I. The importation and production in the kingdom of Italy of saccharine (*benzoato solfinico*) and of saccharine products are prohibited.

Any person contravening or attempting to contravene this prohibition will be subjected to the penalties imposed for contraband.

The rules respecting the importation of saccharine for medical use will be fixed by ministerial decree.

Art. II. The present decree will come into force on the 1st October 1889, and will be presented to Parliament to be converted into law.

A despatch, dated the 15th October last, has been received from Mr. H. N. Dering, Her Majesty's Chargé d'Affaires at Rome, enclosing copy and translation of the regulations framed by the Ministry of Finance, in accordance with the decree printed above, respecting the introduction into the kingdom of saccharine for pharmaceutical purposes. The copy and translation in question may be seen on application at the Commercial Department, Board of Trade, S.W.—*Board of Trade Journal*.

QUEENSLAND.

Exemption from Duty of Sulphate of Ammonia.

The *Moniteur Belge* for the 5th October last states that, according to a recent decision, sulphate of ammonia intended exclusively for the manufacture of liquid ammonia is free from import duties in the colony of Queensland.—*Ibid*.

Foreign Import Duties on Salt.

See *Board of Trade Journal* for November, p. 507.

VICTORIA.

Tariff Alterations.

The revised Tariff Bill was passed in October, and by it all medicines are to pay a duty of 25 per cent. *ad valorem*. Medicines are defined as consisting of two or more ingredients mixed ready for use, not being in chemical combination; drugs and chemicals, packed ready for retail sale or consumption, including medical compounds, containing spirits not exceeding the strength of proof by Sykes' hydrometer; and all preparations recommended as beneficial for any portion of the human or animal body or the cure or the treatment of any disease or affection whatever; and medicine chests or cases, with or without fittings. Patent and proprietary medicines as such disappear from the tariff. Chinaware and porcelain (except photographic and telegraphic materials) is changed from 2s. 6d. per cubic foot to 15 per cent. *ad valorem*; earthenware, including packing (except the above materials), altered to 8d. per cubic foot, measuring outside the package as imported, instead of 1s. 4d. per cubic foot measured after the goods had been unpacked and stacked, and all breakages thrown out; bent and bevelled glass, instead of 1s. per cubic foot, is now 20 per cent. *ad valorem*; all bottles, including medicine bottles, are to be 6d. per cubic foot, measured outside the package, not the solid measurement of the bottles themselves; the duties on oils in bottles are doubled (4s. per dozen quarts and so on), and a new line has been introduced imposing 12s. per dozen on bottles of oil containing more than a quart, but less than a gallon; perfumery is raised from 10 to 20 per cent.; the duty on paper and cardboard boxes is now revised so as to cover paper or cardboard (with or without printing) cut into shapes for wrapping or boxing, and still stands at 25 per cent. Acetic acid, formerly 3d. per pint or lb., is now charged at that rate when containing not more than 30 per cent. of "acidity," and for every extra 10 per cent., or part of 10 per cent., above 30 per cent., 1d. per pint or lb.

Chlorodyne is classed as a drug at 25 per cent. *ad valorem*. *Cocculus indicus* is raised from 1s. 6d. per cwt. to 1s. per lb.; *nux vomica* from 1s. 6d. per cwt. to 2d. per lb., but with no corresponding increase on strychnine. Liquid glue, liquid gum, and cements are made 20 per cent. *ad valorem*; gold and silver leaf, 20 per cent.; inks, writing liquid or powder, 10 per cent.; leather (including split skins, &c.), 6d. per lb.; extracts of or concentrated meat, 20 per cent.; preserved milk, 2d. per pint or lb.

Duties have been removed from carbolic, oxalic, and pieric acids, aloes, *cannabis indica*, *faba amara*, grains of paradise, quassia, iodide and bromide of potassium, and syphon bottles, which are now free.—*Chemist and Druggist*.

FRANCE.

The Match Monopoly.

The French Ministry suffered a serious defeat in the new Chamber on the 21st November, on the question of the lucifer match monopoly. The Government accepted an Order of the Day in favour of its working the monopoly, but this was rejected by 312 to 236. The first clause of a Bill making the manufacture of matches a free industry was carried against the Government by 292 to 232; but 48 hours later the Bill was thrown out by a majority of seven.—*Standard*.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

THE MARGARINE TRADE IN SWEDEN.

A despatch, dated the 24th October last, has been received at the Foreign Office from Sir F. R. Plunkett, Her Majesty's Minister at Stockholm, respecting the Swedish decree relating to the manufacture of margarine. The following is a copy of the *précis* of some of the provisions of the new enactment concerning margarine forwarded to Sir F. Plunkett's despatch:—

The new law which has to-day appeared in print is intended partly to prevent margarine (by which the enactment comprehends every butter-like substance of whatever origin, mixture, or combination it may be, so long as it contains fat which is not produced from milk) from being offered for sale in Sweden, imported thither or exported thence, except under its proper name; partly to provide a control that the margarine which is made in the kingdom be prepared from adequate materials that are innocuous to health, and that the preparation thereof is conducted in such a manner that the article manufactured is not injurious to health.

On comparing it with the present Swedish margarine law, we find that the new enactment presents the following essential differences, viz., constant control of the manufacture; a prohibition of owners of dairies making margarine; certain shapes for the vessels in which margarine is to be kept; the expenses of testing being as a general rule defrayed from the public purse; the greatly increased individual responsibility.

From the brief account we have just given of the characteristics of the new law, it will be observed that it closely resembles the Danish law concerning margarine. In Denmark, however, there is no constant control during manufacture as proposed in Sweden, while on the other hand the Swedish law does not include the decrees laid down by the Danish law concerning the colour of margarine, and the highest percentage of butter which margarine, according to their law, may contain.—*Board of Trade Journal*.

SILICIAN SULPHUR.

(*United States Consular Reports, August 1889, p. 549.*)

The American Consul at Palermo states that compared with former years little brimstone is now exported from Sicily in consequence of the low prices which obtain, and it is feared by some that the industry may have to be abandoned in the near future.—C. G. C.

CHINA.

Drug Exports.

The exports of some of the principal drugs from the Chinese treaty ports in 1888 have been:—

	Star Anise.	Camphor.	Musk.	Galls.	Ess. Oils.	Blue-barb.
Piculs	6,532	3,893	27½	31,201	2,346	1,265
Value, H. taels	80,392	33,631	221,473	316,372	250,475	167,528

The Camphor Trade of Formosa.

Camphor is gathered in the interior of the island of Formosa by Chinese Government employes, and then is taken over at the town of Tawatutia by a Cantonese contractor at the rate of 12 dolrs. per picul of 133½ lb. The work of collecting is done partly by civilians and partly by soldiers, and without military protection to the workmen from the attacks of the savages little collecting could be done in the wilder and more productive regions. Hence, when the soldiers have to be drawn away on more pressing duties, the work amongst the camphor trees is stopped. In 1888 troubles with the aborigines in two different parts of the island have occupied all the available troops, deprived the contractor of the handsome profits he would have made had he received the usual supplies, when Formosa camphor in the Hong Kong market rose to 30 dolrs. per picul. When the new contractor took over the work at the end of 1887, he introduced strong cases with thick lead linings for the carriage of camphor. But recently it has come forward for shipment in the old large tubs, containing nearly four piculs, while the cases contained less than one. It is also said that since the trade became a Government monopoly, camphor has gained in purity by the exclusion of the gum of a species of rattan creeper with which it was adulterated before.

Opium.

With regard to the falling off of the imports of opium into China, our Consul at Chin Kiang states—"The prospects for the present year point to a considerable further diminution of the import of 1888. In my opinion foreign opium is doomed to become, within a very measurable distance of time, a mere expensive luxury, only used by connoisseurs and the very rich, just as the very choice vineyards of France are in Europe."

Packing Goods.

Special attention should be paid to packing, as goods are subjected to very rough usage on their way into the interior of China.

Ground-Nut Oil.

Ground-nut oil has made a first appearance as an article of export by steamer from Pakhoi in 1888. Instead of sending it as formerly, in bulk, by junks, a method is gaining favour of packing it in old kerosene tins and shipping it by steamer, which suggests that considerable development may be looked for in the export of this article. —*Chemist and Druggist.*

MAURITIUS.

Vanilla Exports.

The following were the exports of vanilla from Mauritius in the years 1886 and 1887, according to value and weight:—

	1886.		1887.	
	Quantity.	Value.	Quantity.	Value.
	Kilos.	Rs.	Kilos.	Rs.
To France	12,054	208,312	12,496	182,421
To United Kingdom	10,604	100,537	5,954	67,988
To other countries	234	3,200	51	530
Total	22,792	312,049	18,501	250,939

—*Ibid.*

JAPAN.

Drug Imports.

Among the articles imported into Yokohama last year (1888) the following were of pharmaceutical interest:—

	Quantity.	Value.
	Lb.	£
Western drugs and chemicals.....	..	129,944
Eastern " " " .....	..	20,941
Aniline dyes.....	290,789	45,752
Dyes and paints.....	..	29,013
Indigo.....	379,184	28,734
Logwood extract.....	1,644,393	36,669
Condensed milk.....	..	16,466
Oils and wax .....	..	20,938
Oil paints.....	894,720	11,027
Potash.....	51,658	17,568

—*Ibid.*

PERU.

Drug Exports.

The value of coca leaves exported from Peru in 1888 is returned at 369,361 soles, which represents about 730,000 lb., the price ranging locally from 25 to 30 soles per 50 kilos. The exports of so-called "crude cocaine" are placed at about 100,000 soles.—*Ibid.*

GERMAN CHEMICAL TRADE.

Consul Monaghan, of Mannheim, reports that Germany is exporting to all parts of the world all kinds of drugs and chemicals in a finished state. During the last year 232,800,000 marks worth, mostly raw material, came in, and 236,000,000 marks worth, mostly finished material, went out of the Empire. Seven per cent. of the Empire's entire trade was in these articles in 1888, as follows:—

	Imports.	Exports.
	Marks.	Marks.
Raw material.....	143,300,000	27,800,000
Manufactures.....	99,500,000	208,300,000

The table shows an import of five times as much raw material as export of the same, while the export of manufactured wares was more than double the import of the same. The amount and values may be better expressed in the following table:—

Description.	Imports.	Exports.
	Marks.	Marks.
Raw materials:		
Raw material for chemical purposes	65,200,000	7,700,000
Medicinal drugs	15,600,000	5,800,000
Resins, pitches (Hartz)	21,200,000	7,400,000
Tanning stuffs	24,100,000	1,200,000
Manufactures:		
Bases, acids, and salts.....	27,700,000	60,300,000
Ether, oils, medicines, perfumeries .	9,000,000	27,200,000
Explosives and combustibles.....	700,000	12,800,000
Colours	34,700,000	80,500,000

—*Chemical Trade Journal.*

MISCELLANEOUS TRADE NOTICES.

THE CONDITION OF SIBERIAN INDUSTRY.

The *Lecum Herald* for the 8th October last says that there has recently been published at St. Petersburg an interesting work concerning Siberia, in which the following remarks occur:—

Judging by the official publication, Siberian industry is still in a sad condition. This immense country has only 1,055 factories and works, with 7,163 workmen, and a production of little more than 13 million roubles. And what are these factories? Cotton, woollen, and flax mills are conspicuous by their absence. It is the tanneries, the tallow factories, and the shops for the dressing of sheep skins which predominate. Specialists of a more refined order are almost non-existent. Thus, there was in 1887, for the whole of Siberia, only one factory of chemical products, and it was small, its annual production being only 25,000 roubles. It was the same with the paper factories, the only one existing producing only to the value of 4,000 roubles. It should be stated that the two factories were both in Western Siberia. —*Board of Trade Journal*.

INFLUENCE OF TAXATION ON METHODS OF PRODUCTION.

See *Board of Trade Journal* for November, pp. 568—576.

COMMERCIAL CRISES, AND THEIR PERIODIC RECURRENCE.

Ibid., pp. 577—579.

THE FUTURE PROSPECTS OF THE SALTPETRE INDUSTRY IN TARAPACA.

Chem Zeit. 13, 1915.

The President of the Chilean Republic, in his speech at the opening of Congress on the 1st of June, spoke of the position of the saltpetre industry, and its relation to the country itself. It was the desire of the Government to increase the production and lower the price of saltpetre, and at the same time to give the industry a more national character. This it was proposed to do by dividing out the saltpetre districts, and offering them publicly for sale. A certain portion of the best beds, however, would be reserved for natives and none other, and should they sell, they must sell to natives only. The country could not, of course, be closed to foreigners, but by such measures as these the Government hoped to prevent the industry becoming merely a foreign monopoly.—T. L. B.

CINCHONA HISTORY.

The idea of acclimatising cinchona in the British West Indian Islands was conceived about 30 years ago, when the exploring party who had been sent to South America to obtain cinchona plants and seed for British India were instructed to send any surplus they might have to the Governors of Jamaica and Trinidad for experimenting purposes. In 1861, the year following the receipt of the seed, there were already 400 plants ready for planting out in the Jamaica Botanical Gardens. As the climate of Bath Gardens, where the first experiment was made, was unsuitable for the successful growth of cinchonas, they were tried at Cold Spring coffee plantation, at an elevation of 4,000 feet. There the climate and soil proved all that could be desired, and in November 1862, a plant of *Succirubra* cinchona had attained to the height of 44 in., with leaves measuring $13\frac{1}{2}$ in. long by $8\frac{3}{4}$ in. broad. The same plant, when two years old, measured 6 ft. in height, with ten branches, having a circumference of stem at base of $4\frac{1}{2}$ in.

The experience gained in these preliminary attempts paved the way for the larger enterprise undertaken by the Jamaica Government in 1868, from which date cinchona planting in the island took a fresh departure. A further supply of seed, consisting of *C. officinalis* and *C. calisaya*, was obtained from Ceylon. In 1886 the Government

cinchona plantations in the Blue Mountain district occupied 143 acres. For the purpose of encouraging the cultivation of cinchona by private enterprise, the Government plantations during the last few years have distributed 1,250 oz. of cinchona seed, 1,200,000 cinchona seedlings, and 469,000 cinchona plants.

Large shipments of cinchona bark were made from the Government plantations during the years 1879 to 1884, and the prices realised proved that the climate and soil of Jamaica were particularly well suited to the successful cultivation of cinchona plants. As much as 10s. per lb. was obtained for root bark of *C. officinalis*, while on large shipments the average price realised was 6s. 7d. per lb. All the various species of cinchona have been introduced to Jamaica, including the valuable *C. ledgeriana*.

About 2,600 acres have been taken up by private planters for the cultivation of cinchona in Jamaica, and the industry there is now well established. But as Jamaica was late in the field, and only now produces bark of sufficient age to be placed in the market, the planters are compelled to hold back their bark until there is such an improvement in the market as will justify regular shipments. This, it is hoped, will only be a question of time. Meanwhile two samples of Jamaica loxa bark, from trees six years old, grown on a private plantation at 5,000 feet, have been lately analysed by Mr. David Howard, and found to contain:—

	Quinine.	Cinchonidine.	Cinchonine.	Amorphous.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	2.23	0.44	0.04	0.51
2	1.74	0.57	0.06	0.55

In each case there was a trace of quinine.

The tests are thus very much what loxa bark of similar appearance from South America would give. It is rather a Chaguera than a Crispi or Uritusinga, which gives the richer yields that characterise the finest officialis from the Dodaketta plantations. The fine old South American HO loxa quills, which would now be worth in London from 2s. 2d. to 2s. 6d. per lb., are used by French pharmacists for flavouring liqueurs. They are said to give to the latter a bouquet which cannot be obtained with any other variety of bark, or even with loxa itself when grown in India, Java, or Jamaica. For this reason only the genuine South American loxa realises prices wholly out of proportion to its alkaloidal value. It is also said that common hard pitayo bark at 2d. to 3d. per lb. is used in Spain for giving a "body" to sherry wine.—*Chemist and Druggist*.

GERMAN EXPORT TRADE.

A report on the export trade of the German Empire for the first half of the current year shows a material decline in the export of all German textiles, and a still more serious decrease in iron goods, especially rails, wire, and pig iron, which between 1886 and 1888 declined nearly a half, and the first half of 1889 recovered only slightly. The latter seems to be affected most unfavourably by the tariff policy and "rings." In machinery, the export of locomotives and engines falls considerably short of 1886 as well as of 1888, while the export of other machinery also is less than 1888. Copper goods have constantly declined; lead and zinc have also decreased. The trade in chemicals is still favourable, especially tar colours and chloride of potash, and aniline dyes improve slowly. In sundry articles, which up to last year showed a steady advance, a great decrease is noticeable in 1889, such as glassware, leather, and leather goods. There are also decreases in the exports of alcohol, spirits, beer, and paper, while there is an increase in sugar. The total result is a certain stagnation in the export of industrial products, which in 1888 amounted to 2,337 million marks, and in 1889 to only 2,369 million, and a notable decrease in the last half year. In raw materials there is a steady decrease from 958 million marks in 1880 to 932 million in 1883 and 834 million in 1888.—*Ibid.*

MINERAL RESOURCES OF PERSIA.

Recent surveys have shown that the supply of coal in Persia is not restricted to one or two places, that the quantity is practically unlimited, and that at the pit's mouth it can be produced and sold for 5s. or 6s. a ton. At present coal is only worked at Hir, 40 or 50 miles from the capital, where the output each year is 15,000 tons. Iron is believed to be found in close conjunction with these Persian coal-fields, but at present only one mine near Teheran producing excellent ore and 70 cent. of metal is likely to be seriously worked. The Elburz range is also rich in this mineral—the ore producing from 25 to 60 per cent. of metal. Copper is found throughout the country, and was one of the chief exports from Gombroom 170 years ago. There is also abundance of lead in the Elburz mountains, and as there is a great demand for this metal in Russia, it is expected that a profitable trade in it can be carried on across the Caspian. Among the other mineral resources of Persia may be mentioned borax, manganese, asbestos, and mercury. Naphtha and petroleum have also been referred to, and as they are to be found in greatest abundance near the Karun they can speedily be turned to practical purposes. —*Ironmonger*.

SODA IN HUNGARY.

Soda ash and soda crystals are imported into Hungary in large quantities: in 1888, 9,094 tons; in 1887, 8,660 tons; and in 1886, 8,350 tons, although very large soda deposits exist in the country itself. Near Nagy-Böcskő, in the district of Marmaros, there are large soda works owned by a Swiss, Mr. Friedrich Müller, but these are by no means equal to the supply of the wants of the country. Most of the soda salts imported into Hungary come from Bohemia, Silesia, and Galicia. A considerable quantity is also purchased from England and imported *via* Trieste, notwithstanding there is a duty of about 11d. per lb. on foreign soda ash and crystals. —*Chemist and Druggist*.

QUICKSILVER IN RUSSIA.

From some additional information about the Russian quicksilver mines recently given by a Russian gentleman, it appears that a bed of cinnabar was discovered in 1879 by Mr. A. W. Minenkoff, a Russian mining engineer, in the Catherine-slaff Government district of Bakmouk, about three miles east from the railway station, Nikitoko, on the Koursk-Kharkoff-Azoff line. From want of sufficient means the mine was not worked until Mr. Alexander Auerbach, late Professor of the Imperial Mining Institution of St. Petersburg, obtained from the peasants of the village Zaizelf, the owners of the land, the right of exploitation in the beginning of 1885. He engaged Mr. Minenkoff for careful exploration during the summer. The results being satisfactory, Mr. Auerbach was lucky enough to raise the required capital (exceedingly difficult in Russia, especially for mining affairs), and formed "The Society for the Exploitation of Quicksilver, Alex. Auerbach and Co., in St. Petersburg." At the end of December 1886, all buildings, engines, &c. being ready, the works were started. The lodes discovered are from 21 to 49 ft. thick, running from east to west, with a dip of 50°. The quantity of ore proved by exploration is estimated to be about 194,000 tons, and, calculated at nearly 1 per cent. quicksilver, would produce about 1,900 tons of metal. The works delivered during 1887, 3,905 pounds, or 141,009 lb. of quicksilver; in 1888, 10,060 pounds, or 362,366 lb., but with the present number of furnaces the company will be able to treat annually 51,200 tons of ore, and on the basis of the present extraction of about 15 lb. of pure quicksilver to the ton of ore, the quantity produced for sale will increase up to 22,400 pounds, or 808,864 lb., per annum. The consumption of quicksilver in Russia being about 2,000 flasks of 84½ Russian lb., or 76½ lb., English, every year, the company can export nearly 18,000 lb., say 8,820 flasks, per annum. The cost price of 1 pound (36 lb.) of quicksilver is not quite 15 roubles (1l. 11s. 3d.), or per flask of 2 pounds 4½ lb. (76½ lb. English), 31.50 roubles (3l. 6s.), and, with the selling price between

7l. and 8l. per flask, there are good reasons to expect good dividends in the future. These are the first and the only quicksilver works in Russia. Their establishment and prime cost has been about 630,000l. —*Ibid*.

AN AMERICAN CHEMICAL SOCIETY.

Eng. and Min. Journal, 48, 333.

In the issue of the *Engineering and Mining Journal* for June 8th, 1889, we referred to the proposed formation of an American Chemical Society, a plan for which was to be discussed at the Toronto meeting of the American Association for the Advancement of Science. In accordance with this plan an afternoon was devoted to the consideration of the suggested organisation before the Chemical Section, and in the discussion Professors Barker, Reimsen, Clarke, and Prescott each took an active share. For the most part the gathered chemists evinced their desire for a national society, but the conservative expressions of opinion from certain of the older members led to the loss of the resolution recommending the continuation of the committee with instructions to draw up a plan of organisation; and subsequently a committee was appointed, with instructions to canvas the ground and report at Indianapolis at the next meeting. This committee consists of Professors Clarke, of Washington; Bolton, of New York; Hart, of Easton; Warder, of Washington; and Ellis, of Toronto.

That a national organisation of chemists is desirable is certain, and that it could exist, and hold the same relation to the chemical industries of this country as the American Institute of Mining Engineers does to the mining industries, is also true. To this end, it seems to us, that the plan followed by the Society of Chemical Industry in Great Britain is the best one to adopt, viz., a national organisation with local sections, holding its annual meeting in connexion with that of the American Association. A fear that a new chemical society was to be created has been expressed by the more conservative chemists, but in the minds of those who are most active in the matter, it is consolidation of those existing that is desired.

Let the American Chemical Society of New York, the Chemical Society of Washington, and the Chemical Section of the Franklin Institute appoint delegates to meet and confer, for the purpose of considering ways and means of consolidation. They should decide upon such points as the following:—

1. The establishment of local sections at Boston, New York, Philadelphia, Washington, Baltimore, and other large centres.
2. The date and place of meeting for the election of officers.
3. The preparation of a financial scheme, so that the cost of management should be equitably divided among the different sections.
4. The publication of a suitable journal.

The establishment of a National Chemical Society should come from united action of the existing Societies, and not from without.

FACTORY INSPECTION IN AUSTRIA.

The following information on the subject of factory inspection in Austria is extracted from the last report of the United States Consul at Prague:—

The law creating inspections of industrial establishments went into effect June 17th, 1883. It consists of 20 sections, and its main provisions are given in the following synopsis.

The Minister of Commerce is authorised to appoint, with the concurrence of the Minister of the Interior, the necessary number of factory inspectors in the different provinces, and a general inspector. He may also appoint special inspectors for certain branches of industry whose districts may comprise different provinces. Only persons having the requisite knowledge of business and speaking the languages which prevail in their respective districts may be chosen for the office of inspectors.

It is the duty of the inspectors to enforce the existing laws and regulations in regard to—

1. The arrangements and provisions to be made for protecting the lives and the health of operatives, both in workshops and dwellings.
2. The mode of employing workmen, the hours of work, and the periods of rest.
3. The registry of operatives, factory rules, payment of wages, and working men's certificates.
4. The instruction of apprentices in the trade.

When the inspector produces his commission, issued yearly by the chief administrative officer of the province, the factory owner or manager is bound to permit him to enter the shops and the dwellings of the operatives at all times, but in the night time only when the shops are running. The owner or manager has a right to accompany him during the inspection.

The inspector is authorised to put questions to any person employed on the premises on subjects within the scope of his official cognizance, if necessary, without the presence of witnesses, avoiding, as far as possible, any disturbance of the business.

If entrance is denied to the inspector, or information refused, or employes are prevented from giving the information asked for, or urged to make false statements, the owner or manager makes himself guilty of an offence punishable under the factory code, unless the ordinary penal code is applicable. When the inspector finds that the factory laws and regulations are neglected or violated, he is obliged to insist upon an immediate correction of the failings or abuses. Should it be refused, he has to notify the proper authorities in order to enforce compliance through regular official action, and such authorities must in their turn notify the inspector of their action, from which he has a right to appeal to a higher instance.

Whenever the health of the employes appears to be endangered through the methods used at any manufactory, the inspector may ask the proper authorities to secure the assistance of experts and physicians in making an investigation, and if the defects charged by the inspector are found to exist the expense is to be borne by the owners. It is further made the duty of the inspectors to assist the manufacturers in complying with the law, to mediate between the employer and the employed when differences arise, and to try his best to maintain good relations between them.

The inspectors are required to report yearly to the Minister of Commerce, containing a list of the accidents met with by the operatives in the discharge of their duties, with their causes, and with suggestions of such legislative or administrative measures as may be in the interest of both employers and employed.

The inspectors are bound by their oath not to divulge any information they may become possessed of concerning the business condition or management of different industrial establishments, and particularly all such information the secrecy of which is enjoined by the owners of factories. A violation of this rule, and the use of the acquired knowledge of such secrets for his own benefit, either during the term of office or after, is punished by imprisonment from three months to two years, unless the ordinary penal code provides severer punishment.

An inspector must not be engaged in any industrial business either himself or by proxy, or be employed in any capacity in connexion with such business. He is not allowed to accept compensation of any kind or nature from the employers or workmen, and is bound to refuse their hospitality if offered.

Fourteen inspectors of factories and a general inspector have been appointed under the law. During the first trial, voices were loud prophesying the certain failure of the institution. The manufacturers were mostly hostile to the system of inspection, trying to impede its workings, and workmen were dismissed in some cases for bringing their grievances before the inspectors.

In regard to the enforced reduction of the hours of work from 12 to 11, it was asserted that it would cripple Austrian industry in its struggle with foreign competition, but evil

prophecies have not been fulfilled, and the system of factory inspection has by this time become popular even with the employers of labour.

The first annual reports were made in 1885, and the reports for the 1888 have recently been published. From the latter it appears that the factory inspectors have prevented many a strike, caused the redress of numerous just grievances, and brought about the adoption of measures in many factories for the protection of the operatives against accidents and injury to health.

In the course of last year the factory inspectors received 2,780 applications for advice, assistance, intervention, and mediation from factory operatives, and 1,350 applications from employers. They intervened successfully in favour of the operatives in 1,785 cases, and refused 757 such applications as not being well founded. During the same time the inspectors rendered opinions in 3,490 cases, and took part in 1,590 commissions and investigations. The number of orders and directions given by them in regard to better arrangements, ventilation, heating, lighting, &c., exceeds in the same period 10,000. The number of factories and shops inspected by them was 4,068, as against 4,190 during the previous year, with 270,000 operatives. There are in this Empire about 370,000 establishments subjected to the supervision of those officers, and since the creation of the present system of inspection until the close of last year there were 16,000 premises inspected. Hence it would appear that the number of inspectors is far too small for a comprehensive and thorough working of this last in the early period of its existence.—*Board of Trade Journal*.

CONFERENCE OF HYDROCHLORIC ACID MANUFACTURERS.

The hydrochloric acid manufacturers of Widnes, Runcorn and Birmingham have been holding a series of weekly meetings in Liverpool lately, with the object of maintaining the present high price for next year's contracts. They also considered a proposal to "pool" the whole production of the associated works, but the anticipation that other firms who have not been in the association will be sellers of acid next year has prevented its adoption. The last meeting, on October 30, authorised the members to sell at their own price, when, where, and as they liked, in the meantime. Some contracts were immediately made at 8d. per carboy, then at 7d., for considerable quantities, and more was offered at this price from Widnes than could be sold. Now 6d. per carboy is spoken of as the price for next year, though the combination quotation remains 10d. This price has been too high in comparison to the price of bleach, and it has undoubtedly reduced the consumption of hydrochloric acid. Vitriol has been far cheaper for a variety of purposes, and has been largely used in preference. By increasing the consumption of hydrochloric acid by selling it at a reasonable price, there will be the less necessity to make much more bleach next year than has been made this year. The price of bleach could be maintained by a moderate increase in the make, but it will not yet bear an increase equal to the nominal capacity of the works.—*Chemist and Druggist*.

THE BLEACH ASSOCIATION.

A meeting of members of the chemical trade was held at Liverpool on November 14, to consider the question of renewing the combination of bleaching powder manufacturers which is due to expire at the end of this year. The combination has existed for seven years, and its immediate financial results have been exceedingly beneficial to the makers, as the price of bleach, which was 4l. per ton before the combination, has been maintained by it at 6l. to 8l. per ton, the Leblanc process, by which the combined manufacturers work, being thus artificially kept up, and the output regulated to the requirements of the markets. At the Liverpool meeting it was, however, unanimously agreed not to renew the combination, as no common mode of action could be found, the proposal to continue on the basis of the limitation of the decomposition of salt by 25 per cent. proving unacceptable to the majority. From the beginning of next year there will thus be free competition in this important article, and some of the larger manufacturers

regard this prospect with much satisfaction. Coal, salt, and wages, however, are so much dearer now than seven years ago, that it is questionable whether, even without the combination, the previous low rates will return. The acid association follows the dissolution of the bleach combination.—*Ibid.*

THE AUSTRIAN SUGAR TRADE.

About 20 large beetroot sugar factories are being built in Austria-Hungary, the greater number in Hungary, where, indeed, some of them are already working. The export of sugar being at present very slack, the consequent over-production has resulted in the lowest price since 1886—14 florins 25 kreuzers for 100 kilos. of raw sugar. The present rate of production will be doubled if all the new factories in Hungary enter into competition, and the Austrian sugar industry, as apart from that of Hungary, will suffer accordingly, the Hungarian law regulating domestic taxation and the export bounties being far more favourable.

To cope with this prospect the Austrian State railways have just reduced the rates for the carriage of sugar to the frontier, and pressure is being exercised upon the southern lines to lower the rates to Trieste. Judging by this, we may expect a period of very cheap sugar, over-production being equally great in all the bounty-giving countries.—*Standard.*

ITALIAN TRADE.

It would be impossible to maintain that the financial and economic conditions of Italy can be painted altogether in rose colour; but it is instructive to note, as a set-off against some exaggerations on the other side, that here and there little awakenings of commercial activity may be observed, and that considerable productive power, hitherto dormant, is endeavouring to erect itself on a purely national basis.

As this increased activity certainly dates from the breaking off of the commercial treaty with France, it must be supposed that, together with much evil, that change brought also with it some good.

Several home industries in Italy have taken a development within the last few months which could scarcely have been the case had the general economic conditions been so bad and so unstable as they have frequently been described. Numerous and important factories have arisen, especially for the manufacture of machinery, textile fabrics, and metals. A report is being prepared, by order of the Minister of Agriculture and Commerce, tabulating the increase in this direction since 1887. This report is at present very incomplete, and notes from the various Chambers of Commerce are still wanting, but the following figures give the result of the official inquiry thus far.

Three new silk factories have arisen in the province of Udine, and one in Varese. In the latter district an important establishment for weaving silken fabrics has been erected, and two others have been enlarged. Four cotton mills have been built at Udine, Carrara, Lucrea, and Varese, and one greatly enlarged. Large establishments for the production of glass-ware, paper, dressed leather, woollen goods, soap, furniture of various descriptions, dairy produce, and alimentary produce of all kinds have in the period above indicated sprung up at Chiaravalle, Mucera, Ventimiglia, Udine, Varese, Rimini, and a long list of other places which cannot be given here; and in the province of Udine alone they included one for the manufacture of metric instruments, two for supplying plant for illumination by electricity, one for aerated waters, two for the fabrication of spirits and liqueurs, and two for carriage building.—*Ibid.*

THE CAUSE OF SPONTANEOUS COMBUSTION IN HAY.

The celebrated Breslau botanist, Professor Cohn, recently proved, by a series of exhaustive experiments, that the heating of masses of damp hay to a temperature resulting in spontaneous combustion is caused by fungus. He first examined the thermogenous action of the *Aspergillus fumigatus*, a plant having an evil reputation for causing illness, and which occasions the heating of sprouting barley.

Through the breathing of the small germ—that is to say, through the combustion of the starch and other carbohydrates, which are changed by diastatic fermentation into maltose and dextrin—an increase of temperature to about 40° C. follows, when the germs become stiff and heated, a condition in which they soon die. A heating of the germs to over 60° C. takes place only when the fermentation activity of the *Aspergillus fumigatus* sets in, and this exhibits its highest development and action in a temperature above blood heat, in which state it rapidly consumes the carbohydrates. Of all the actions of the fungus, and these are of an extremely manifold character, this action of the *Aspergillus fumigatus* is probably one of the most singular.—*Ibid.*

A CURIOUS BORAX MINE.

The *Oil, Paint, and Drug Reporter* writes as follows about a curious borax mine in the Calico district of California:—"Usually borax is obtained all over the world by collecting the accumulations of the baborate of soda in the beds of dry lakes, where the borax has been left as a residuary deposit, the same as salt and gypsum. The mine referred to is a vein found enclosed in sandstone and shale, and the borax is mined the same as quartz or any other mineral. Beautiful crystalline specimens of snowy whiteness are frequently found. The mine is a geological curiosity. The origin of the borax mine is simple enough. In past ages the now nearly vertical vein was a bed of borax in the bottom of a dry lake, where the deposit had accumulated by the evaporation of the waters of the lake, which contained the mineral in solution. Subsequently the waters spread over the land and lake, and mud and sand were carried down into the lake, and the borax was covered. This process continued until hundreds of feet of sedimentary deposit had accumulated. In the course of time these hardened and became rocks. When the main range of the Calico mountains was uplifted the borax deposit was also tilted with its enclosing rocks, and it now has every appearance of a vein. It follows perfectly, however, the line of sedimentation of the adjacent rock."—*Chemist and Druggist.*

CHEMICAL PRIZES IN FRANCE.

The French Society for the Encouragement of National Industry annually offer a large number of prizes for discoveries and researches connected with the industries, and for excellence in art work. Among the prizes which it has been decided to award for chemical subjects during the coming year are the following:—2,000 francs for the industrial preparation and application of ozone, 1,000 francs for the best process of utilisation of residual products, 1,000 francs for the most useful new application of a simple non-metallie body, 1,000 francs for the discovery of a new alloy practically useful in the arts, 1,000 francs for the discovery of the synthetic manufacture of organic bodies such as quinine, cane sugar, &c., 2,000 francs for the discovery of practically useful new tannin, 2,000 francs for a body which will replace the use of sulphuric acid in dyeing, especially in silk dyeing, two prizes of 1,000 francs and 2,000 francs respectively for the industrial manufacture, in France, of anhydrous and fuming sulphuric acid, one of 2,000 francs for improvements in the manufacture of chlorine, 3,000 francs for the manufacture of glass vessels, for use in chemical operations, 2,000 francs for the manufacturer of sulphuric acid who shall be the first to bring into commerce sulphuric acid manufactured from pyrites which shall be perfectly free from arsenic, and 4,000 francs for the most practically useful paper on chemistry or metallurgy. There are also several special prizes, one of which, of 800 francs, will be awarded every year to the workman who has been for the longest period in the employ of a single firm. The fund for this prize was contributed, at the initiative of M. Fourcade, by the exhibitors in Class 47 of the Universal Exhibition of 1878.—*Ibid.*

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ended 31st October	
	1888.	1889.
	£	£
Metals.....	2,016,123	1,735,623
Chemicals, dyestuffs, and tanning materials	490,799	560,897
Oils.....	646,769	753,132
Raw materials for non-textile industries.....	1,157,309	1,735,798
Total value of all imports.....	35,022,155	38,195,166

SUMMARY OF EXPORTS.

	Month ended 31st October	
	1888.	1889.
	£	£
Metals (other than machinery)	3,117,977	1,182,774
Chemicals and medicines	692,842	715,244
Miscellaneous articles.....	2,903,733	3,372,850
Total value of all exports.....	29,893,566	23,000,638

IMPORTS OF METALS FOR MONTH ENDED 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
			£	£
Copper:—				
Ore..... Tons	14,291	9,014	126,620	75,529
Regulus and precipitate	7,097	12,561	253,812	333,100
Unwrought	5,915	2,782	388,516	123,963
Iron and steel:—				
Iron ore	246,664	318,572	168,954	215,395
Bar, bolt, &c.	11,842	13,030	108,901	123,153
Steel, unwrought	1,467	1,097	11,203	10,592
Lead, pig and sheet	11,984	11,256	200,817	143,794
Pyrites	47,738	44,581	95,448	78,516
Quicksilver..... Lb.	18,439	79,750	5,402	8,596
Tin..... Cwt.	59,170	39,611	249,785	135,451
Zinc	5,078	5,892	99,597	117,873
Other articles ... Value £	..	..	307,068	310,051
Total value of metals	..	..	2,016,123	1,735,623

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDED 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
			£	£
Alkali..... Cwt.	5,816	2,996	5,944	2,738
Bark (for tanners' and dyers' use) ..	25,834	31,500	9,942	10,646
Brimstone	73,949	51,341	17,010	11,157
Chemicals..... Value £	..	..	112,040	110,607
Cochineal	799	704	5,410	4,413
Cutch and gambier Tons	2,586	1,664	64,511	48,909
Dyes:—				
Aniline .....	..	..	27,310	27,103
Alizarine .....	..	..	26,795	25,069
Other .....	..	..	1,397	1,220
Indigo	739	1,535	11,782	22,739
Madder	1,268	2,156	1,557	2,316
Nitrate of soda....	86,500	254,849	41,798	106,986
Nitrate of potash ..	36,126	38,099	29,623	33,078
Valonia	1,657	296	24,080	3,921
Other articles... Value £	..	..	111,600	149,165
Total value of chemicals	..	..	490,799	560,897

IMPORTS OF OILS FOR MONTH ENDED 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
			£	£
Cocoonut	57,402	28,344	75,933	38,279
Olive	1,286	1,233	47,929	44,766
Palm	79,404	102,024	80,166	113,169
Petroleum	8,316,792	13,855,717	248,185	310,235
Seed	1,469	1,695	30,563	48,285
Train, &c..... Tons	2,504	2,380	46,727	47,532
Turpentine	37,093	33,311	59,038	57,626
Other oils..... Value £	..	..	57,928	63,600
Total value of oils ...	..	..	646,769	753,132

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDED 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
			£	£
Bark, Peruvian ..	9,218	6,876	35,261	22,544
Bristles..... Lb.	182,725	315,467	20,916	43,867
Caoutchouc..... Cwt.	16,399	19,615	163,822	213,530
Gum:—				
Arabic.....	6,498	3,286	27,405	12,334
Lac, &c.....	6,139	6,350	15,377	24,092

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDED 31ST OCTOBER—*cont.*

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Gutta-percha Cwt.	1,811	5,417	£ 15,571	£ 82,128
Hides, raw:—				
Dry..... ..	41,411	35,911	196,357	97,508
Wet..... ..	71,211	57,321	176,172	131,737
Ivory..... ..	1,676	1,317	73,975	63,815
Manures:—				
Guano..... .. Tons	2,916	2,153	23,551	16,209
Bones..... ..	3,399	4,764	19,650	24,157
Paraffin..... .. Cwt.	25,908	31,046	33,168	38,680
Linseed rags..... Tons	3,009	3,333	32,667	35,186
Esparto, &c..... ..	17,377	11,151	91,671	57,301
Pulp of wood..... ..	10,500	12,658	65,216	61,187
Rosin..... .. Cwt.	35,686	43,130	6,816	10,898
Tallow and stearin ..	103,581	111,052	112,008	111,510
Tar..... .. Barrels	32,023	19,562	19,860	20,320
Wood:—				
Hewn..... .. Loads	223,395	283,765	500,144	628,167
Sawn..... ..	583,150	711,539	1,384,178	1,685,139
Staves..... ..	11,752	22,685	52,673	71,974
Mahogany..... Tons	3,328	5,973	30,361	53,196
Other articles.... Value £	..	..	1,112,147	1,193,313
Total value..... ..	..	..	1,157,309	4,735,798

Besides the above, drugs to the value of 75,000*l.* were imported during the month, as against 81,600*l.* in October 1888.

EXPORTS OF METALS OTHER THAN MACHINERY FOR MONTH ENDED 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Brass..... .. Cwt.	9,469	10,883	£ 45,069	£ 48,518
Copper:—				
Unwrought..... ..	19,131	69,290	71,176	156,283
Wrought..... ..	9,691	39,142	41,299	110,807
Mixed metal..... ..	19,812	41,003	67,697	100,909
Hardware..... Value £	..	..	296,319	278,566
Iron and steel..... Tons	344,211	429,195	2,291,223	2,836,616
Lead..... ..	3,258	5,211	50,831	74,676
Plated wares.... Value £	..	..	44,505	57,634
Telegraphic wires ..	..	..	17,938	205,603
Tin..... .. Cwt.	9,367	13,765	48,768	61,888
Zinc..... ..	5,305	11,306	5,261	10,015
Other articles... Value £	..	..	161,567	238,329
Total value..... ..	..	..	3,117,077	4,182,774

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDED 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Alkali..... .. Cwt.	611,189	580,521	£ 162,529	£ 153,315
Bleaching materials ..	172,832	133,639	66,655	48,131
Chemical manures. Tons	..	28,374	119,161	175,593
Medicines..... Value £	..	..	83,177	196,294
Other articles.... ..	..	..	230,717	261,958
Total value..... ..	..	..	692,842	715,244

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDED 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Gunpowder..... Lb.	1,335,500	90,200	£ 30,497	£ 21,932
Other military stores..... Value £	..	..	141,692	131,613
Candles..... .. Lb.	853,100	1,316,500	15,915	24,559
Caoutchouc..... Value £	..	..	109,097	106,161
Cement..... .. Tons	47,119	67,874	90,251	133,603
Earthenware... Value £	..	..	206,190	207,404
Stoneware..... ..	..	..	8,806	19,310
Glass:—				
Plate..... .. Sq. Ft.	369,369	430,486	22,413	29,627
Flint..... .. Cwt.	10,707	13,023	27,523	32,003
Bottles..... ..	86,212	101,900	39,885	50,556
Other kinds..... ..	18,133	16,212	11,393	12,241
Leather:—				
Unwrought..... ..	12,612	14,221	112,592	128,292
Wrought..... Value £	..	..	37,836	50,683
Seed oil..... .. Tons	5,925	6,331	121,362	113,311
Floor cloth..... Sq. Yds.	1,325,700	1,424,000	63,920	70,229
Painters' materials..... Value £	..	..	127,443	166,026
Paper..... .. Cwt.	88,963	100,396	158,753	179,220
Rags..... .. Tons	5,331	6,909	41,597	46,385
Soap..... .. Cwt.	42,003	50,180	41,530	51,197
Total value..... ..	..	..	2,903,733	3,372,850

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY. APPLICATIONS.

- 16,249. J. B. A. Simonnet and S. W. Cragg. *See Class X.*
 16,283. T. A. Bullough. *See Class XVIII.—B.*
 16,289. C. Pontifex. *See Class XVII.*
 16,295. E. Gregory. Apparatus for controlling the cold air supply to heating stoves for blast furnaces and other like purposes. October 16.
 16,298. H. F. Rushton. Apparatus for draining or drawing off surface liquid from settling or depositing tanks. October 16.
 16,452. F. Hoeking. Apparatus for heating, evaporating, cooling, and condensing. October 18.
 16,478. A. de Kunwald. Improvements in and relating to distillatory apparatus. October 18.
 16,520. J. Price. Apparatus for distilling and concentrating solutions. October 19.
 16,583. A. Collingridge. Condensing apparatus. Complete Specification. October 21.
 16,588. J. Orme. Means for preventing corrosion in apparatus used for chemical or like purposes. October 21.
 16,763. J. Popper. Air condensers and cooling apparatus. October 23.
 16,863. A. H. Hobson. Apparatus for use in making extracts from and otherwise treating soluble or partially-soluble substances by means of steam pressure and heat. October 25.
 16,997. A. L    , C. A. Reman  , and A. T. Job. Air and vacuum pumps. October 28.
 17,018. W. K. Bruce. Vacuum pans. October 28.
 17,050. H. Barlow-Massieks and W. Crooke. An improved gas valve, particularly applicable for hot blast stoves or furnaces. October 29.
 17,084. V. W. Blanchard. Furnace and apparatus for generating heat. Complete Specification. October 29.
 17,184. T. O. Easton and A. Watt. *See Class XVI.*
 17,219. G. G. B. Cresswell. Evaporating and distilling apparatus. October 30.
 17,432. L. Fromm. Improvements in thermometers. Complete Specification. November 2.
 17,505. J. Martinez-Ancira. An improved centrifugal pump. Complete Specification. November 4.
 17,637. T. Duggan. Making a non-conducting heat composition for application to steam boilers, steam pipes, cylinders, char kilns in sugar refineries, &c. November 6.
 17,686. R. Davidson and E. Emanuel. Apparatus for supplying a continuous and unvarying quantity of air to blast furnaces, blow pipes, &c. Complete Specification. November 6.
 17,775. E. W. Killiek. Improvements in and relating to the drying chambers of kilns. November 7.
 17,814. H. Hanneville. An improved serpentine coil for evaporation, suitable for the concentration of sulphuric acid. November 8.
 17,853. W. W. Beaumont and J. Kirkaldy. Improvements in condensers, distillers, water heaters, and coolers. November 8.
 17,938. J. G. Chamberlain and G. E. Davis. Apparatus for the evaporation of liquids. November 11.
 18,108. J. Ruscoe. Apparatus for charging and drawing retorts mechanically. November 13.

18,153. J. Foster. Vacuum evaporating and distilling apparatus. November 13.

18,169. R. Fradera. Apparatus for vaporising water and other liquids. November 14.

18,324. W. W. Bengough. Apparatus for heating, evaporating, and condensing, applicable as a feed-water heater, distiller, or condenser. November 16.

COMPLETE SPECIFICATIONS ACCEPTED.*

1888.

15,460. R. Cunliffe. Apparatus for calcining, drying, roasting, or carbonising substances, and extracting gases, spirits, acids, &c. therefrom. October 23.

16,139. E. Fahrig and H. E. Billing. Apparatus for production of ozone. November 6.

18,153. J. Foxhall. Controlling the pressure of gas, fluids, and liquids. November 13.

18,954. G. C. Dymond.—From The A  rated Fuel Co. Furnaces for utilising hydrocarbons as fuel, and operating devices therefor. October 30.

1889.

34. T. Slater. Apparatus for evaporating liquids. November 6.

13,549. H. Bower. Process for facilitating chemical reactions. October 23.

16,037. H. H. Lake.—From C. A. Catlin, C. S. Sweetland, and R. Cox. Charging liquids with gas. November 20.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

16,138. E. Tatham. Improved gas or gaseous mixtures for use in the production of light, heat, and power. Complete Specification. October 14.

16,142. E. Tatbam. Improvements in coal-gas and like gases, and in the manufacture thereof. Complete Specification. October 14.

16,223. W. C. Sellar. Improvements in the method of using coal and other substances for generating heat. October 15.

16,441. T. H. Gray and S. S. Bromhead. Improvements in the preparation of coal-gas for combustion. October 18.

16,486. A. Coze. Improvements in gas retorts and in apparatus connected therewith. October 18.

16,488. J. R. Wigham. Improvements in lighthouse illumination. October 18.

16,489. F. Morris and L. van Vestrant. Improvements in apparatus for charging inclined gas retorts. October 18.

16,646. D. H. Knapp. Improvements in the manufacture of gas. Complete Specification. October 22.

16,795. D. Dixon. Improvements in the methods of generating gas for heating and other purposes, and in the apparatus used therefor. October 24.

16,889. G. Bower. Means or apparatus for carburetting air or gas. October 25.

16,977. J. A. Yeadon and R. Middleton. An improved method of utilising small coke or breeze. October 28.

17,001. F. H. Crittall. Improvements in screw caps or covers for closing the openings in hydrocarbon chambers of gas-light apparatus and other uses. October 28.

17,134. J. Jones. Improvements in the method of and apparatus for burning fuel, debris, and water, and for consuming smoke in furnaces and fireplaces, and utilising the products thereof. October 29.

17,140. A. A. Fritz. Apparatus for producing an inflammable gas by carburation of air. October 29.

17,232. N. M. Henderson. Improvements in apparatus for distilling mineral oils. October 31.

17,467. E. Lund. Improvements in nightlights and similar articles, and in the holders used in burning the same. November 4.

17,480. J. H. Wood. A new or improved artificial fuel. November 4.

17,535. F. B. Dortmund. Improvements in manufacturing coke. November 5.

17,673. The Coltness Iron Co., Lim., and W. Young. See Class X.

17,697. D. Irving. Improvements in hydraulic gas mains, and in valves connected therewith. Complete Specification. November 6.

17,700. J. W. Thomas, F. S. Harbridge, and D. Thomas. An improved system of ventilation, smoke prevention, and combustion of fuel. November 6.

17,778. H. H. Lake.—From G. W. Wilcox, United States. Improved apparatus for preventing the formation of smoke and for effecting economy in the consumption of fuel. November 7.

17,810. J. H. R. Dinsmore. Improvements in and connected with the manufacture of illuminating gas. November 8.

17,817. E. de Pass.—From E. Demagnin and L. Bourdier, France. An improved firelighter, serving also as fuel. November 8.

17,945. J. Morley. A compound for making into fire-lighters. November 11.

17,954. T. D. Rock. Improvements in coking and in coke ovens and plants connected therewith. November 11.

18,063. A. L. Blackman. Improvements in the manufacture of peat fuel. November 12.

18,064. A. L. Blackman. Improvements in or relating to the treatment of peat. November 12.

18,162. F. Pritchard. Enriching and increasing the volume of gas obtained from coal, and the utilisation of waste heat from retort settings. November 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

15,935. D. Latchinoff. Production of oxygen and hydrogen in large quantities for ballooning, by the electrolysis of water. November 13.

16,179. I. Carr. Manufacture of illuminating gas. October 13.

16,217. J. Jefferay. A new firelighter. November 13.

16,970. B. H. Thwaite. Producing combustible gases, and apparatus therefor. November 13.

17,869. F. B. Hill. Apparatus for utilising liquid hydrocarbon for lighting and heating. November 13.

18,451. E. Brook and J. J. Brook. Regenerative kilns. November 20.

18,573. E. Solvay. Purification of gases. October 23.

18,678. F. R. Jones. Preventing the emission of smoke from chimneys. October 23.

18,918. J. Nimmo and J. Scotland. Manufacture of coke, and ovens, &c., therefor. November 6.

18,954. G. C. Dymond.—From The Aërated Fuel Co. See Class I.

1889.

703. H. S. Maxim. Apparatus for carburetting gas. October 30.

1271. H. Simon. Coke ovens. November 6.

2508. H. S. Maxim. Apparatus for carburetting gas. October 30.

7252. J. von Langer and L. Cooper. Generation of water-gas, Siemens-gas, and producer-gas, and apparatus therefor. November 20.

10,700. J. W. Rock, C. G. Moore, J. H. Wood, and J. B. Nicholson. Gas-making apparatus. October 23.

12,584. R. R. Main, A. P. Main, and H. Darwin. Gas fires. October 23.

14,031. J. Loves. Apparatus for carburetting gas or air. November 20.

14,291. S. Pitt.—From C. B. Harris. Apparatus for the manufacture of gas. October 23.

14,644. W. P. Thompson.—From F. P. Dewey. Separating and collecting the solid materials from fume, smoke, &c. November 6.

14,686. H. Howell and L. Smith. Apparatus for enriching or generating illuminating gas from volatile liquid hydrocarbons. October 23.

14,881. A. Kitt. Gas-making apparatus. October 30.

14,922. A. Kitson. Apparatus for manufacturing heating gas. November 6.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATION.

16,554. O. Imray.—From J. Dehust, Germany. Process for the purification of crude naphthalin. October 19.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

16,261. The Clayton Aniline Company, Limited, and P. Brunner. A method of preparation of new azo dyestuffs. October 16.

16,382. S. R. Brinkworth. Improvement in dyes for leather goods. October 17.

16,448. J. Dawson. Manufacture of a grey basic colouring matter soluble in water. October 18.

16,698. S. Pitt.—From L. Cassella and Co., Germany. Production of new colouring matter. Complete Specification. October 22.

16,699. S. Pitt.—From L. Cassella and Co. The preparation of amidonaphtholsulphonic acid and of colouring matters therefrom. October 22.

17,204. O. Imray.—From The Farbwerke Griesheim-on-Main, W. Noetzel and Co., Germany. Manufacture of indulin-like colouring matters. October 30.

17,223. H. H. Lake.—From Wirth and Co., agents for A. Leonhardt and Co., Germany. An improved manufacture of colouring matter. October 30.

17,491. O. Imray.—From The Farbwerke Vormals Meister, Lucius, und Brüning, Germany. Improved manufacture of diazonaphtholmonosulphonic acids, and of diazonaphtholdisulphonic acids. November 4.

17,957. O. Imray.—From The Actien Gesellschaft für Anilin Fabrikation, Berlin. Process for the preparation of orange-yellow colouring matters. November 11.

17,964. J. O. O'Brien.—From The Fabriques de Produits Chimiques de Tann et de Mulhouse, Germany. Improvements in the production of azo-colours upon cotton or other fabrics of a vegetable nature by printing or dyeing. November 11.

17,971. H. H. Lake.—From A. Leonhardt and Co., Germany. Improvements relating to colouring matters. November 11.

18,217. C. Romen. A process for rendering dry alizarine fit for colouring and printing purposes. November 14.

18,354. B. Wilcox.—From The Farbenfabriken vorm. F. Bayer and Co., Germany. Improvements in the manufacture and production of direct-dyeing yellow colouring matters. November 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

16,333. B. Wilcox.—From The Farbenfabriken vorm. F. Bayer and Co. Production of a new sulphone or diethylsulphone-methyl-ethyl-methane. October 23.

17,333. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. A new manufacture of dyestuffs. November 6.

1889.

2941. T. R. Shillito.—From J. R. Geigy. A new violet dye or colouring matter. November 6.

12,767. H. H. Leigh.—From R. G. Williams. Manufacture of mixed azo-colours. November 6.

15,360. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran. Manufacture of new derivatives of tannin and catechin, and of colouring matters therefrom. November 6.

15,558. F. Rhodes. Dye-extracting apparatus. November 13.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

16,258. J. Schofield. Improvements in the production of cotton yarn, and in machinery therefor. October 16.

16,708. C. Baswitz. Improvements in the treatment of textiles by means of copper and ammonia for the purpose of making them waterproof and unflammable. Complete Specification. October 22.

17,137. E. Johnson.—From T. Burrows, France. Improved means and apparatus for ungumming and otherwise treating flax and other like fibres, also leaves and plants. October 29.

17,449. P. J. Evans, A. Evans, and E. E. Evans. Preparing for spinning a woollen yarn, so that one, two, or more colours can be spun or doubled by one process. November 4.

18,180. I. Smith and J. Smith. Improvements in the method of and apparatus for treating or scouring and washing wool and other fibrous substances. November 14.

COMPLETE SPECIFICATION ACCEPTED.

1888.

17,429. G. L. P. Eyre and T. J. Hopkins. Process of treating and scouring wool and other materials containing fatty matters, and apparatus therefor. October 23.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

16,156. T. Holliday. Improvements in producing azo-colours on or in cotton or other textile fibre or fabric. October 11.

16,157. T. Holliday. Improvements in preparing cotton or other textile fibre for the production thereon of certain azo-colours. October 14.

16,368. A. Greg. A new or improved method of bleaching wood bobbins, reels, and other articles made from wood. October 17.

16,822. W. Junge. Improvements in apparatus chiefly designed for washing, bleaching, dyeing, impregnating, or drying fabrics and other materials. October 24.

16,925. J. H. Gartside. Improvements in and apparatus for bleaching fibres, yarns, and woven or other fabrics. October 26.

17,321. F. M. von Kalkreith Browne. See Class VIII.

17,964. J. O. O'Brien.—From The Fabriques de Produits Chimiques de Thann et de Mulhouse, Germany. See Class IV.

18,073. B. Willecox.—From The Farbenfabriken vorm. F. Bayer and Co., Germany. Dyeing and printing animal and vegetable fibres with dinaphthyl-dichinhydrone, or with beta-naphtho-chinone, or tetra-oxydinaphthyl. November 12.

18,115. A. Graemiger. Improvements in machines for dyeing, bleaching, or otherwise treating fibres in a raw, spun, woven, or intermediate state of manufacture. November 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

18,010. J. Inray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis. Dyeing cotton or other vegetable fibres with blended colours. October 30.

1889.

197. J. Inray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis. Process for dyeing with yellow, orange, and red azoic colouring matters. October 30.

350. W. Mather.—From V. G. Bloede. Process for tinting fabrics with fast colours. November 6.

376. W. L. Wise.—From M. von Gallois. Manufacture of new chrome mordanting substances, and the application thereof for dyeing and printing. November 13.

2525. H. Erdmann. Cold process of dyeing hair and feathers by means of paraphenylenediamine or similar bases. November 20.

2743. F. A. Blair. Vats for dyeing, washing, bleaching, and mordanting fibrous materials. October 23.

15,881. J. C. Mewburn.—From La Société Grandsire et fils. Apparatus for dyeing skins. November 13.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

16,213. W. Shapleigh. Improvements in the method of producing chloride of lead. Complete Specification. October 15.

16,351. L. Q. Brin, A. Brin, and F. H. Varley. An improved process of and apparatus for extracting phosphates from associated earthy substances. October 17.

16,609. W. Wolters. A new or improved process for the recovery or regeneration of nitric acid employed in the manufacture of chlorine. October 21.

16,630. R. H. Steedman, A. Campbell, and W. Boyd. Improvements in obtaining chlorine and alkali and in reconverting and utilising by-products of the processes. October 22.

16,711. E. Augé. Improvements in the manufacture of soda alum. October 22.

16,928. W. Borrows and N. J. Borrows. Improvements in the treatment of black-ash waste, applicable for use with Chance's sulphur recovery process, and in apparatus therefor. October 26.

17,054. J. Pointon. Improvements in and relating to the manufacture of sodium carbonate and apparatus therefor, applicable also to the manufacture of potassium carbonate. October 29.

17,055. J. Pointon. Improvements in and relating to the manufacture of alkaline manganates, and apparatus therefor. October 29.

17,056. J. Pointon. Improvements in and relating to apparatus for the manufacture of alkaline silicates and aluminates, applicable also to other purposes. October 29.

17,074. T. Turner. Improvements in the treatment of waste pickle from galvanising works, and other such like acid liquors, and in the apparatus employed therefor. October 29.

17,217. F. M. Lyte and J. G. Tatters. Improvements in the recovery of chlorine from the residual liquors of the ammonia-soda process, from solutions of calcium chloride, from certain impure solutions of magnesic chloride, and from some other industrial residues. October 30.

17,218. F. M. Lyte and J. G. Tatters. Improvements in the production of hydrochloric acid from certain industrial residues, together with the recovery of sulphur and oxide of magnesium. October 30.

17,272. P. de Wilde and A. Reyehler. Processes for the production of chlorine, and for obtaining concentrated gaseous hydrochloric acid for that purpose. October 31.

17,348. J. E. J. Johnson. Improvements in the manufacture of acetic acid and calcium sulphite. Complete Specification. November 1.

17,395. W. Garroway. Improvements in obtaining caustic soda or caustic potash by means of boracic acid. November 2.

17,730. W. Darling and J. Anderson. Abstracting sulphur from sulphurous coal or ores or other minerals. November 7.

17,888. F. M. Spence and D. D. Spence. Improvements in the manufacture of alum. November 9.

17,916. C. F. Claus. Improvements in the manufacture of soda. November 9.

18,356. E. Bowen. Improvements in or connected with the manufacture or production of ammoniacal salts. November 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

17,541. M. Flaschendräger and H. Flaschendräger. Flat or prismatic evaporating pans for the treatment of salt. October 23.

17,807. J. V. Hewson. Treatment of salt, and means therefor. October 23.

17,930. M. H. Simpson. Preparation and treatment of bromine for the extraction of gold from ore, or for other purposes. November 6.

18,056. A. Campbell and W. Boyd. Obtaining chlorine. October 23.

18,921. R. H. Steedman and A. J. Kirkpatrick. Reconvertng and utilising by-products formed in processes for obtaining chlorine. November 13.

19,023. E. W. Parnell and J. Simpson. Treating alkaline sulphides in solution, or an aqueous mixture of same with carbonic acid gas, for production of sulphuretted hydrogen, and apparatus therefor. November 20.

1889.

881. R. H. Steedman and A. J. Kirkpatrick. Obtaining chlorine, and reconvertng and utilising the by-products. November 20.

1007. O. E. Pohl. Manufacture of salt and apparatus therefor. November 20.

7901. G. Veitch. Concentration of sulphuric acid, and apparatus therefor. October 23.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

16,264. W. West. Improvements in the mode and means employed for the manufacture of flower or plant pots or other articles from clay or other semi-plastic material. October 16.

16,285. R. B. Baugh. Improvements in or connected with the brushing-out process in the manufacture of lettered or decorated enamelled metal or glass plates, or other similar surfaces. October 16.

16,326. E. Smith. Improvements in apparatus for making earthenware socket pipes. October 16.

16,449. R. B. Baugh. Improvements in or connected with the brushing-out process in the manufacture of lettered or decorated enamelled metal or glass plates, or other similar surfaces. October 18.

16,475. W. B. Fitch. Improvements in the manufacture of metal-coated glass and porcelain bottles, jars, jugs, stoppers, and other like articles. October 18.

16,536. H. Hall. Improvements in tiles for lining walls and other surfaces. Complete Specification. October 19.

16,683. E. Leak and H. Aynsley. Improved apparatus for supporting pottery ware while being fired. Complete Specification. October 22.

16,696. F. E. Rostaing, L. A. Garchey, and N. E. Geille. An improved manufacture of vitreous material suitable for artificial marble, stained glass, and analogous objects. October 22.

16,742. E. Leak and H. Aynsley. Improved means to be used in supporting pottery ware while being baked or otherwise fired. Complete Specification. October 23.

16,744. J. Hall. An improvement in the manufacture of fireclay goods and of refractory material for lining Bessemer converters or other like purposes, and the preparation of a substance for use in such manufacture. October 23.

16,843. A. Drummond. Improvements in apparatus for rolling out glass sheets with designs or patterns upon the surface. October 25.

17,064. G. Scott. A new or improved method of manufacturing glass slates, and in the apparatus employed therefor. October 29.

17,105. J. B. Curtis and J. W. Mackintosh. Improvements relating to the manufacture of hollow-ware from glass and similar material. Complete Specification. October 29.

17,320. G. A. Gritton. An improved method for blowing ink wells in moulds. November 1.

17,321. F. M. von Kalkreuth Browne. Producing printed designs in any number of colours by one operation of machinery, especially for pottery decoration. November 1.

17,142. J. Hamblet and A. Plant. Improvements in the manufacture of flooring tiles and other similar tiles. November 2.

17,446. J. P. Guy. A machine for pressing and making solid fireclay and other solid earthenware articles. November 2.

17,468. D. Rylands. Improved means of manufacturing hollow glass ware and glass tubes by machinery. November 4.

17,565. J. G. Sowerby. Improvement in the manufacture of antique and other descriptions of sheet glass, and improved apparatus in connexion therewith. November 5.

17,933. D. Rylands and J. W. Horner. Improved means or apparatus for withdrawing molten glass or molten metals from furnaces, and controlling the outflow thereof. November 11.

18,070. W. B. Fitch. Improvements in the manufacture of glass bottles and similar articles. November 12.

18,094. J. Powell and W. Powell. Improvements in earthenware pots for horticultural or other purposes, and appliances for making the same. November 13.

18,152. B. J. Brearley. Improvements in the construction and arrangement of plant and machinery for casting, rolling, and annealing plate glass. November 13.

18,242. J. J. Downes. Enamelled metal tile hearth and sheets of enamelled metal tiles for wall decorations and ceilings. November 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1889.

7919. R. T. Grocott. Apparatus for making certain articles of pottery ware. November 13.

17,965. W. Boulton. Apparatus for blending potters' clay, &c. October 23.

18,238. W. Ambler. Manufacture of sheet glass and cylindrical glass articles. October 23.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

16,327. G. B. Jerram. Improvements in paving for roadways, pathways, and floors. October 16.

16,579. W. Bradford. A flooring material. October 24.

16,941. H. D. Blake. Improvements in block paving. October 26.

17,211. W. S. Akerman. Improvements relating to kilns or ovens for burning cement, lime, bricks, and other materials, and to the utilisation of the waste heat therefrom. October 30.

17,280. L. Blumer and J. Tait. Improvements in lime kilns. October 31.

17,623. R. E. B. Crompton and B. H. Jenkinson. Improvements in resistant coverings for battery room floors or surfaces, laboratory floors, and like uses. November 5.

17,640. W. P. Thompson.—From C. Kohn, Austria. Improvements in the manufacture of artificial stone or of articles formed of the same. Complete Specification. November 6.

17,758. H. A. Bassett. Improvements in the manufacture of building material for architectural and other purposes, and of a composition for use in connexion therewith. November 7.

17,908. S. J. Warr. Improvements in ornamental bricks or mouldings, and in dies to be used in the manufacture of the said bricks or mouldings. November 9.

17,961. J. C. Fell.—From G. Phillips, United States. Improvements in the coating or covering of exposed wooden structures or timbers. Complete Specification. November 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

15,041. G. J. Randall and F. Carter. Hardening the surfaces of soft oolites limestone, for the purpose of enamelling same and producing imitation marble, &c. October 23.

17,503. J. Cadbury. Machinery for polishing or surfacing glass. October 30.

18,491. W. Joy. Apparatus for use in the preparation of slurry, and in mixing slurry with fuel. October 23.

1889.

11,922. G. F. Redfern.—From J. G. Maardt. Composition for covering walls, &c. November 6.

12,623. T. Shaw. Utilising the waste product from sewage works for the manufacture of building materials. November 6.

14,281. S. Jørgensen. Heating cements and hydraulic lime. November 13.

14,515. A. J. Paris. Cloth-covered plaster blocks for ceilings, walls, &c. October 23.

15,669. J. Ersley. Manufacture of artificial asphalt. November 13.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

16,249. J. B. A. Simonnet and S. W. Cragg. Improvements in apparatus for filtering, more especially adapted for use with apparatus used for the extraction of gold, silver, and other metals from their ores. October 15.

16,250. J. B. A. Simonnet and S. W. Cragg. Improvements in means or apparatus for the extraction of gold, silver, and other metals from their ores. October 15.

16,318. H. Marbeau. Improvements in the manufacture of alloys of nickel with other metals. October 16.

16,338. F. E. Ross. Improvements in furnaces such as cupolas and blast furnaces. October 16.

16,394. J. H. Darby. Improvements in the manufacture of iron from iron sand or fragmentary or other soft iron ores. October 17.

16,396. W. P. Thompson.—From J. B. Brewster, United States. Improvements in or relating to amalgamators for extracting precious metals from the various impurities combined with them in ores or the like. October 17.

16,447. C. A. Burghardt. Improvements in the manufacture of tin plates. October 18.

16,474. R. F. Ludlow. An improved method of decarbonising iron. Complete Specification. October 18.

16,649. G. G. Mullins. An improvement in the art of treating copper and its alloys. Complete Specification. October 22.

16,760. A. Briu. Improvements in the production of aluminium and aluminium alloys. October 23.

16,776. J. B. Alzugaray. A new metallurgical dry process by means of Baxere's universal furnace. October 24.

16,794. D. Dixon. Improvements in the manufacture of aluminium and other metals. October 24.

16,868. E. A. Cowper. A method of recovering float gold. October 25.

16,871. J. J. C. Fernau and E. H. Hartmont. Improvements in appliances for calcining and smelting copper. October 25.

16,960. J. M. Bennett. Improved means for smelting metals and the recovery of volatile and other metallic products escaping therefrom. October 26.

16,979. T. Doughty. Annealing case for steel ingots. October 28.

17,060. T. Packer. Improvements in electrical furnaces and their manipulation. October 29.

17,063. F. D. Taylor. Improvements in or connected with moulding or casting, and in moulds therefor. Complete Specification. October 29.

17,178. F. Wicks. Improvements in the process of alloying metals by vapours, and particularly by sublimated aluminium. October 30.

17,269. W. D. Bohm. Improvements in hydrometallurgical apparatus. October 31.

17,319. G. W. Hart. A process and apparatus for deoxidising or reducing metallic oxides. November 1.

17,393. J. Evans. Improvements in cupolas. November 2.

17,492. E. H. Cook and W. T. Gibbs. Improvements in the manufacture of aluminium. November 4.

17,512. S. W. Cragg. Improvements in and connected with apparatus or means for separating gold, silver, and other metals from their ores, or materials containing them, or for analogous operations. November 4.

17,627. H. H. Lake.—From S. H. Emmens, United States. Improvements in the production of ductile iron from cast iron.

17,673. The Coltness Iron Co., Limited, and W. Young. Improvements in treating gases from blast furnaces, gas producers, and coke ovens, and in apparatus therefor. November 6.

17,699. C. Davy. Improved means for suspending and manipulating ingots or forgings whilst being heated and operated upon. November 6.

17,701. J. C. Orr. Improvements in and relating to the treatment of furnace slag, and the recovery of by-products therefrom. November 6.

17,878. J. Meese. Improved means and process for treating iron and other metals, and the production of a fireproof coating thereon preparatory to ornamenting with fusible colours. November 9.

17,890. A. Evard. The application of baths of molten metals to the tempering, annealing, or treating of castings or forgings of copper, nickel, cobalt, and aluminium, and of alloys of these metals with each other, or with manganese, cast or wrought iron, or steel. November 9.

17,911. M. J. Berg. Improvements in the manufacture of aluminium. November 9.

17,933. D. Rylands and J. W. Horner. See Class VIII.

18,048. S. Pearson and J. H. Pratt. Improvements in the manufacture of alloys of iron and aluminium and alloys of steel and aluminium. November 12.

18,061. H. Y. Castner. Improvements in the manufacture of sodium and potassium. November 12.

18,062. H. V. Castner. Improved process of purifying the anhydrous double chloride compounds of aluminium. November 12.

18,170. J. Pointon. Improved wet copper extraction process, applicable also to the production of sulphate of copper and iron. November 11.

18,297. T. Haeghe and The Cape Copper Co., Lim. Improvements in the treatment of copper or cupreous compounds for the production of sulphate of copper and the extraction of the precious metals, and in apparatus applicable therefor. November 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

15,698. A. Levy. Dipping process for depositing metals upon iron and steel. November 6.

16,567. H. Schneider. Manufacture of iron and steel alloyed with nickel. November 13.

16,568. H. Schneider. Manufacture of iron and steel alloyed with copper. November 13.

16,796. J. H. Pollok. Wet method of extracting gold from crushed ores, &c. November 20.

17,269. G. Prout and D. Murray. Coating iron or steel plates with copper or other comparatively non-oxidisable metals. October 30.

17,420. A. Wylie. Manufacturing metal pipes and rods, and covering same (or telegraph and telephone cables and wires) with lead or metallic compounds for electric purposes. October 30.

17,476. W. Charnocks. Coating certain metals with other metals or alloys. November 13.

18,178. D. Davy. Apparatus for traversing and turning ingots and blooms. October 23.

18,218. G. Prout and D. Murray. Coating iron or steel with copper and other comparatively non-oxidisable metals. October 30.

18,632. T. Summers. Cleaning tin, terne, or other metal plates, and apparatus therefor. November 6.

1889.

28. A. B. Cunningham.—From H. Havemann. Extraction of gold, silver, and lead from substances containing same, and apparatus therefor. November 13.

187. P. M. Parsons. Production of metallic alloys. November 20.

359. C. Netto. Extraction of aluminium from cryolite &c. November 20.

769. R. S. Casson. Casting metals. November 20.

841. J. B. Hannay. Extracting precious metals from ores. November 20.

890. R. Stanfield and T. Clarkson. Separating metals and heavy minerals from ores. November 20.

1099. J. Richardson. Manufacture of iron and steel. November 20.

7013. L. Petit-Devaucelle. Manufacture of aluminium and alloys thereof. November 13.

11,021. P. H. Adams, jun., and O. T. X. Adams. Apparatus for smelting ores. November 6.

11,083. P. H. Adams, jun., and O. T. X. Adams. Apparatus for smelting ores. November 6.

12,322. F. L. Bartlett. Treatment of ores containing lead, zinc, and other metals. October 23.

14,235. C. Schreiber and H. Knutsen. Treatment of auriferous and argentiferous antimony ores. November 20.

14,473. M. A. Howell, jun. Manufacture of soft back steel, and apparatus therefor. November 6.

15,428. T. F. Rowland. Apparatus for welding metals. November 6.

15,824. G. Archbold. Manufacture of iron and steel. November 13.

15,887. P. P. Craven. A fluxing material for use in welding, brazing, and coating metals. November 13.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

16,130. A. E. Robinson. An improvement in conductors or poles for use in electrical furnaces. October 11.

16,210. A. Wolfshmidt and C. Brehm. Improvements in electric dry batteries. October 15.

16,231. G. Pfannkuche. Improvements in dynamo-electric generators. Complete Specification. October 15.

16,241. H. H. Carpenter. Improvements in secondary or electric storage batteries. Complete Specification. October 15.

16,375. C. B. de Montaud. Improvements in secondary batteries. October 17.

16,555. W. J. Brewer. Improvements in electric storage batteries. October 22.

16,890. E. Frankland, A. H. Hough, and D. G. Fitzgerald. Improvements in elements for secondary batteries. October 25.

17,025. A. S. Elmore. Improvements in the process for obtaining zinc by electrolysis. October 30.

17,252. F. M. A. Laurent-Cély and I. A. Timmis. Improvements in electric secondary cells. October 31.

17,793. G. J. Weir and A. Weir. Improvements in galvanic batteries. November 8.

17,831. J. V. Sherrin. Improvements in electric battery carbon, and carbon compound elements and their connexions. November 8.

17,974. H. H. Lake.—From H. Lemp, United States. Improvements in apparatus for welding by aid of electricity, which improvements are also applicable for other purposes. November 11.

18,067. A. B. Cunningham. Improvements in the manufacture of secondary batteries or accumulators. November 12.

18,350. J. H. Davies. Improvements in dynamo-electric machines. November 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

18,858. F. J. Brougham.—From La Société Perreux-Lloyd et fils. Electro-chemical generators. November 20.

18,968. E. L. Zalinski and H. J. Smith. See Class XXII.

18,978. T. W. Bush. An oblique meshed grid plate for storage batteries. November 6.

18,981. M. Doubleday. An inner expanded chamber grid plate for storage batteries. October 30.

18,994. G. C. Dymond.—From J. M. A. G. Léscuyer. Manufacture of metals or alloys by means of electricity. November 20.

19,058. J. Y. Johnson.—From F. Gendron. Electric batteries. November 6.

1889.

126. G. B. Lückhoff. An improvement in dynamos. November 13.

997. T. Cuttriss. Secondary batteries. November 13.

11,601. G. Macanlay-Cruikshank.—From S. H. Barrett. Connector for the elements of electric batteries. October 23.

15,383. G. E. Heyl. Manufacture of electrodes for accumulators from chromates and wolframates, and from amalgams of chrome or of wolfram with other metals. November 6.

15,446. S. C. C. Carrie. Method and apparatus for "forming" or charging plates for accumulators. November 6.

15,775. C. F. Winkler. Electro-dynamic and dynamo-electric machines. November 20.

15,821. S. C. C. Currie. Electrolytically reducing plates of metallic salts to a metal state to "form" the electrodes of secondary batteries. November 20.

16,231. G. Pfaukuche. Improvements in dynamo-electric generators. October 23.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

16,347. G. Henschell and P. W. Kitto. Improvements in the manufacture of soap tablets. October 17.

16,518. T. Anyon. Improvements in the composition of soap. October 19.

16,525. P. Smith. Improved preparation of petroleum for cleansing, washing, polishing, and similar domestic operations. October 19.

16,671. H. Duerden. Improvements in the treatment of raw lard and lard compounds. October 22.

16,805. W. P. Thompson and G. Tall. Improvements in or relating to the treating or purification of crude or semi-refined cotton-seed oil. October 24.

16,821. M. D. Penney. Improved method of or process for extracting or removing oil from oil-containing bodies, animal and vegetable. October 24.

17,163. W. Brinck. An improvement in lubricants. October 30.

17,385. T. T. Wildridge. Soap cores—or the inclusion in pieces of soap of various contrivances for the increase of economy and convenience. November 2.

17,741. W. Hepworth-Collins and W. J. Smith. An improved dry soap or washing powder. Complete Specification. November 7.

17,742. W. Hepworth-Collins and W. J. Smith. A disinfectant and detergent dry soap or washing powder, or soap extract or essence. Complete Specification. November 7.

17,870. R. Hunt. Improvements in treating crude cotton-seed oil, and oils containing resinous matter and free fatty acids, to obtain oil-soap and resinous colouring matter. November 9.

18,046. C. H. Robinson. A new method of thickening linseed oil. Complete Specification. November 12.

18,345. H. A. A. Dombain and O. Trumper. Improvements in apparatus for extracting fatty and other matter from substances by means of volatile solvents. November 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

16,845. J. Gott. Manufacture of soft soap. November 13.

18,782. R. Stone. Manufacture of soap. November 20.

1889.

1430. J. Ascough. See Class XVIII.—C.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

16,545. L. Schulhof and M. B. Vogel. Method of manufacturing glycerio-tannic acid, and by its means lakes soluble in water. October 19.

16,706. P. Broumer. Improvements in the manufacture of white lead. October 22.

17,236. G. E. Heyl. The manufacture of isolating compositions for cables. October 31.

17,264. A. Melville and P. Whitecomb. Improvements in the manufacture of solid inks and the like. October 31.

17,671. W. S. Courad and H. T. Lilley. An improved copying ink. November 6.

17,771. W. P. Thompson.—From E. W. Mus, Holland. New or improved composition applicable for protecting or preserving the bottoms of navigable vessels, pontoons, or the like, and for preventing the adherence thereon of seaweed, limoria, and other like marine vegetable or animal growth. November 7.

18,042. J. C. Martin. Improvements in pigments or paints. November 12.

18,076. H. H. Lake.—From J. B. Tibbits, United States. Improvements relating to the manufacture of white lead. November 12.

18,286. T. Pridham. An improved preservative and waterproof coating for metals, timber, masonry, concrete, or other structures or surfaces. Complete Specification. November 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

18,705. H. B. Condy. Manufacture of white lead. November 13.

18,716. C. Mortit. Manufacture of rosin liquor for paper makers. October 23.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

16,595. H. Bogenschild and F. Busch. Process and apparatus for glazing leather. October 21.

17,328. W. A. Leonard. Greatly facilitating the tanning of hides, &c., and forcing syrup into lemon, orange, and citron peels, &c. November 1.

17,436. H. J. Haddan.—From J. Landini. A new process for discolouring tannic acid solutions. November 2.

17,813. R. M. Presland, sen. An improved waterproofing for leather. November 8.

17,941. H. Belcher. Improvements in the treatment of skins and hides for the preparation of leather. November 11.

18,307. W. S. Smith. An improved method of utilising waste or secondary products obtained in certain processes of leather manufacture. November 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

16,545. L. D. S. Cufflin and G. Hughes. Machine for extracting the hair from skins. November 13.

17,782. P. A. Jesson. Machinery for treating hides, skins, and leather. November 6.

18,399. M. P. Halsechek. Extract for use as a ferment, and as leather food or dressing. October 23.

1889.

645. H. E. Frendenberg. Treatment of hides and skins, and apparatus therefor. October 23.

12,070. A. Weber. Kilns for burning bone-black. November 20.

12,521. J. Hauff. Process for freeing kips, skins, and hides from lime, and causing same to swell. October 30.

14,595. A. Hull. Preparing hides for tanning. October 30.

XV.—AGRICULTURE AND MANURES.

APPLICATIONS.

16,351. L. Q. Brin, A. Brin, and F. H. Varley. See Class VII.

18,148. J. T. Dinsdale and W. B. Kemshead. See Class XVIII.—B.

COMPLETE SPECIFICATION ACCEPTED.

1889.

14,633. N. B. Powder. A compound of animal substances and earths containing phosphate of iron and alumina for fertilising purposes. November 20.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

16,540. A. Wohl and A. Kollrepp. Improvements in the production of invert sugar. October 19.

17,184. T. O. Easton and A. Watt. Improvements in or appertaining to apparatus for filtering saccharine or other liquids. October 30.

COMPLETE SPECIFICATION ACCEPTED.

1889.

9021. J. Foster. Drawing off and condensing the vapour from sugar pans, and apparatus therefor. November 20.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

16,289. C. Pontifex. Improvements in refrigerators for cooling brewers' worts or other hot liquids. October 16.

16,325. C. P. Goode. Improvements in the treatment of brewers' grains for cattle food. Complete Specification. October 16.

16,556. D. Wickham. Novel construction or arrangement of condensing cylinder, used for gasating malt and other liquors. October 19.

16,906. W. B. Giles and A. Shearer. Improvements in brewing and the treatment of worts for distillers' use. October 26.

16,947. A. de Méritens. Improvements in treating and rectifying or ageing alcohol or alcoholic liquors or the like by electricity. October 26.

17,431. J. White. Improvements in the manufacture of of degerminated, flaked, boiled, and torrefied maize to be used for brewing and distilling purposes, and also as a prepared and cooked food, and in apparatus employed therein. November 2.

17,515. J. Lillie. Improvements in treating, ageing, or purifying alcoholic or other liquids, and in means or apparatus employed therein. November 4.

17,523. H. H. Lake.—From J. Barnes, United States. Improvements in yeast cakes. Complete Specification. November 4.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

14,225. A. Behr. Apparatus for malting grain. November 13.

14,965. E. A. B. Beaumont. Rendering alcoholic liquors more wholesome. October 23.

17,338. H. E. Sorel. Treatment of commercial alcohols. November 20.

18,286. H. A. Birrell. Treatment of ground malt for brewing purposes, and apparatus therefor. November 6.

18,422. C. Philippart. Improving the quality of alcohols and alcoholic liquors. October 23.

1889.

86. O. Inray.—From A. Bergh. Process and apparatus for aerating and purifying beer worts and beer. November 13.

14,642. L. Frisch. Manufacture of beer, ale, porter, and the like. October 23.

16,325. C. P. Goode. Improvements in the treatment of brewers' grains for cattle food. October 23.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

16,325. C. P. Goode. See Class XVII.

17,380. R. Denby. Improvements in the preparation of rennet powder for use in cheese making. Complete Specification. November 2.

17,434. J. White. See Class XVII.

18,195. F. T. Robinson.—From R. Robinson, New Zealand. Improvements in, or process for, the preservation of articles of food or other animal or vegetable matters. November 14.

B.—Sanitary Chemistry.

16,283. T. A. Bullough. Improvements in or appertaining to filters for filtering sludge and other semi-liquid matter. October 16.

16,298. H. F. Rushton. See Class I.

16,388. G. W. Brenner. Improvements in lamps for destroying sewage gas and noxious vapours. October 17.

16,867. E. A. Cowper. Improvements in apparatus for purifying water and sewage. October 25.

16,981. A. Green. Improved means for purifying water. October 28.

17,552. W. Birch. Improved apparatus for filtering sewage and other liquids. November 5.

17,784. T. Thorp and J. Bentley. Improvements in or connected with the purification of sewage. November 8.

17,898. A. Young. Improvements in asbestos sewerage gas destructor and ventilator or sanitary lamp. November 9.

17,991. G. F. Priestley. New or improved apparatus for treating sewage matter. November 12.

18,148. J. T. Dinsdale and W. B. Kemshead. Improvements in the treatment of sewage and sewage matters, and in the production of manurial products therefrom. November 13.

18,263. R. W. Penrose. An improvement in the treatment of germs. November 15.

18,291. F. W. Brookman. Improvement in the construction of destructors or furnaces for the combustion and cremation of town and other refuse, garbage, or offal, and in the method of disposing of and utilising the products of combustion therefrom. November 15.

C.—Disinfectants.

16,369. J. Orchardson. Improved means of and apparatus to be used for disinfecting, and for destroying vermin, and like purposes. October 17.

16,427. H. Staples, J. Staples, and W. Staples. Improvement in the manufacture of a cattle cleanser, sheep dip, or disinfecting fluid. October 18.

17,042. J. Jackson. An improved disinfectant. The combination and arrangement of substances for the purpose of disinfecting. October 29.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1889.

771. G. D. Wheaton. Means for preserving articles of a perishable nature. November 20.

9861. C. Heinemann. Manufacture of a malt product called "wheat coffee." November 20.

15,526. B. Graf and F. Pickenbrock. Producing ozone-water in which the ozone is retained for a considerable period without alteration. November 20.

16,325. C. P. Goode. See Application, Class XVII.

B.—Sanitary Chemistry.

1888.

16,093. J. G. Lorrain. Method and apparatus for formation of organic oxides, and the oxidation of matter suspended or dissolved in liquids. October 30.

18,568. C. H. Beloe. Purification of sewage and other foul liquids. October 30.

18,719. W. Warner. Means and apparatus for treating refuse. November 20.

18,791. J. Chabanel. Apparatus for separating, filtering, and disinfecting fecal matters. October 23.

1889.

12,623. T. Shaw. See Class IX.

C.—Disinfectants.

1889.

1430. J. Ascough. Manufacturing glazing, antiseptic and washing compounds. October 30.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

16,342. D. C. Simpson. A new or improved composition for treating paper and similar material to render writings or other markings indelible thereon. October 17.

16,930. C. G. Cresswell. Improvements in or relating to toilet paper. October 26.

17,141. D. H. Ferguson. Improvements in the process of manufacturing articles from pulp. Complete Specification. October 29.

17,496. E. A. Blumel. Improvements relating to the covering of various articles with xylonite or celluloid. November 4.

18,090. I. Appletree. A new composition to be used as a substitute for ivory and for other purposes. Complete Specification. November 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

18,716. C. Morfit. See Class XIII.

1889.

9694. F. J. Cheesbrough.—From H. Pataky and W. Pataky. Preparation of wood pulp for the manufacture of paper cloth, cordage, or other textile fabric. October 23.

14,494. T. Volstorff. Method and apparatus for straining paper pulp. October 23.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

16,197. J. Matthews and H. Johnson. Consolidated perfume. October 15.

16,555. O. Imray.—From W. MacKean, France. Process for obtaining salts of thorium, zirconium, and like metals from their ores or from waste residues of hoods used for incandescent gas lighting. October 19.

16,663. E. G. Scott. Improvements in the manufacture of chloride of carbon. October 22.

16,807. A. W. Rake. An improved anæsthetic compound. October 24.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

17,627. R. I. Hunter. Dental anodynes or obtundents. November 13.

18,521. E. Schnauffer and Hupfeld. Manufacture of a substitute for musk. October 30.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

17,406. S. V. Dardier. Improvements relating to permanent coloured photographic prints obtained by direct printing from negatives. November 2.

17,773. E. H. Farmer. Improvements in photography. November 7.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

16,715. A. R. Brown. Printing photographs, especially "blue printing," and apparatus therefor. November 6.

1889.

9012. A. H. Cros. Colour photography. November 20.

13,523. W. P. Thompson.—From C. Spiro. Solutions for developing or fixing the latent images on photographic plates or sheets. November 13.

XXII.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

16,426. J. S. Taylor and S. W. Challen. Improvements in plant for burning special charcoal for the manufacture of gunpowder. October 18.

16,597. T. J. Brown. Improvements in fireworks. October 21.

16,629. J. S. Taylor and S. W. Challen. Improvements in plant for preparing gunpowder carbon, consisting in the application of gaseous or liquid fuel to heat the carbonising vessel. October 22.

17,327. W. L. Roberts. Lighting purposes. A new or improved match, to strike on both ends with ignitive composition on both ends. November 1.

17,353. G. W. Thomas. Improvements in matches, fuses, and the like. November 1.

17,430. A. Walter. Improvements in or appertaining to percussion and time fuses for firing explosives. November 2.

17,474. C. E. Rhodes and A. T. Cocking. Improvements in explosives. November 4.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

17,456. W. R. Hodgkinson. Manufacture or treatment of explosives to better control combustion or prevent detonation. November 20.

18,968. E. L. Zalinski and H. J. Smith. Electric primers or igniters for blasting or firing mines, torpedoes, &c. November 20.

18,663. H. S. Maxim. Manufacture of explosives, and apparatus therefor. October 30.

1889.

39. A. Martin. Percussion fuses for explosive projectiles. November 6.

6332. W. H. Scott, L. Paris, and Scott, Lim. Electric fuses. October 30.

14,362. J. G. Gomez and P. Franco. Manufacture of matches of the vesta type. October 23.

XXIII.—ANALYTICAL CHEMISTRY.

APPLICATION.

18,141. C. R. Valentine. New or improved apparatus to be used for estimating the acidity of milk, cream, curd, and whey. November 13.

cal Industry:

RECORD

ICAL MANUFACTURES.

1889.

[Non-Members 30/- per annum; Members 21/- per Set of extra or back numbers; Single Copies (Members only) 2/6.]

ASSISTED BY THE FOLLOWING STAFF OF
Abstractors:

L. Bailey, Ph.D.	Chas. A. Kohn, Ph.D.
H. Beckett.	F. W. T. Krohn.
Bendix.	T. A. Lawson, Ph.D.
Bentz.	J. Walter Leather, Ph.D.
s. Bernays, M. Inst., C.E.	A. Liebmann, Ph.D.
E. Berry.	D. A. Louis.
J. Bevan.	W. Macnab.
rtam Blount.	N. H. J. Miller, Ph.D.
thur G. Bloxam.	J. M. H. Munro, D.Sc.
H. Bothamley.	H. S. Pattinson, Ph.D.
. Lant Carpenter.	H. T. Pentermann.
G. Clayton.	S. G. Rawson, D.Sc.
lius B. Cohen, Ph.D.	A. Rée, Ph.D.
F. Cross.	F. W. Renaud.
R. Davis.	Frank Scudder.
. W. Haldane Gee, B.Sc.	Edward Simpson.
Napier Hake.	A. J. Smith, B.Sc.
wald Hamilton.	Oscar J. Steinbart, Ph.D.
rtam Hunt.	A. L. Stern, B.Sc.
C. Hutchinson.	D. A. Sutherland.
E. Jones, B.Sc.	F. 'ram Thomas.
. E. Kay.	Eustace Thomas.
J. King, B.Sc.	V. H. Veley, M.A.
S. Kipping, D.Sc.	A. Wingham.

Please substitute the following for corresponding passage on p. 973, col. 1.:-

An increase in—

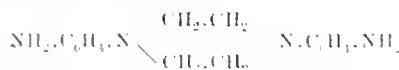
Volatile constituents of the coal of	26—40 per cent.
Specific gravity of the gas.....	0.755—0.749
Illuminating power	132—104 $\frac{1}{2}$ litres per 1 candle.
Carbonic acid	1.10—3.13 per cent.
Carbonic oxide.....	6.50—12.00 ..
Methane.....	34.00—37.00 ..
Heavy hydrocarbons of the fatty series ..	2.50—4.80 ..
Tar.....	3.90—5.60 ..
Gas liquor.....	1.50—10.00 ..

A decrease in—

Hydrogen	55.00—42.00 per cent.
Coke.....	71.50—57.8 ..
Temperature, obtained by burning the coke in the retort furnaces = 1,330°—1,220°.	

The author also investigated the other heavy hydrocarbons not belonging to the aromatic series, and found ethylene, propylene and acetylene—the first of these in large quantities. He also examined the illuminating constituents of the gas, and found that, of the total illuminating power of the gas, the heavy hydrocarbons of the fatty series produced 34.9 per cent.; the aromatic hydrocarbons containing 52 per cent. of benzene (down to -22) 15.9 per cent.; while the aromatic hydrocarbons containing 92 per cent. of benzene (-22 to -70) produced 49.2 per cent.

Also the following formula for that appearing on p. 976, foot of col. 2.:-



NOTICES.

Members are hereby advised that the subscription of 1890 falls due on January 1st. Only those members have paid their subscriptions will be entitled to receive Journal.

Orders and orders should be made payable at the Royal Post Office, London, to the Honorary Treasurer, Mr. Cook, and should be forwarded to him at Bow, so it be desired to notify a change of address for the coming new list of members, in which case the subscription should be forwarded together with the change to the Royal Secretary.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or of its Local Sections, are requested to take notice that Rule 41 of the bye-laws, the Society has the right of title of publication for three months of all such papers. Engagement of this bye-law renders papers liable to be used by the Publication Committee, or ordered to be acted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

B.—Sanitary Chemistry.

1888.

16,093. J. G. Lorrain. Method and apparatus for for
tion of organic oxides, and the oxidation of matter suspen
or dissolved in liquids. October 30.

18,568. C. H. Beloe. Purification of sewage and of
foul liquids. October 30.

18,719. W. Warner. Means and apparatus for treat
refuse. November 20.

18,791. J. Chabanel. Apparatus for separating, filter
and disinfecting faecal matters. October 23.

1889.

12,623. T. Shaw. *See* Class IX.

C.—Disinfectants.

1889.

1430. J. Ascough. Manufacturing glazing, antiseptic
washing compounds. October 30.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

16,342. D. C. Simpson. A new or improved composit
for treating paper and similar material to render writing-
other markings indelible thereon. October 17.

16,930. C. G. Cresswell. Improvements in or relating
toilet paper. October 26.

17,141. D. H. Ferguson. Improvements in the proc
of manufacturing articles from pulp. Complete Specificati
October 29.

17,496. E. A. Blumel. Improvements relating to
covering of various articles with xylonite or cellulose
November 4.

18,090. I. Appletree. A new composition to be used
a substitute for ivory and for other purposes. Compl
Specification. November 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

18,716. C. Morfit. *See* Class XIII.

1889.

9694. F. J. Cheesbrough.—From H. Pataky and
Pataky. Preparation of wood pulp for the manufacture
paper cloth, cordage, or other textile fabric. October 23.

14,494. T. Volstorff. Method and apparatus for strain
paper pulp. October 23.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCE
AND EXTRACTS.

APPLICATIONS.

16,197. J. Matthews and H. Johnson. Consolidat
perfume. October 15.

16,555. O. Imray.—From W. MacKean, France. Proce
for obtaining salts of thorium, zirconium, and like meta
from their ores or from waste residues of hoods used f
incandescent gas lighting. October 19.

16,663. E. G. Scott. Improvements in the manufactu
of chloride of carbon. October 22.

16,807. A. W. Rake. An improved anæsthetic cor
pound. October 24.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

17,627. R. I. Hunter. Dental anodynes or obtundent
November 13.

18,521. E. Schnauffer and Hupfeld. Manufacture of
substitute for musk. October 30.

THE JOURNAL

OF THE

Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 12.—VOL. VIII.]

DECEMBER 31, 1889.

[Non-Members 30/- per annum; Members 21/- per Set of extra or back numbers; Single Copies (Members only) 2/6.]

The Society of Chemical Industry.

Past Presidents:

Sir H. E. Roseoe, M.P., LL.D., V.P.R.S.	1881—1882.
Sir Frederick Abel, C.B., D.C.L., F.R.S.	1882—1883.
Walter Weldon, F.R.S.	1883—1884.
W. H. Perkin, Ph.D., F.R.S.	1884—1885.
E. K. Muspratt	1885—1886.
David Howard	1886—1887.
Prof. James Dewar, F.R.S.	1887—1888.
Ludwig Mond	1888—1889.

COUNCIL FOR YEAR ENDING JULY, 1890.

President: Sir Lowthian Bell, Bart., F.R.S.

Vice-Presidents:

R. Forbes Carpenter.	S. H. Johnson.
Prof. F. Clowes, D.Sc.	Ludwig Mond.
Sir J. Neilson Cuthbertson.	Dr. Hugo Muller, F.R.S.
Prof. James Dewar, F.R.S.	Dr. W. H. Perkin, F.R.S.
Jas. Duncan.	Dr. Edw. Schunck, F.R.S.
Dr. John Evans, F.R.S.	Prof. W. A. Tilden, F.R.S.

Ordinary Members of Council:

L. Archbutt.	B. E. R. Newlands.
S. B. Boulton.	Jno. Pattinson.
Jno. Brock.	Jno. Spiller.
Jno. Calderwood.	E. C. C. Stanford.
Alexander M. Chance.	J. C. Stevenson, M.P.
A. E. Fletcher.	A. Norman Tate.

With the Chairmen and Secretaries of Sections.

Honorary Treasurer:

E. Rider Cook, East London Soapworks, Bow, E.

Honorary Foreign Secretary:

Dr. Ferdinand Harter.

General Secretary: Charles G. Cresswell.

Offices:

Palace Chambers, 9, Bridge Street, Westminster, S.W.

ASSISTED BY THE FOLLOWING STAFF OF Abstractors:

T. L. Bailey, Ph.D.	Chas. A. Kohn, Ph.D.
G. H. Beckett.	F. W. T. Krohn.
D. Bendix.	T. A. Lawson, Ph.D.
E. Bentz.	J. Walter Leather, Ph.D.
Jos. Bernays, M. Inst., C.E.	A. Liebmman, Ph.D.
E. E. Berry.	D. A. Louis.
E. J. Bovan.	W. Macnab.
Bertram Blount.	N. H. J. Miller, Ph.D.
Arthur G. Bloxam.	J. M. H. Munro, D.Sc.
C. H. Bothamley.	H. S. Pattinson, Ph.D.
W. Lant Carpenter.	H. T. Pentermann.
E. G. Clayton.	S. G. Rawson, D.Sc.
Julius B. Cohen, Ph.D.	A. Rée, Ph.D.
C. F. Cross.	F. W. Renant.
A. R. Davis.	Frank Scudder.
W. W. Haldane Gee, B.Sc.	Edward Simpson.
C. Napier Hake.	A. J. Smith, B.Sc.
Oswald Hamilton.	Oscar J. Steinhart, Ph.D.
Bertram Hunt.	A. L. Stern, B.Sc.
C. C. Hutcheson.	D. A. Sutherland.
D. E. Jones, B.Sc.	F. W. Thomas.
W. E. Kay.	Eustace Thomas.
A. J. King, B.Sc.	V. H. Veley, M.A.
F. S. Kipping, D.Sc.	A. Wingham.

NOTICES.

Members are hereby advised that the subscription of 25s. for 1890 falls due on January 1st. Only those members who have paid their subscriptions will be entitled to receive the Journal.

Cheques and orders should be made payable at the General Post Office, London, to the Honorary Treasurer, E. Rider Cook, and should be forwarded to him at Bow, unless it be desired to notify a change of address for the forthcoming new list of members, in which case the subscription should be forwarded together with the change to the General Secretary.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

THE JOURNAL.

Publication Committee:

The President.

Sir F. A. Abel, F.R.S.	Prof. A. K. Huntington.
A. H. Allen.	F. Harter, Ph.D.
G. H. Bailey, D.Sc., Ph.D.	Ivan Levinstein.
Joseph Bernays, M.I.C.E.	Prof. R. Meldola, F.R.S.
H. Brunner.	Ludwig Mond.
W. Lant Carpenter.	E. K. Muspratt.
Prof. Frank Clowes, D.Sc.	B. E. R. Newlands.
W. Y. Dent.	C. O'Sullivan, F.R.S.
Prof. Jas. Dewar, F.R.S.	John Pattinson.
John Heron.	W. H. Perkin, Ph.D., F.R.S.
D. B. Hewitt, M.D.	Sir H. E. Roseoe, M.P., F.R.S.
David Howard.	John Spiller.
Prof. J. J. Hummel.	A. Norman Tate.
	Thomas Tyrer.

Editor:

Watson Smith, University College, London, W.C.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January 1883, and January, February, and April 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once, stating price required, with Mr. Cresswell. The stock of all other numbers is at present sufficient for the Council's requirements.

LIST OF MEMBERS ELECTED, 23rd DECEMBER, 1889.

Bartlett, Frank L., Portland, Maine, U.S.A., State assayer.
 Bernard, Jas. jun., 37, Great Western Road, Glasgow, analytical chemist.
 Buchanan, Josh., 118, Keppochhill Road, Glasgow, managing chemist, Pollok Patents Gold Extracting Co.
 Burgess, Wm. T., 1, Ringley Cottages, Reigate, Surrey, analytical chemist.
 Caines, Chas. M., 5, Rochester Terrace, Camden Road, N.W., analytical chemist.
 Carulla, F. J. R., 38, Argyll Terrace, Derby, chemical manufacturer.
 Conroy, Jas. T., The Hollies, Montpellier Crescent, New Brighton, student.
 Dunlop, Robt., Stanrigg Oil Works, Airdrie, N.B., manager.
 Eastwood, Chas., Linacre Gas Works, Bootle, near Liverpool, gasworks manager.
 Fort, Jas., 16, Adelphi Bank Chambers, South John Street, Liverpool, chemical broker.
 Hayes, Jno., 109, Upper Stanhope Street, Liverpool, patent agent.
 Hooper, Ernest F., c/o Burt, Boulton, and Haywood, Chemical Works, Silvertown, E., chemist.
 Hunton, Henry, Greystone Redmarshall, Stockton-on-Tees, chemist.
 Ingle, Harry, Pool, near Leeds, chemical student.
 Johnston, Thos., 149, West George Street, Glasgow, manager Nobel's Explosives Co., Ltd.
 Jourmand, J. L., Sainte Colombe-lez-Vienne, Rhône, France, chemist.
 Keen, Austin, Technical School, Huddersfield, secretary.
 Manhes, P., 30, Rue du Plat, Lyons, France, metallurgical engineer.
 Meggitt, H. A., Chemical Works, Mansfield, Nottingham, glue and manure manufacturer.
 Müller, Geo., 125, Mercer Street, Jersey City, N.J., U.S.A., chemist.
 Pickard, Wm., Stafford Villa, Norfolk Park, Sheffield, manufacturing chemist.
 Ramage, Alex. S., The Stag Chemical Co., Widnes, manufacturing chemist.
 Saeré, Howard C., Breeze House, Higher Broughton, Manchester, chemical manufacturer.
 Shand, Francis J., Aldersyde, Bridge of Weir, N.B., assistant manager Nobel's Explosives Co., Ltd.
 Shaw, Saville, Durham College of Science, Newcastle-on-Tyne, chemical demonstrator.
 Speakman, J. J., 29, Greenway Road, Runcorn, clerk in chemical works.
 Starkey, R. W., Pemman, Hampton Wick, Middlesex, engineer.
 Walker, Ralph W. M., 107, St. George's Road, Warwick Square, S.W., distiller.
 Williams, Geo. G., 102, North 19th Street, Philadelphia, Pa., U.S.A., student.
 Wishart, Jno., 39, St. Vincent Place, Glasgow, mineral oil manufacturer.

CHANGES OF ADDRESS.

Abel, Sir F. A., C.B., Journals to 40, Cadogan Place, London, S.W.
 Barret, E. L., 1/o Willesden Green; 192, Belsize Road, Hampstead, N.W.
 Bell, J. Carter, 1/o Bankfield; Bank House, Higher Broughton, Manchester.
 Brookes, E. A., 1/o Whalley Range; 22, Claremont Grove, Barlow Moor Road, Didsbury, near Manchester.
 Brown, A. E., 1/o Lewisham; Thought Cot, Brentwood.
 Carpenter, H. S., Journals to Beckington House, Weighton Road, Anersley, S.E.
 Coghill, P. de G., 1/o Derby Lane; Borax Works, Old Swan, Liverpool.
 Coleman, G. F., 1/o Philadelphia; c/o Griffing Iron Co., Jersey City, N.J., U.S.A.
 Dyson, H., 1/o Wakefield; 2, Exchange Place, Middlesbrough-on-Tees.
 Farrant, N., 1/o Bearwood Road; 107, St. Paul's Road, West Smethwick.
 Field, S. E., 1/o Melton; Stone Trough Brewery, Halifax.
 Francis, G. B., 1/o Coleman Street; 38, Southwark Street, London, S.E.
 Francis, W. H., 1/o Coleman Street; 38, Southwark Street, London, S.E.
 Hall, Edgar, 1/o Sydney; Post Office, Burwood, New South Wales.
 Hardy, H. J., 1/o Sheffield; Chemical Department, Royal Naval College, Greenwich, S.E.
 Hoegger, A., 1/o Victoria Crescent; Melrose Villa, Ellesmere Park, Eccles.
 Howarth, R. S., 1/o Cheetham; Rozel, Heath Road, Cale Green Park, Stockport.
 Hudson, F. V. M., 1/o Albany; 459, 6th Street, Brooklyn, N.Y., U.S.A.
 Iriyó, K., 1/o Widnes; c/o China and Japan Trading Co., 4, East India Avenue, E.C.
 Isherwood, Oswald, 1/o Broughton; 1, Crescent View, Salford, Manchester.
 Joynson, F., 1/o St. Helens; Wellington Road, Dndley.
 Maenair, D. S., 1/o Wurzburg; People's Palace Technical Schools, Mile End, E.
 Miller, W. M., 1/o Pln. Tusehen den Vrienden; Pln. Uitvlugt, West Coast, Demerara.
 Richmond, H. D., 1/o Willesden; Khedivial Laboratory, Cairo, Egypt.
 Singer, Ignatius, 1/o Ilkley; Calverley, near Leeds.
 Smith, J. Wm., 1/o Boston; Solvay Process Co., Syracuse, N.Y., U.S.A.
 Spence, Jno. W., 1/o West Regent Street; 58, Dobbie's Loan, Glasgow.
 Trnby, Chas., 1/o 53; 20 High Street, Manchester.
 Tyrer, Thos. Journals, &c., to private address 179, Bridge Road, Battersea, S.W.
 Wright, J. C., 1/o Redear; 12, Eglinton Street, Irvine, N.B.

Death.

H. M. Robertson Ewing, Alexandria, Dumbartonshire, N.B.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	R. Messel.
H. E. Armstrong.	B. E. R. Newlands.
W. Lant Carpenter.	B. Redwood.
W. Crowder.	T. Royle.
W. J. Dibdin.	John Spiller.
C. Graham.	Wm. Thorp.
S. Hall.	C. R. Alder Wright.
C. C. Hutchinson.	

Hon. Local Sec. and Treasurer: Thos. Tyrer.

SESSION 1889-90.

1890.

Jan. 6th:—

Mr. C. T. Kingzett. "Hydrogen Peroxide. Its Preservation and Commercial Uses."

Mr. J. W. Lovibend. "An Analytical Tintometer."

Feb. 3rd:—

Messrs A. H. Allen and W. W. Staveley. "On the Properties and Applications of Metallic Compounds of the Phenols."
Mr. Watson Smith. "A New Method of Hardening Steel for Cannon and Projectiles."

March 3rd:—

Dr. H. Schlichter. "Analysis of Textile Fibres and Fabrics."
Dr. L. T. Thorne. "A Review of the Methods of producing Oxygen commercially."

Notices will be found in the Journal and other Scientific Papers.

Meeting held Monday, December 2nd, 1889.

MR. DAVID HOWARD IN THE CHAIR.

- (1.) ON NAPHTHALENE OBSTRUCTIONS IN GAS SERVICE-PIPES; ALSO ON
- (2.) VARIATIONS IN THE PRODUCTS OF THE DESTRUCTIVE DISTILLATION OF DIFFERENT GAS COALS.

BY WATSON SMITH, F.C.S., F.I.C.

Lecturer in Chemical Technology in University College, London.

(1.) *Naphthalene Obstructions in Gas Service-Pipes.*—Many and bitter have been the complaints which have been made about the naphthalene obstructions, and especially by gas manufacturers of the United States. The term is perfectly understood by all gas makers, and only for those less acquainted with the gas industry may it be desirable to offer explanation.

Naphthalene obstructions arise when so much naphthalene vapour occurs in the gas introduced into the mains that the crystalline flakes of that hydrocarbon get into, or condense in the smaller service-pipes, and partially, or at last, and in some cases, entirely stop these up, thus obstructing the flow, and partially or entirely extinguishing the lights. Whole districts have in some cases been thus plunged into darkness from this cause. The cause of the nuisance I have heard attributed to the excessive presence of naphthalene in certain of the varieties of coal used for carbonisation in the gas retorts, and indeed this explanation is more generally current than many chemists are aware of. Thus in a case which came under my observation two years ago, a large heap of cannel on the ground in the gasworks I refer to, was pointed out to me as having stood exposed to a hot sun for some weeks, and it was suggested that coal thus air- and sun-dried would, at the high temperature of carbonising, suffer a more drastic carbonisation, if I may

use the term, than coal in the usual condition of dampness, and hence give off more naphthalene. This deduction of my informant would be more plausible if naphthalene really did exist as such in coal of any kind. I imagine, however, that all steam derived from hygroscopic moisture would have left the retorts before the formation of naphthalene could take place to any extent. Doubtless, however, the fresh charge of coal must cool the retort to some extent, and the formation of steam from moisture present, if considerable, must certainly, by absorption of heat, delay the rise of temperature during the fixed period of gasification, to that usual as the maximum heat. Hence, if we take it that a coal on the average containing a certain amount of moisture is carbonised, and yields gas of usual quality and not excessively burdened with naphthalene, a coal of the same kind but well desiccated may suffer a more prolonged intense heat though the firing arrangements remain constant; and the heat thus attained and prolonged may suffice to materially increase the naphthalene formed. But the hot weather and sun which cause the desiccation of coal exposed to them, will also detract greatly from the efficiency of the atmospheric condensers, and will tend to warm up the rest of the apparatus, and if, through drought or other causes, supply of water to condensers and scrubbers run temporarily short or become warm, or if the usual and normal condensation by cooling be suspended for a time, then great risk is run of naphthalene being carried by the flow of gas into the mains in dangerous abundance, for we have a general concurrence of circumstances favouring deficiency of condensation. Now it is a fact that when a certain ratio exists between naphthalene and the vapours of liquid hydrocarbons, and especially of those of carbolic acid and other phenols, the naphthalene will not sublime so as to deposit in crystals. It seems as if at the moment of the formation of a minute crystal and its deposition from the mixed vapour, a minute quantity of naphtha also condenses upon this point, and the crystal vanishes, so to say, at the moment of formation, a minute drop containing the naphthalene in solution being the result. (That naphtha laden with naphthalene does condense in the mains, is proved by an examination of the street-siphon condensates. See Lunge's Work on Coal Tar, 1887, 28.) But let the proportion of naphthalene increase, and a point will be attained at which sublimation becomes possible and condensation in crystals follows just as in the predominance of snow over drizzle or sleet, snow at last settles, spite of the drizzle. I can give an interesting example of the fact referred to, which was presented to my notice a few years ago. When I visited the first installation of 25 Simon-Carrès coke ovens at Pease's West, Crook, near Darlington, I not only observed that the tar produced was of very high specific gravity, but found that it ran into the tar-well, not cold but milk-warm, and on removing the lid of the well I noticed that the underside, besides the well-sides, were lined with naphthalene to a thickness of about half an inch—the result of sublimation. The atmosphere of the well also smelt strongly of naphthalene vapours—and not of the benzene hydrocarbons, &c. Naphthalene was excessively present in that tar, and the amount of other and liquid constituents was insufficient to exercise any restraint upon the free sublimation of the hydrocarbon. This shows what an awkward intruder naphthalene must be when it once gains, if only for a short period, access to the gas-mains. We then meet with a phenomenon somewhat resembling that of the drifting of snow, and even when the cause has been removed the hydrocarbon will remain in the mains for a considerable time, to be vaporised when warm and redeposited when the weather becomes cold. This peculiarity deceives the gas managers frequently, who think something is continually going wrong, and many vain attempts and useless experiments to remedy the defect are tried. There is thus no doubt that inefficient and insufficient cooling and condensation of the gas before its entry into the mains is a prolific cause of the naphthalene difficulty. I have been recently reminded of Brémont's experiments showing that desiccation of the gas by dry lime is a cure for "any tendency" of such gas to deposit naphthalene. I can only say that though dryness of the gas may put back or delay the deposition till a somewhat higher point of saturation is

attained, it is utterly absurd to say that the cure is an absolute one and that no deposition at any higher point of saturation can take place.

If we trace the progress of the gas after condensation, cooling and scrubbing, we come to the gasometers where it is stored. It is clear that if these be not sufficiently large for the supply required, but also to allow a *certain reserve*, then the condensation and deposit of the naphthalene sublimate from the gas can never take place. During hot weather sufficient condensation then becomes almost impossible.

In preventing naphthalene obstructions all the following points need attention:—

- (a.) The quality of the coals used and the coal mixtures; also the heat of carbonisation.
- (b.) The cooling and condensation of the gas. That sufficient time be allowed for this.
- (c.) The proportion of the condensing and storage plant to the gas supply required.

If there be any doubt (as I understand there is) as to purified gas containing naphthalene, let the doubter read of the experiment of G. E. Davis recorded in this Journal, 1883, 523.

The observation previously noted as to the non-sublimation of naphthalene in presence of an ample quantity of naphtha vapours that are condensing to form liquid products, shows us the benefit of using a mixture of coals containing a good proportion of cannel, which on distillation always yields very liquid tars. The vapours condensing to such liquid products wash or scrub down the naphthalene from the vapours of tars otherwise rich in the hydrocarbon and proceeding from other than true cannels in the coal mixture used.

Let us suppose that naphthalene, in a hot summer, is carried into the mains which are underground, and compared with the apparatus above ground, are cooled. A hot summer will mean plenty of daylight and so little gas consumption, and hence but a slow current of gas through the mains, and the condensers being insufficiently cooled, naphthalene may get into these mains and stop there. In the winter there will be a more rapid current of gas, since there will be a larger demand both in the homes and in places of business, factories, &c., in the early evenings, and if the naphthalene collect and lie about, more especially at bends and angles in the mains, whilst a slow current would not disturb such deposits materially, at the period when some tens of thousands of gas burners are lit up in an early winter's evening, when both offices and homes are inhabited, we may imagine something like a "gust" of gas, if I may use the term, carrying along the naphthalene flakes further and further to the service-pipes and at last causing stoppages in them. Moreover the cold air will aid crystalline condensation in the service-pipes themselves where they reach above ground, for here cooling-surface is relatively much greater than in any part of the system yet traversed. We have not here the conditions for realising the high illuminating value of naphthalene as in the albo-carbon lamp, as has been recently suggested, but the reverse, for though the mains in summer may be cooler than the service-pipes above ground, yet in winter, the opposite will often be the case and the mains be the warmest. In this latter case, we may have slightly warm gas in the mains, to some extent saturated with naphthalene, rising into and through cold service-pipes above ground and exposed to frosty air, the result will be gradual deposition of naphthalene flakes in the service-pipes, especially if the gas be allowed to stand and stagnate there for some time, whereas a considerable use of the gas may not give time for the obstructive condensation.

Hence the frequent observation of stoppages in blind pipes and disused services.

I have now dwelt somewhat at length upon the theme of naphthalene obstructions.

It seldom happens, to the best of my belief, that the observations of the mere practical man are wholly at fault. He may not express himself with scientific accuracy, but there is generally a germ of truth in his utterances which needs, as it were, transplanting, pruning, and cultivation, and then the full truth develops. The statement made to me to the effect that coals differed as to the amounts of naphthalene contained in them, made me pause and consider whether it might not

be possible that what is really the proper way of putting it, is that *different coals carbonised under like conditions yield varying amounts of naphthalene, and also of other products.* This, then, leads us to the second part of my subject, viz.:—

(2.) *Variations in the Products of the Destructive Distillation of different Gas Coals, heated under similar Conditions.*—This idea formed the basis of a series of experiments that was proposed to a large gas company whose customers were grievously plagued by naphthalene in the service-pipes. The company had an experimental plant, the retorts being of cast iron. The proposal was to carbonise 5 cwt. of each kind of coal used, separately, to collect the gas, tar, and gas liquor, and to send me a sample of each tar, in which I was to determine the amount of naphthalene. Each variety of coal of 17 different kinds was thus treated, representing the principal or typical cannels and gas-producing coals in the northern coal-fields of England. Since all these coals passed under the same treatment and through the same retort, the conditions as to temperature of distillation may be regarded as identical.

As more deductions will be attempted from the results of these experiments than those relating to naphthalene, let us now consider the subject in a more general way, and observe what differences are already known as resulting from the carbonisation of different varieties of gas-coals. Many people are not aware of the great influence which the physical properties or, perhaps better, the chemico-physical properties of different coals have upon the products of their destructive distillation, even upon the character of the cokes they leave behind. Thus, you may take three coals, one from the Staffordshire coal-field, one from the North Yorkshire, and the other from the Scottish. Charge all three varieties into three adjoining Simon-Carvès coke ovens, and carbonise under precisely similar conditions. Without taking into account the variations of the other products obtained, you then find three varieties of coke. The first (Staffordshire) of the highly silvery appearance so characteristic of the product from the Beehive coke ovens and in every way answering for blast-furnace use, and indeed from its similarity of appearance exciting no question; the second, less silvery than the Staffordshire product, also successfully used in the blast furnaces, the smaller pieces being excellent for foundry use. The third (the Scottish) gives a loose and more friable product unsuitable for blast-furnace use. Hence the coal-fed blast furnaces of Scotland.

Again, let us suppose a gas retort charged with an ordinary bituminous coal, not distinctly a cannel, but approaching it, and destructive distillation to follow, and again let us suppose it charged with a pronounced cannel coal, and again carbonised precisely as in the former case, or at a still more elevated temperature. In the first case you will get a tar high in specific gravity, and rich in naphthalene and anthracene, but deficient in paraffins and middle oils; in the second case the specific gravity of the tar will be low, paraffins will be plentiful to the detriment of the anthracene, and anthracene and naphthalene scarce. Moreover, the light naphthas with middle oils will be plentiful. The specific gravity of the rectified benzenes in the first case will be 0.880 to 0.890, but in the second it may be about 0.870 or even lower. (See also von Hohenhausen, this Journal, 1884, 74.) In the first case the creosote oil will on cooling partially solidify from crystallisation of naphthalene; in the second, even on cooling crystallisation may not take place. A sample of the clear reddish oil distilled, and the latter small portion taken, boiling at 220° to 250° or thereabouts, may solidify on cooling, but it will present the appearance of a greasy thick mass without much crystalline appearance, and contain a mixture of naphthalene and paraffin. I well recollect the time when Gräbe and Liebermann's great synthesis of artificial alizarin was first effected, and I remember the trouble caused by the anthracenes obtained from the tar from the gas works of the Manchester Corporation, where Wigan cannel was principally carbonised. The difficulty was only overcome by mixing more friable and less bituminous coals with the cannels for charging the gas retorts.

On reading the very instructive paper of Mr. Lewis T. Wright in our Journal for 1888, pages 59—62, I observe that the investigation he there records had for its object the

discovery of the influence of various degrees of heat upon coal during carbonisation in the gas retorts as regards the yield and character of the tar and its products, and the ammonia produced, and also as regards the sulphur compounds other than sulphuretted hydrogen occurring in the gas. The results I offer, on the other hand, have regard to the variation of products with variation of the characters of the gas-coals used, keeping temperature of destructive distillation pretty much constant. As soon as we learn that not only does variation of temperature of destructive distillation affect the yields and characters of products, but also variations in the physical characters of the coals used, we become

impressed with the fact that the question is a more complex one than may have at first sight appeared. With regard to the varieties of gas-coals employed, there were 17 varieties, but as regards the names of them, these I am not able to give, and I prefer also to withhold the name of the gas company for whom the investigation was conducted, though it robs me of the pleasant opportunity of publicly thanking its chairman for allowing me to publish the figures obtained. I now give a tabulated statement of the experimental results of the investigation which will speak for themselves, giving numbers for coals experimented on from 1 to 17, and adding that the experiments were made in 1887.

No. of Coal Tested.	Yield of Gas in Cu. Feet per Ton of Coal.	Illuminating Power in Standard Candles.	Ammoniacal Liquor.		Tar.		Actual Sp. Gr.	Naphthalene Percentage.
			Gallons.	Sp. Gr. Degrees, Twaddell.	Gallons.	Sp. Gr. Degrees, Twaddell.		
1	10,442	15.16	20.0	2.0	..	36	1.191	4.67
2	9,920	27.70	21.3	3.0	11.8	34	1.182	3.94
3	10,826	24.23	18.6	2.5	11.1	32	1.175	4.85
4	10,500	14.22	12.3	4.0	9.1	37	1.186	4.06
5	10,716	15.13	12.0	4.0	8.1	36	1.196	5.32
6	10,890	14.68	13.3	3.5	10.0	37	1.201	6.00
7	10,786	14.92	16.6	4.5	10.5	36	1.193	5.39
8	10,733	14.76	15.0	3.5	9.3	36	1.190	5.20
9	10,506	14.51	12.0	4.0	7.5	36	1.187	3.53
10	10,200	15.71	17.3	4.5	12.6	34	1.177	4.00
11	10,946	14.63	13.3	4.5	9.0	35	1.186	4.56
12	10,333	15.14	11.6	4.0	10.0	35	1.187	5.26
13	10,760	14.99	15.0	3.5	9.2	35	1.180	4.63
14	9,666	26.78	25.6	3.0	14.8	30	1.170	4.13
15	10,280	25.06	26.0	4.0	14.6	29	1.167	3.18
16	9,716	25.97	27.0	3.5	14.0	31	1.164	2.68
17	9,333	29.09	22.3	3.5	10.8	31	1.147	3.15

TABLE OF SPECIFIC GRAVITIES OF TARS, WITH CORRESPONDING PERCENTAGES OF NAPHTHALENE ARRANGED IN ASCENDING SCALE.

No. of Sample.	Specific Gravity.	Percentage of Naphthalene.
16	1.164	2.68
17	1.147	3.15
15	1.167	3.18
9	1.187	3.53
2	1.182	3.94
10	1.177	4.00
4	1.186	4.06
14	1.170	4.13
11	1.186	4.56
13	1.180	4.63
1	1.191	4.67
3	1.175	4.85
8	1.190	5.20
12	1.187	5.26
5	1.196	5.32
7	1.193	5.39
6	1.201	6.00

A glance at the adjoining figures for specific gravity and percentages of naphthalene will show that they fit together remarkably well, rising and falling together. This is more clearly shown in the arrangement on page 953, where the specific gravities are placed in order of magnitude, and it is seen that as these numbers rise so the numbers representing the naphthalene rise, not precisely in all cases, but very nearly so. For the specific gravities of the tars, the Twaddell hydrometer was used and also known volumes were weighed. The second mode may be taken as being about accurate, and the numbers show on comparison with the Twaddell degrees how very inaccurate a method of determining the specific gravity of so thick a fluid it is to use the hydrometer. The Twaddell gravities were taken at the works in the usual manner.

According, then, to the first of the preceding tables, we observe that the coal which, whilst yielding at the given temperature employed a good volume of illuminating gas of good illuminating power, yields also a minimum of naphthalene, is No. 15.

It is now additionally clear from what results have been given:—

(1.) That it is a rational procedure to select a gas-coal or mixture of gas-coals, which will, other circumstances being equal, yield with a good illuminating gas such a fair minimum of naphthalene as will contribute to its illuminating value without the obstructive complications already described; and

(2.) That in the specific gravity of the tar produced we have a fair criterion as to the amount of naphthalene present in that tar (I am here speaking exclusively, of

course, of benzenoid tars), and again also by analogy, some idea as to the relative naphthalene-condition of the gas.

With regard to the effect of high temperature carbonisation irrespective of quality of gas-coal, Mr. Lewis T. Wright in his interesting paper (this Journal, 1888, 61) gives the analysis of a tar obtained from a mixture of Yorkshire and Derbyshire coals distilled at a high temperature. The following result was obtained. Specific gravity of the tar = 1.23. Results of distilling it were as follows:—

	Per Cent.
Ammoniacal liquor	4.39
Crude naphtha	4.11
Light oil .....	..
Creosote oil	18.99
Anthracene oil	12.14
Pitch	59.14
	<u>98.77</u>

Mr. Wright remarks "Here the light oils are practically absent, and as soon as the crude naphtha (rich in benzenes) had come over solid naphthalene made its appearance."

Let us now see how nearly this result obtained by Mr. Lewis T. Wright upon mixed Yorkshire and Derbyshire coals will agree with results obtained according to my experience with a Staffordshire coal carbonised also at a very high temperature in the Simon-Carvès coke ovens, and producing, as already remarked earlier in this paper, a coke of very silvery lustre undistinguishable both in appearance and action in the blast furnaces from Beehive coke-oven coke. I have calculated my percentage result of an examination of this tar (made in May 1885) so as to give the same amount of ammoniacal liquor as the tar examined by Mr. Wright. The specific gravity of this tar was 1.2, and on distillation it gave—

	Per Cent.
Ammoniacal liquor	4.39
Crude naphtha (sp. gr. 0.950)	9.70
Distilling over below, (Light oils .....	..
but up to 300° C. (Creosote oil	22.70
Above 300° C. Anthracene oil	10.70
Pitch	52.51
	<u>100.00</u>

Thus, there were no light oils and indeed no heavy oils, for the so-called creosote oil was a greasy solid or semi-solid mass of crude naphthalene.

The anthracene "oil" was also a semi-solid mass.

No doubt the temperature here had even exceeded that employed by Mr. Wright in carbonising his coal. The similarity of results is somewhat conspicuous, and the tendency of still higher temperatures has been still further to accentuate the absence of oils, both creosote oils and anthracene oils, as well as ordinary light and heavy oils. Other differences in results will, as already seen, be due to different qualities of the coals carbonised. The crude naphtha obtained as above, and of sp. gr. 0.950, yielded 79.5 per cent. by volume of naphtha and 2.16 per cent. of crude carbolic acid, or 0.14 per cent. on the tar.

I can thus confirm Mr. Wright's observation as to the apparent diminution of the tar acids (phenolic bodies) as well as middle oils with increase of temperature, by these results of mine in 1885, and gas-retort tar generally contains 0.5 per cent. of crude carbolic acid as against the 0.14 per cent. I obtained in this Simon-Carvès oven product. Possibly though, as I have yet to show, neither Mr. Wright nor I sought for the carbolic acid in the right oils, and we did not get all there was in such case. The other results with the crude naphtha were—

Temp. °C.	Per Cent. by Volume.	
Below 100°	1.36	} 63.29
" 110°	8.84	
" 150°	38.08	
" 200°	15.00	
Above 200°	56.71 (chiefly naphthalene).	
	<u>100.00</u>	

The presence of carbolic acid and phenols, whilst the benzenes keep up, and probably increase, confirms Schulze's view (Ann. 227, (1) and (2), 143), that "the primary products of the dry distillation of coals are phenols. These phenols are then at the high or higher temperatures of the retorts split up so as to yield water and high boiling hydrocarbons, whilst another portion of them is reduced to lower boiling hydrocarbons, or finally, with more entire decomposition, into illuminating gas."

Of course, as L. T. Wright observes (*loc. cit.* p. 61), "the gravity of the products in regard to boiling points, increases with increased coal-distillation temperature," and this is easily shown by distilling the same kind of coal at temperatures of increasing elevation and taking the specific gravities of the tars, but my table shows that with approximately the same temperature (the usual gas-making one) and similar conditions, the specific gravities of the tars may differ, if the coals be different in "physical" or chemico-physical character—and differ somewhat considerably.

It is interesting to note that when naphthalene is high in a tar, anthracene is also high, and then usually creosote oil is scarce, and intermediate oils almost or quite absent; but benzenes do not suffer diminution, though if condensation be not good they may be carried off by the gas to a considerable extent. (See G. E. Davis, this Journal, 1883, 520.)

Glancing again at our table, we see great variations in the quantities of tar obtained, which cannot be fully explained by any reference to either volumes of gas obtained, illuminating power of the same, or by reference to the specific gravities of the tars, or the amounts of naphthalene, whether any of these are taken singly or in conjunction. I take it then that the volumes of tar obtained, the carbonising heats being about the same, are functions of the physical and chemical conditions of the coals employed, and hence we may say that in carbonising coal for the sake of aromatic tars, a selection of a special coal among many kinds of gas-coal, may be reasonably sought for. Indeed, I believe the more scientific coal-carboniser has already, to some extent, become aware of this fact, through the experience gained in concentrating attention upon the tar products rather than upon the gas. We find in the table, for example, that whilst No. 9 yields only 7.5 gallons of tar per ton, of sp. gr. 1.187, No. 14 yields 14.8 gallons of sp. gr. 1.170, *i.e.*, nearly double the amount.

If now we arrange the table in the order of the specific gravities of the tars obtained, as on page 953, a curious fact is brought out, *viz.*, that whilst the tar of lowest specific gravity corresponds to the smallest volume of gas obtained of highest candle power, yet it has not followed that naphthalene shall be present in least percentage in that tar, nor has it followed that the tar shall be smallest in percentage amount on the coal carbonised. The yield of tar is good in this instance, and the amount of naphthalene is smallest in amount save one case. The most notable is that at the foot of the table, where, with the tar of highest specific gravity, and gas of low candle power, the yield of gas is highest, and the amount of naphthalene in the tar is highest, yet the amount of tar obtained is also considerable.

It would seem that some coals may be carbonised at a high temperature; a large volume of gas obtained, of rather low illuminating power, and also a considerable volume of tar may be obtained containing much naphthalene, and consequently a thick tar. In short, it would appear, as indeed we have supposed, that some coals have a greater tendency at high temperatures to produce naphthalene and similar high boiling hydrocarbons than others whose tendency is to be more refractory on destructive distillation in this respect, and by preference to form bodies of the phenolic type and benzene hydrocarbons, the phenolic bodies, breaking up in accordance with Schulze's hypothesis, into benzene and other hydrocarbons, and these, or some of them, probably passing off more largely with the gas, increasing its illuminating power, as seen in the table. It must be plain that on the whole the thinner tars, hence containing bodies of lower specific gravity, correspond to gases of highest illuminating power, collaterally produced.

These thin tars are always characteristic of the true canal coals, such as the Wigan canal, notably, and we know that such coals yield highly illuminating gas.

What will strike us most in the table is that in spite of the variations referred to, we see strong evidences of the general rule that with a tar of moderate specific gravity (1·16 to 1·17) we have a large yield of that tar, a good yield of gas of high illuminating power, and a moderate amount of naphthalene with doubtless a good yield of anthracene, and a fair amount of benzene and carbolic acid, whilst with one of high specific gravity, the gaseous volume is larger,

illuminating power smaller, naphthalene (and anthracene) larger, and the amount of tar obtained, smaller. The special deviations from the rule indicate, I take it, differences in the properties of the different coals used, and show that within the general rule, there is room for selective improvement and advantage. The percentages of naphthalene given only, of course, represent the amounts in the tar. That in the gas is considered as gas, and is valuable there so long as it does not deposit and cause obstructions. That in the tar is to some extent an index of what may be expected, other things being equal, in the gas.

TABLE WITH YIELDS ARRANGED IN THE ORDER OF THE SPECIFIC GRAVITIES OF THE TARS.

—	Specific Gravities of Tars.	Amounts of Tar in Gallons.	Yields of Gas.	Candle-Power of Gas.	Percentages of Naphthalene.	Gallons per Ton of Tar.		
						Light Oils distilling below 180°.	Light Oils above 180° with Heavy Oils for Carbolic Acid.	Total.
			Cubic Feet.			Crude Naphthn.		
17	1·147	10·8	9,533	*29·09	3·15	7·4	21·5	32·0
16	1·164	14·0	9,746	25·97	2·68	8·4	21·0	32·0
15	1·167	14·6	10,280	25·06	3·18	1·4	26·4	31·0
14	1·170	14·8	9,666	26·78	4·13	5·0	21·5	30·6
3	1·175	11·1	10,826	24·23	4·85	6·0	23·0	33·0
10	1·177	12·6	10,200	15·71	4·00	7·1	30·0	41·1
13	1·180	9·2	10,760	14·99	4·63	4·2	18·0	26·8
2	1·182	11·8	9,920	27·70	3·94	7·1	11·6	22·6
11	1·186	9·0	10,946	14·63	4·56	1·4	21·5	27·5
4	1·186	9·1	10,590	14·22	4·06	3·8	20·5	28·4
9	1·187	7·5	10,906	14·51	3·53	5·3	13·7	22·5
12	1·187	10·0	10,333	15·44	5·26	4·1	19·0	28·4
8	1·190	9·3	10,733	14·76	5·20	2·1	17·0	24·3
1	1·191	..	10,442	15·16	4·67	8·2	5·6	18·5
7	1·193	10·5	10,786	14·92	5·39	4·5	15·5	25·4
5	1·196	8·1	10,716	15·13	5·32	5·0	16·0	26·3
6	1·201	10·0	10,890	14·68	4·00	4·0	13·3	23·3

* Highest candle power.

† Most gas.

‡ Most naphthalene.

I will now pass on to a more special consideration of the tar constituents as obtained from the various coals, similarly distilled, and referred to in the table. By distilling off the crude naphtha and light oil, including some creosote oil, and measuring them, the amounts of these constituents were determined. As crude naphtha, all that coming over on distillation below 180°C. was measured. As to the remaining oil, it may be said that it consisted of light oils, including some heavy oils, and the bulk of it sunk in water. The amounts were measured, and are given in the last table, so as to follow with the specific gravities of the tars, taken in increasing order. It will be seen that as the tars rise in specific gravity, there is clearly a tendency to a falling off in the quantity of crude naphtha and of the light oils; but variations are again very perceptible, depending, no doubt, on the varieties of coal carbonised. The tendency to the falling off in the middle oils manifest above, bears out the observations of Lewis T. Wright (this Journal, 1888, 60 and 61). With regard to the falling off of anthracene in tars of a higher specific gravity than 1·086, my experience does not coincide with that of Mr. Wright; but what I do find is, that with the naphthalene the anthracene also increases, and the specific gravity with increase of both. Moreover, that as the naphthalene increases, the creosote oil gets thicker and the more anthracene is carried over with the creosote oils, and is consequently to be found in them. Hence, to estimate the absolute amount of anthracene in those thicker tars rich in naphthalene, not only the usual anthracene oils

must be examined and extracted, but also the creosote oils, or it will appear as if there were a falling off in the amount of anthracene present, whereas that hydrocarbon has been distributed more widely along with that very widely distributed substance, naphthalene.

There may thus be a kind of change of *locus* in the crude anthracene, and it then appears as if it had been carried or shifted back in part from the higher boiling oils in which it is usually found, and called "anthracene oils," to the lower boiling or creosote oils generally containing naphthalene as the principal solid constituent.

Mr. Charles Lowe, of Reddish, near Manchester, the well-known manufacturer of carbolic acid, informs me that in a precisely similar manner in tars formed by the distillation of coals at very high temperatures, as in the London gasworks, in which the middle oils are somewhat scarce, and the creosote oils thick with naphthalene, the carbolic acid is, to a great extent, carried forward, and is also found mostly in the creosote oils. Thus, years ago, it was considered not worth while to work up the usual "carbolic oils" or "light oils," for carbolic acid in London, because they contained so scanty an amount of phenols. But Mr. Lowe discovered that it was in the thick "creosote oils" of the London tars that they must be sought, and so he took out his patent, No. 3005 of October 11, 1872, on "Treating Coal-gas Tars."

The object of his invention was to obtain phenol, cresol, &c. from the mixed dead or heavy oils of the London coal

tar, or similar tars. He collected about the first 300 galls. of the oils heavier than water, immediately following the crude naphtha and light oils obtained in the distillation of $12\frac{1}{2}$ tons of London gas tar or similar tars, which oils, heavier than water, are at ordinary temperatures in a semi-solid state, owing to the presence of naphthalene, and had not, previous to Mr. Lowe's discovery, been employed for the manufacture of carbolic acid, cresol, and other tar phenols.

Thus we see that the effect of excess of naphthalene with a paucity of middle oils in the tar is to "shift back" the anthracene and to "carry forward" the phenol and cresol into the creosote oils. As regards anthracene, I first showed, in 1869, that this is to be found in varying quantities in all parts of the creosote oils, and could, in some cases, be traced back into the "light oils" (*vide* Lunge's Coal Tar and Ammonia, 1887, page 310). However, though to some practical tar distillers these things may seem strange, they are all, nevertheless, capable of explanation and of being foreseen when once the results of an experimental distillation of the tar have been examined (*vide* Lunge's Coal Tar and Ammonia, 1887, 329—330, also 229—230, with references to the writings of Bossios, Wanklyn, Naumann, and Winkelmann).

But the importance of Charles Lowe's observation and subsequent patent lies further in the fact that not only were the London tars not very poor in carbolic acid, as was then thought to be the case, but they were, and are, on the contrary, actually among the richest in phenol. Besides these, however, benzene, naphthalene, and anthracene, if condensation has been effectively carried out, are also abundant, whilst the less dense tars and those containing more liquid products, like those of the Manchester district, are richer proportionately in cresol and xyleneols, with toluene, and xylenes, and their higher homologues, &c. as well as in paraffins. (I should not be at all surprised if the heavier, the creosote oils, of the Simon-Carvès coke-oven tars do not, like the same oils of the London tars, similarly contain the bulk of the carbolic acid rather than the light oils.) As regards the benzenes in London and Manchester tars, it may be said that though less "light" and "middle oils" come over from the London tars, yet the "light oils" are richer in benzene and poorer in toluene and xylene than the corresponding oils from Manchester tars.

By this latter observation it is not claimed that any constant rule or law can be laid down either by Mr. Charles Lowe or by myself, but it refers to matters based on facts and experience, and so bears evidence to general rule, of course open to certain exceptions.

The London benzenes contain more carbon bisulphide and less paraffins, whilst the Manchester benzenes contain more paraffins and less carbon bisulphide. I take it that the larger quantity of carbon bisulphide is an index of higher temperatures of carbonisation, whilst the increased amount of paraffins and usual greater fluidity of the tars, with greater absence of naphthalene, is by far out of proportion to differences of temperature, and is due principally, though in addition, to the fact that, in Manchester and neighbourhood the coals used for carbonisation are largely composed of rich cannel. When we consider K. Schulze's theory of the production of the benzenes by the degradation of the phenols, Mr. Lowe's patented process of 1872 contains evidence, and is a kind of anticipation on practical grounds of the truth of that theory. For where benzene is rich, we should expect, according to that theory, that phenol is at least, somewhere in the tar, fairly abundant, assuming that the tar is in a normal condition. I am now putting Schulze's theory to some experimental tests, and hope soon to lay my results before the Society.

I cannot conclude without thanking my assistant, Mr. Hamilton, for the intelligent help he rendered in carrying out most of the experiments recorded in this paper.

THE EMPLOYMENT OF CRESOTINIC (OR CRESOTIC) ACID.

BY J. HAUFF.

Read by Joseph F. Fuerst.

THERE is hardly any branch of industry which in proportion to the simplicity of the labour produces such varied *final* results as tanning.

Although dependent upon local and outside circumstances, tanners have the difficult task of combining public taste with the real use which the article serves, and at the same time of maintaining a standard product.

When it became possible by the advance of chemistry to ascertain the influence of water, tanning materials, and lime, upon the manufactured article, the necessity of finding methods and means to reduce the effects of uncertain conditions was felt all the stronger.

The aim of scientific research to predict and regulate effect from cause has lately borne good fruit to the tanning branch of industry; and it is now only a question of time for chemistry with its boundless resources to prescribe the means whereby to obtain a uniform product independent of all outside factors.

The two chief sections of work in tanning—

Firstly, the preparation of hides for tanning;

Secondly, the actual tanning process;

are equally important in their bearing upon the quality of the finished product.

The preparation of the hides is again subject to two divisions:—

(a.) The unhairing process.

(b.) The cleaning process.

It is the last-mentioned with which we have to deal more particularly, and that which has reference to the *new process* for "*freeing skins from lime by cresotinic acid*" as now manufactured.

Every tanner doubtless knows that the hides, in the unhairing process with *lime*, absorb a large portion of it—up to 3 per cent. of its weight in the dry state. The lime remains partly on the outside, fills the pores and apertures of the grain, and enters partly into a kind of chemical combination with the substance of the hide itself.

Experience has shown that lime is to a certain extent a necessity for many kinds of leather, but there are a great many sorts where the presence of lime even in small quantities is positively injurious, preventing the production of certain qualities; so that the regulation of the amount of lime in the hides must be considered as one of the principal operations in the cleaning process.

But it is not alone the amount of lime in itself, which influences the tanning and the quality of the finished leather; it is even more the amount of lime combined with the substance of the hides, which affects the softness, suppleness, elasticity, and greater or lesser density.

The operation which follows the mechanical cleaning of the hide by means of a polishing stone or sand iron, and which removes the lime and makes it fit for tanning, is called "*bating*."

The process of "*bating*," that is "*unliming*," always entails a change in the aggregate condition of the hide, so to speak, and it is therefore the chief aim of the tanner to keep within the desired limits. To this must be added the process of removing the fat in the hide which has nearly always been carried out by the mechanical means following the operation of "*bating*."

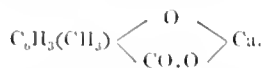
The "*bate*" has the same object in the tanning industry—as bearing on the specific qualities of the leather—as the mordants have in the dyeing and printing industries; and it is owing to the recognition of their importance that so much attention is being given to their development.

It is assumed that the purpose of the "*bating*" and its effects are known. I have therefore only to dwell upon the advantages, and the application, of the new method of removing the lime by means of cresotinic acid.

Cresotinic or cresotic acid belongs to the number of the so-called aromatic carbon acids which are derived from the

cresols of the coal-tar methylphenols in the same way as the salicylic acid is derived from the carbolic acid.

By cresotinic acid is understood the isomeric carboxylic acids, obtainable by the action of carbonic acid upon the sodium compounds of the cresol-isomers. The union of cresotinic acid with lime gives a salt of the following formula:—



There are several isomeric cresotinic acids, and all of them have this same power of removing lime.

Being produced from nearly the same raw materials, cresotinic acid, although consisting of several isomers, has nevertheless a decided character of its own. The manufacture of it has attained a high state of perfection, and it is now saleable at a price which offers no impediment to its use in tanneries.

Cresotinic acid has the same antiseptic qualities as salicylic acid—in fact in a much higher degree; its use excludes therefore all the dangers so disastrous with other “bates.”

Its solubility in water is very low. It requires 800—1,000 parts of water and consequently it avoids any formation of skin-destroying concentrated solutions.

A hide or skin may be immersed in a concentrated solution of cresotinic acid containing 22 gallons of water and about 4½ oz. of cresotinic acid, for weeks, without showing the slightest trace of decomposition or destruction, whereas other acids which have been used for the same purpose—such as sulphuric, muriatic, acetic, lactic, and butyric acids, &c., in the same degree of concentration, were seen to destroy the skins in a few days, may even in a few hours.

The reason is that cresotinic acid possesses besides its faintly acid properties certain tanning or hide-preserving functions.

It has, moreover, by its action upon the hide substance known to tanners as “hide gelatin” the great power of bringing the hides down and softening them quite as much as the “bating” with “dungs.”

By reason of its great affinity for lime, and by the formation of crystalline combinations effecting osmotic changes in the interior of the hides, cresotinic acid forms easily soluble basic lime salts which remove the lime very quickly, often within a few hours.

Cresotinic acid thus combines the power of removing lime and softening the hides, saving the tanners (by its subtle influence upon the hides, and on the solution of “glue-forming” substances which are not precipitated by tanning) unnecessary loss of weight and damage to the hides through decomposition.

Cresotinic acid, as an acid, has, moreover, the power of swelling the hides. For this reason it has great value in the plumping of sole leather, and the hide preserving and antiseptic properties are here of the greatest importance.

To “bate” with free cresotinic acid, the same vat or pit that has served the purpose hitherto may be employed (one with a revolving paddle wheel is preferable). It should contain water to the extent of about double the total weight of the hides, not more.

For instance: to 50 heavy “butts” of about 56 lb. each, about 450 to 550 galls. of water are used. To every 250 galls. of water 7 lb. to 9 lb. of cresotinic acid are then taken. To 500 galls. of water about 18 lb. of the cresotinic acid would be taken, previously made in a small vessel into a paste, with about 7 galls. of hot water, until no lumps large enough to resist solution remain (or steam can be turned on to hasten solution).

This solution is then gradually and equally added to the vat or pit with active stirring. This “bating” liquor will then be found acid.

If it does *not* redden litmus paper, the cresotinic acid has been neutralised by the presence of free lime which the vessel contained from previous “bates.” This circumstance necessitates the addition of more cresotinic acid until the desired acid reaction is observable.

The hides or skins ready for “bating” are then put in, and it may here be remarked that with this new method, no

alteration is necessary in the preparation of the hides for “bating” beyond a little more attention to the removal of the “ground” hairs, because these would become somewhat fixed again by the astringent properties of cresotinic acid.

For economy's sake it is also of importance to free the hide from lime in the usual way by the ordinary mechanical means as much as possible, before commencing the “bating” process proper.

Generally speaking the work to be done beforehand is the same with the cresotinic as with all other methods, but this can be materially reduced at the expense of the quantity of cresotinic acid used, and of the duration of the process.

This is, however, a question which every tanner will solve for himself.

The hides or skins now remain in the “bating” liquor, which is kept at a temperature of 80° to 85° F. until they are sufficiently smooth or “brought down,” the liquor being meanwhile frequently stirred or “plunged,”—that is, wherever there is no paddle wheel to keep the whole agitated.

The length of the process depends partly on the thickness of the hides and partly on the condition in which they have been put in. In most cases four to six hours, or even less, will suffice. During the whole time, the hides should be watched until the point is reached when they are sufficiently brought down.

The work to be done after “bating” is the same as by the old process. In most tanneries the hides are cleaned with the polishing stone, and “scud-iron” immediately afterwards. Some tanners put them through the “stocks” and wash them with clean tepid water. Others put them immediately after the “bating” into the tan liquor. There the experience of the tanner will decide which course is best to take.

The “bating” liquor is by no means exhausted with the first batch of hides. On the contrary, several more may be put in; but the water wasted should be replaced by turning on steam or by adding hot water along with dissolved cresotinic acid in proportion to its volume (1:300), and the temperature should be again brought up to 80°—85° F.

It is desirable to avoid the loss of “bating” liquor as much as possible. Experience has shown that with such a “bating” liquor, *i.e.*, 500 galls. water to 18 lb. of cresotinic acid, four lots of 50 hides each can be bated, which at the present price of 1s. 6d. per lb. amounts to 1½d. per hide.

For every further lot of 50 heavy hides, only 4 lb. to 5 lb. of cresotinic acid need be added, and the liquor may be used until it becomes unfit, by accumulation of dirt, &c. It may here be stated that in a well-known tannery, many thousand hides have been treated in the same liquor, after being freshened each time, without the action of the liquor being weakened or rendered useless by putrefaction (as would be the case with dung liquors).

If the hides are required to be brought down exceptionally low and smooth in the grain, then the following method has been shown by experience to be capable of replacing advantageously the dog-dung “bate”:—

Instead of taking free cresotinic acid, its combination with ammonia is taken, and another ammonia salt is added (either chloride of ammonium or sulphate of ammonia); all the other manipulations—the proportion of water to the weight of the skins, the mechanical work before and after the bating—remain the same.

Only the ingredients of the “bating” liquor are different, as the following examples will show.

With 500 *sheep*-skins for glove leather, each skin weighing about 2 lb., 225 galls. of water are taken, and 11 lb. of cresotinate of ammonia. This the tanner can easily make himself, by adding gradually to his solution of 11 lb. cresotinic acid, prepared in the before-mentioned manner with hot water, a watery solution of ammonia (spirits of hartshorn), and stirring it until the cresotinic acid is dissolved, but taking care that the reaction still be acid.

With a solution of 20 per cent. ammonia, only about a gallon of it is required to 11 lb. of cresotinic acid. This solution as well as a solution of 11 lb. sulphate of ammonia or of chloride of ammonia is mixed with the 225 galls. of water brought up to 80°—85° F., the skins are then put in a vat with a paddle-wheel and revolved for about half an

hour so as to be in every way fit for tanning. Close observation is here also necessary to determine the duration of the bating. The skins are treated afterwards according to requirements. Those destined for glove leather are put into clean tepid water, "scudded," smoothed and freed from hairs. Should there be any difficulty about the latter, which however seldom happens, sulphide of sodium in the proportion of 1:1,000 is added to the tepid water, by which the hairs are completely removed.

This "bating" liquor, after being revived each time with hot water or steam, as described, but *without* adding cresotinic acid, can also be used as long as it has any effect:—which, by the way, means about eight lots of 500 skins each, and then *only* about 3 lb. cresotinic acid with the corresponding quantity of solution of ammonia and 1 to 2 lb. of chloride or sulphate of ammonia is added for every further lot of skins.

For other kinds of skins the proportions are the same.

By this method, the "sudding" and working of the skins after the "bating" should not be omitted, because by it the skins are freed from all dirt and fat. Whether it is also necessary to put them through the "stocks" must be left to the choice of each individual tanner.

These methods of "bating" are a complete substitute for the so-called "stink" or "dung" processes in tanning.

The practical results fully bear out the theoretical considerations of their superiority, as is shown by the samples of leather which are here.

It deserves to be mentioned in conclusion that the weight obtained per hide is quite in accordance with the peculiarity of cresotinic acid, which *preserves* the substance of the hide *instead of destroying it*.

A HYDROCARBON FURNACE FOR ASSAYING, &c.

BY GEO. E. R. ELLIS, F.C.S., OF MONTANA.

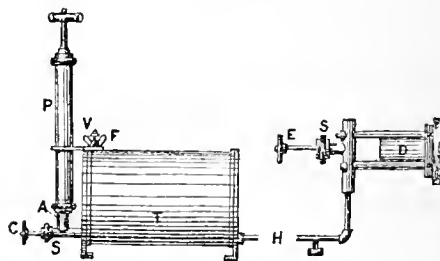
I HAVE ventured in this paper to give particulars of a piece of apparatus, which my own experience—confirmed by that of many other assayers—has shown to be eminently serviceable as a readily controllable source of intense heat, such as is required by analysts, assayers, metallurgists, and others. This furnace has been before the American public for several years and is therefore past the experimental stage, but, so far as I am aware, it is comparatively or wholly unknown to the English scientist.

Assayers know full well that there are many inconveniences and annoyances necessarily connected with the use of furnaces burning coal or coke; this apparatus, on the contrary, does away with the constant replenishing of fuel, with all dust and ashes, and with a large amount of radiated heat; indeed it may be said that it possesses all the advantages of a gas furnace with the additional advantage that it may be forced to practically any extent without the use of a blower or foot-bellows. Once pumped up—which operation occupies only a few seconds—the blast will continue for a long time without further attention.

The apparatus consists of three parts (each of which may be procured separately), viz.: the tank and blowpipe, the muffle furnace, and the crucible furnace. The tank and blowpipe are represented in Fig. 1. P is an ordinary force-pump at the bottom of which, at A, is a valve which closes automatically upon releasing the pressure from the pump. C is a check valve which closes the inlet to the tank T completely; F is a filling screw for introducing the fuel used, viz., gasoline; V is a vent screw for letting off the pressure when the operation or experiment is finished; H is a pipe leading from the tank to the burner D; E is a burner regulator, terminating in a fine point, closing the orifice of the burner; SS are packing boxes. Upon opening C and pumping a few strokes a pressure is created in the tank and on top of the fluid, forcing it through the tubes of the burner, which being previously heated, vaporise the

gasoline. This issues from the orifice at the end of E as a highly heated gas, and burns as such in the form of a powerful blast. After being once started the heat of the flame passing through the burner D, vaporises the fluid in the tubes and hence the apparatus is automatic.

Fig. 1.



The air which is forced in is not consumed, so that to keep up the blast it only requires a few strokes of the pump occasionally (every half-hour or so) to maintain the pressure lessened by the consumption of the gasoline.

The way to start the blowpipe is simple and as follows: close E, unscrew F and introduce gasoline according to the capacity of the tank. Replace F, close V; open C one or two turns, and give three or four full strokes of the pump P, then close C. Heat the burner by burning some of the gasoline in a suitable vessel (an old scroffier will do well) placed under the burner; when hot apply a match and open E gradually until the action is more or less uniform. The burner is hot enough when no liquid or spray issues from the orifice; if not hot enough let the oil burn slowly until no liquid or spray issues. When sufficiently heated the blast can be made of any desired intensity by the use of the force-pump as above. The mouth of the burner D should be 2—3 inches from the inlet of either furnace, otherwise the combustion in the interior of the furnace will not be complete. To stop the action of the blowpipe, simply shut the regulator E or open screw V, or do both. When not in use, keep V open.

For very high temperatures or muffle work we proceed as follows:—

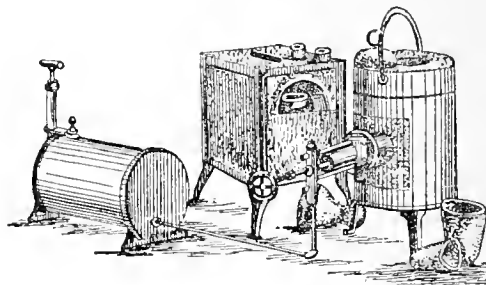
- (1.) Light as above, and heat inside of furnace to bright redness.
- (2.) Place the burner *against* the inlet of the furnace.
- (3.) Turn out burner flame with E, and immediately turn it on again without lighting it (or simply blow the flame out), when, if the furnace is hot enough, the gas will light *inside* the furnace. When burning inside the furnace, there must be no flame in the burner tube.

The heat can be regulated by the use of E and P.

The tanks are made in two sizes; one contains half a gallon of oil, the other one gallon, and cost (with blowpipe complete) at Chicago respectively, 23.00 dollars and 26.00 dollars.

The muffle furnace is represented in Fig. 2; it is made

Fig. 2.



in two sizes, the one taking a "C" Battersea muffle (8 in. long x 4 3/4 wide x 3 high), the other an "F" Battersea

(10 × 6 × 4). The inlet for the blast is opposite to, and below, the mouth of the muffle, and cannot be seen in the cut. The muffle furnace requires a length of two (not more) of stove-pipe in order to create a draught through the muffle, or they may be connected with a flue; in the latter case a damper must be put in the pipe, for too much draught is prejudicial.

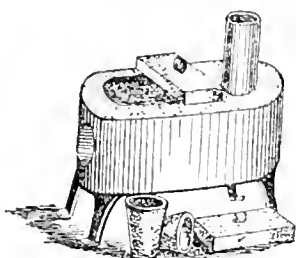
The smaller muffle furnace costs 10.00 dollars, the larger one 15.00 dollars.

Figs. 3 and 4 represent the two kinds of crucible furnace; Fig. 3 being adapted for taking one crucible at a time, Fig. 4 for taking two or four crucibles at the same time. The No. 1 furnace costs 4.00 dollars, and takes a crucible 4 in. in diameter, and 5½ in. deep inside; No. 2 takes a crucible 5 in. in diameter and 6½ in. deep inside, and costs 5.00 dollars; No. 3 costs 7.00 dollars, and takes two crucibles, 4 in. in diameter, while No. 4 costs 12.00 dollars, and can take four No. 10 French crucibles, or equivalent sizes.

Fig. 3.



Fig. 4.



We will now consider some of the conveniences attending the use of this apparatus.

Cost of Running.—This naturally depends upon the local price of the fuel used as the source of heat, viz., gasoline. In a large city, *e.g.*, Chicago or New York, the cost per hour does not exceed 3 cents (1½¢), while 5 cents may be put down as the maximum in out-of-the-way districts. A certain prejudice exists against the use of gasoline, but, from its construction, no accidents can happen from the use of this apparatus save as the result of gross carelessness.

Power of Furnaces.—The heat of the blowpipe can be controlled from that of a Bunsen burner to that required to melt cast iron. Using the crucible furnace, ½ lb. of cast iron can be melted in 15 minutes (furnace cold at the start), or 1 lb. of brass can be melted in 7 minutes (furnace hot at the start). The muffle furnace can be heated to a scorification temperature in 15 minutes. Six scorifications can be performed at the same time in the larger furnace.

Amount of Heat Radiated.—In this respect these furnaces will compare favourably with any in the market. The following readings were taken with the larger size muffle furnace during the scorification of some copper-silver ores:—

Distance from Side (or Front) of Muffle.	Temperature.	Distance from Side of Muffle.	Temperature.
5 ft. (front)...	17° C.	9 in. (side)...	42° C.
22 in. " ...	21° C.	6 in. " ...	52° C.
13 in. " ...	25° C.	3 in. " ...	81° C.
19 in. (side)...	26° C.	1 in. " ...	106° C.
12 in. "	34° C.		

The temperature of an ordinary room at the same time was 16° C.

The general compactness of the apparatus is also a feature in its favour; the larger size muffle furnace stands 14 in. high, is 9 in. wide, and 12½ in. long, while the

corresponding measurements for the crucible furnace taking two crucibles at a time are 10½, 8, and 14½ in. respectively. The whole apparatus can be conveniently used on a table 4 ft. long by 2 ft. 3 in. wide. It is also to be noticed that the burner in Hoskin's apparatus is *outside* of the furnace during the whole of the operation and is, therefore, not subjected to the destructive influence of very high temperatures, as is the case in many forms of furnaces using ordinary coal-gas as a source of heat.

Note.—Since writing the above I find that a muffle furnace is now manufactured sufficiently large to accommodate a 15 in. by 9 in. muffle. This furnace is heated by two blowpipes of the same size and power as described in the above paper.

NOTE ON A NEW TRIPLE BUNSEN BURNER.

BY F. W. BRANSON.

MR. F. W. BRANSON, of Leeds, exhibited a high or low power triple Bunsen burner, a drawing of which is here given:—

Fig. 1.

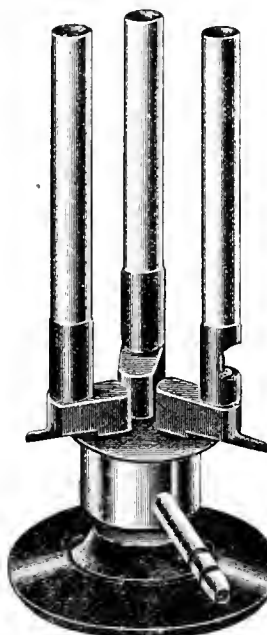
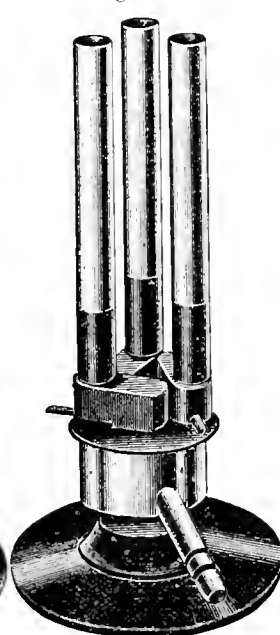


Fig. 2.



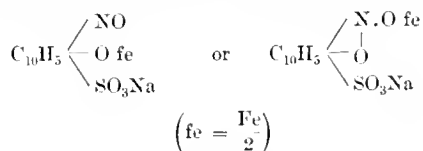
The above combines in one piece of apparatus several gas burners, and is simple in construction and not liable to derangement. Either one, two, or three Bunsen, or luminous flames may be used, and the air or gas supply of either jet can be regulated independently or entirely cut off.

The air regulators are arranged in the usual way. The gas supply is controlled by altering the position of the jets. If arranged as in Figs. 1 or 2, the gas supply is at full. If, however, either jet be rotated in the opposite direction, the gas is gradually reduced and finally cut off. Fig. 2 shows the three jets arranged for a single large flame, but if the jets are separated as in Fig. 1, a much larger area can be heated by means of the three distinct flames which then result.

NOTE ON EIKONOGEN, THE NEW PHOTOGRAPHIC DEVELOPER.

BY RAPHAEL MELDOLA, F.R.S.

IN 1880, when studying the action of nitroso-compounds on phenols, I discovered a nitrososulphonic acid of β -naphthol, which at that time was the first known representative of the class of aromatic nitrososulphonic acids (Jour. Chem. Soc. Trans., Jan. 1881, 40). The compound in question was afterwards utilised as the source of a colouring matter introduced into commerce by the Frankfurter Anilinfarben-Fabrik, Gans and Co., under the name of "Naphthol green B." (Ger. Pat. 28,065, January 19th, 1884). This compound, which was briefly described by Otto Hoffmann (Ber. 1885, 46), is the sodium ferrous salt of the β -naphthol-nitrososulphonic acid referred to, and may have the formula—



according to the view taken with respect to the presence of a nitroso-group or an isonitroso-group in the compound. The colouring matter is of considerable technical value at the present time, and is of interest as being the only known artificial colouring matter which contains iron as an essential constituent, excepting, of course, the well-known iron-cyanogen compounds.

Theory indicates the existence of seven isomeric monosulphonic acids of β -naphthol of which only four are known at the present time. Only one of these is concerned in the present communication, viz., that modification first discovered in 1869 by Schaeffer, and which is best prepared by heating one part of β -naphthol with twice its weight of strong sulphuric acid to the temperature of boiling water till the naphthol is completely sulphonated. One, if not two other, monosulphonic acids are produced at the same time together with a certain quantity of isomeric disulphonic acids, but the chief product under the conditions specified is Schaeffer's monosulphonic acid. It is the latter acid, which on a small scale can best be isolated in the form of its ammonium salt, which gives the nitroso-acid under consideration. In order to prepare the latter it is only necessary to dissolve a given weight of the ammonium or other salt of Schaeffer's acid in cold water together with the necessary quantity of sodium nitrite, and then, keeping the solution well cooled, gradually add hydrochloric acid to acid reaction. The nitrososulphonic acid is at once formed and remains in the solution, imparting to the latter an orange colour. The acid can, if necessary, be isolated in a state of purity as a barium or calcium salt (Jour. Chem. Soc. Trans., 1881, 44).

By the reduction of the nitrososulphonic acid an amidosulphonic acid was prepared, which was isolated and analysed and described in the paper referred to (*loc. cit.*, 47). This acid was the first amidosulphonic acid of naphthol ever obtained, and it is the sodium salt of the said acid which has recently been introduced as a photographic developer under the name of "Eikonogen." As the discoverer of the acid I have been urged to give this note upon its chemical history for the use of English chemists, and in doing so, I think it only fair to add that although the easily oxidisable character of the acid and its salts naturally suggested trying it as a photographic developer, I was not at the time engaged in photographic work, and the idea was never carried out till the substance was actually introduced into commerce for this purpose.

Of the advantages of eikonogen as a developer I do not propose to say anything on the present occasion, since its qualities have been thoroughly tested by photographers, and it is becoming very popular for many reasons, which will be found in the papers dealing with its application. (See for instance papers by Professor G. D. Livinge, Photog. News, September 20th, 1889; John Spiller, in the recently-published "Year Book of Photography" (1890), 124;

also Lyonel Clark and H. M. Elder in the "Photographic News" of December 13th, 1889). Some months after the publication of my paper Griess obtained an amido- β -naphtholmonosulphonic acid which was no doubt identical with the one described by me (Ber. 1881, 2041). He obtained it by reducing the azo-compound formed by the action of metadiazobenzoic acid on Schaeffer's acid. The whole subject has since been thoroughly investigated by O. N. Witt (Ber. 1888, 3468 and 3489), who has not only confirmed and extended my original observations, but has also obtained the three other amidosulphonic acids corresponding to the three β -naphtholmonosulphonic acids made known since the time of my investigations. Witt's amidosulphonic acids were all prepared by the reduction of azo-derivatives of the respective β -naphtholmonosulphonic acids by means of stannous chloride. There are thus known at the present time:—

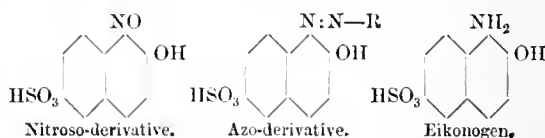
- (1.) Amido- β -naphthol- β -sulphonic acid, from Schaeffer's acid.
- (2.) Amido- β -naphthol- α -sulphonic acid, from Bayer's (Crocic) acid.
- (3.) Amido- β -naphthol- δ -sulphonic acid, from Casella's F-sulpho acid.
- (4.) Amido- β -naphthol- γ -sulphonic acid, from Dahl's acid.

Of these four acids the first appears to be the most readily oxidisable and therefore the most suitable for photographic development. It is possible that some specimens of eikonogen may contain the acids (2), (3), or (4), but I have not yet met with a preparation in which these isomerides could be detected. With respect to the constitution of eikonogen, I am glad of the present opportunity of being able to correct my earlier statement, because more exact information has been obtained by numerous workers during the nine years which have elapsed since my own investigation. The constitution of the amido-sulphonic acid is, in the first place, dependent upon the constitution of Schaeffer's acid, which was practically unknown in 1881. It was not even known with certainty whether the hydroxyl and sulpho-groups were in the same or in different rings. It has now been shown that this acid is a heteronuclear derivative and the most probable formula is—

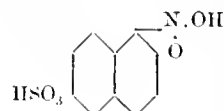


It is true that by the oxidation of my amido- β -naphthol-sulphonic acid I obtained phthalic acid, and this led me to the conclusion that Schaeffer's acid was a homonuclear compound. There is now no doubt, however, that the product of oxidation is β -sulphophthalic acid (Remsen and Comstock, Amer. Chem. Journ. V., p. 106; Rée, Inaug. Diss. Bern, 1886), and that the phthalic acid obtained by me from the amido-sulphonic acid was the result of the hydrolysis of this sulphophthalic acid.

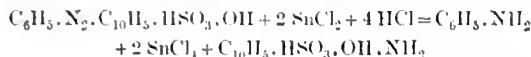
It is well known that in compounds which furnish both azo- and nitroso (isonitroso) derivatives the azo-group and the nitroso (isonitroso) group occupy the same position in the aromatic ring. In Schaeffer's acid the most readily replaceable hydrogen atom is undoubtedly the α -(ortho)-atom with reference to the hydroxyl, so that the constitution of these derivatives and of eikonogen is as follows:—



If the first of these compounds be regarded as an isonitroso-compound its formula will be:—



Eikonogen may thus be made either by the reduction of the nitrososulphonic acid or of an azo-derivative of Schaeffer's acid. By the action of diazobenzene chloride upon this last acid an orange colouring matter is obtained, which is met with in the market under the names of "Crocetin Orange," "Brilliant Orange," "Ponceau 4 G.B.," &c. It is one of the oldest known azo-colours, having been described by Griess in 1878 (Ber. 1878, 2197). This compound may be used as a source of eikonogen, using stannous chloride as a reducing agent:—



It would seem more economical, however, for manufacturing purposes to revert to the original method and reduce the nitroso- β -naphthol-sulphonic acid, which need not even be isolated for this purpose, but can be formed by the action of nitrous acid in the manner previously described and reduced in the same solution. The use of aniline can thus be dispensed with, and tin replaced by a cheaper reducing agent, such as zinc dust. The raw material is, moreover, practically a waste product, since the azo-colours obtained from Schaeffer's acid are of but little value compared with those obtained from the other monosulphonic acids of β -naphthol, and it is in the manufacture of some of the latter that Schaeffer's acid is obtained as a by-product. Owing to the readily oxidisable character of the salts of eikonogen, it is necessary, after the free acid has been obtained, to convert the latter into the sodium or potassium salt in the presence of excess of sulphite.

To the numerous coal tar products which have given to chemical industry such a wealth of technically valuable compounds, we can now add this new photographic developer, which threatens to drive the older and related compounds, pyrogallol and hydroquinone, altogether out of the field.

Liverpool Section.

UNIVERSITY COLLEGE, BROWNLOW STREET.

Chairman: F. Hurter.

Vice-Chairman: A. Norman Tate.

Committee:

J. Campbell Brown.
H. Brunner.
E. Carey.
H. Deacon.
T. Fletcher.
H. Gaskell, jun.

F. Gossage.
W. D. Illeman.
A. H. Knight.
D. McKechnie.
G. Shack-Sommer.
Henry Tate.

Hon. Treasurer: W. P. Thompson.

Hon. Local Secretary:

Dr. C. A. Kohn, University College, Liverpool.

SESSION 1889-90.

1890.

Jan. 15th:—

Discussion on Dr. Hurter's paper on "The Condensation of Hydrochloric Acid."

Miscellaneous Communications.

Feb. 5th:—

Dr. G. Shack-Sommer. "The Manufacture of Sugar from Beetroot grown in Lancashire and Ireland."

Dr. S. G. Rawson. "A New Form of Sprengel Pump and Apparatus connected therewith."

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Wednesday, December 4th, 1889.

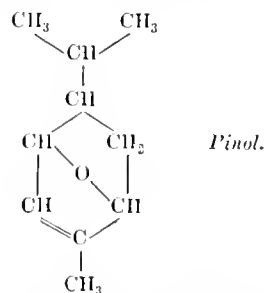
DR. F. HURTER IN THE CHAIR.

NOTE ON THE FIRST SYNTHETICALLY PREPARED BASE ISOMERIC WITH QUININE.

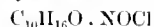
BY CHARLES A. KOHN, B.Sc., PH.D.,

Demonstrator of Chemistry, University College, Liverpool.

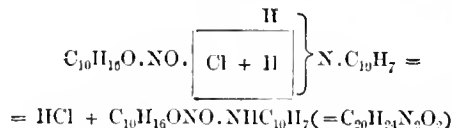
In a recent number of the *Annalen* (253, 251), Wallach and Otto have described an isomer of camphor ($\text{C}_{10}\text{H}_{16}\text{O}$) obtained by treating oil of turpentine in presence of glacial acetic acid with ethyl nitrite and hydrochloric acid. This substance, to which they have given the name of *Pinol*, is a crystalline body possessing a camphor-like odour, and melting at 183° — 184° . Its specific gravity is 0.953, and its index of refraction at 20° is $n_D = 1.46949$. Like many members of the camphor group it readily takes up a molecule of bromine to form a crystalline dibromide $\text{C}_{10}\text{H}_{16}\text{Br}_2\text{O}$. Oxidised with nitric acid or with potassium permanganate carbon dioxide, oxalic acid and terebinic acid result, whence the following constitution is assigned to it as probable:—



Treated with amyl nitrite and glacial acetic acid in the cold, pinol yields a crystalline nitroso-chloride—



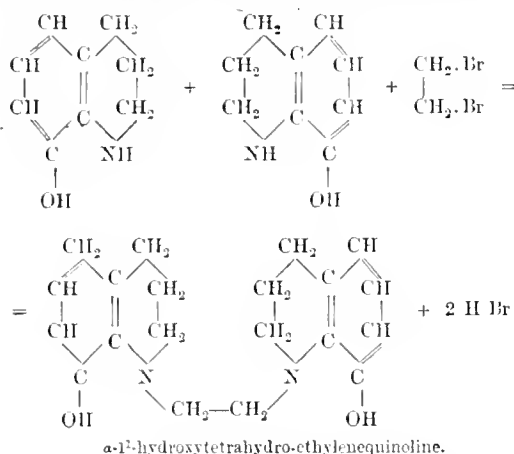
which melts at 103° . This body combines readily with ammonia and with amines with the liberation of hydrochloric acid, but whilst α -naphthylamine does not appear to enter readily into combination with the nitroso-chloride, β -naphthylamine does, and the resulting compound is spoken of as of interest, "being the first base isomeric with quinine that has been prepared synthetically." The base is a crystalline body melting at 194° — 195° ; it is insoluble in water, slightly soluble in hot alcohol, readily soluble in ether. Its formation may be represented by the equation—



A somewhat remarkable property both of the base and of its salts is that they are fluorescent. The physiological action of this and of other terpene derivatives is being investigated, but no results have been obtained as yet. As regards the above base, the slight solubility of its salts is a hindrance to its application in this respect. (Private communication from Professor Wallach.)

Having prepared a base some three years ago also isomeric with quinine, it may not be without interest to place on record the relative properties of the two hitherto known isomers of the alkaloid. The substance in question is described in a paper read before the Chemical Society in 1886 (J. Chem. Soc. 1886, 508; also this Journal, 1886, 676). It is a quinoline derivative, and is formed by the action of ethylene dibromide on α -1'-hydroxyhydroquinoline, the latter being prepared by the reduction of hydroxyquinoline with tin and hydrochloric acid. One molecule of ethylene dibromide is heated with two molecules of

α -1'-hydroxyhydroquinoline in a sealed tube to 150° for six hours, and the base is isolated from the hydrobromide first formed by recrystallising this and then decomposing it with sodium carbonate. Its formation may be represented thus:—



The free base forms small glittering prisms, which melt at 233°; it dissolves readily in chloroform and in benzene, with difficulty in hot alcohol, and not at all in water. The basic properties of the substance are only slight, the salts being decomposed by water with the separation of the free base. Owing to the presence of the two hydroxyl groups the body also behaves as an acid, but its acid properties are very weak, in fact, both the basic and acid tendencies of the hydroxyhydroquinoline appear to have been much weakened by the uniting of two molecules in this manner.

Although chance cases of isomerism, such as these, have no bearing on chemical synthesis, it is worth while to note that α -1'-hydroxyhydro-ethylenequinoline approaches much nearer to quinine as regards its chemical constitution than Wallach and Otto's pinol derivative does. Without going into the present state of our knowledge on the constitution of the cinchona alkaloids, there is little doubt that they contain a quinoline ring, most probably in combination with a reduced pyridine ring. (See Armstrong, this Journal, 1687, 482; also Skraup, this Journal, 1889, 474 and 815.) The relation of quinoline to quinine and its allies has been borne out by the preparation of several derivatives of the former possessing physiological properties resembling, to some extent, those of the cinchona alkaloids. Kairin (α -1'-hydroxyhydro-ethylquinoline) has proved the most valuable of these as an antipyretic. This and other febrifuges derived from quinoline contain only one quinoline group, and the above isomer of quinine was prepared with the view of examining the change in physiological action effected by uniting two reduced quinoline rings. The result was that, although α -1'-hydroxyhydro-ethylenequinoline does act as an antipyretic, its action is much weaker than that of kairin, and thus, as far as the evidence afforded by the physiological effect goes, the double quinoline ring is less closely allied to quinine than the single ring compounds are. This is quite in accordance with Skraup's researches on the constitution of quinine, &c., which further go to show that it is improbable that the one quinoline ring contained in these alkaloids is reduced. One important difference in the physiological action of these quinoline derivatives, when compared with that of quinine, is the fact that they are of no value in cases of malaria or of other intermittent fevers.

THE DINSMORE PROCESS FOR THE MANUFACTURE OF COAL GAS.

BY ISAAC CARR.

THE Dinsmore process has for its object the conversion of the tar formed in the distillation of coal into permanent illuminating gas. The gas being generated in conjunction with the ordinary coal gas increases the quantity and the quality of the production over that of the ordinary method of carbonising. The essential points in the process, as it is used at the Widnes Gas Works, are the following:—At the centre of each bed of six retorts (between the second and fourth retorts) an empty ordinary fireclay retort is fixed, called the *duct*, and through this the whole of the gas passes from each retort by means of connecting pipes and suitable taps, before it reaches the hydraulic main, on which there is a heavy seal. In addition to this pipe each retort is connected to the hydraulic main in the usual way. The duration of the charges was six hours, one retort being charged every hour. This renders the supply of gas to the duct continuous. When a retort is drawn, the tap in the pipe connecting the retort with the duct is closed, direct communication with the hydraulic main is thus made and the drawing and charging are effected as usual. After charging, the connexion with the duct is made as before. The tarry vapours passing with the gas through the heated duct are partially converted into permanent gas. The regulation of the temperature in the duct is of great importance, as it is found that if the duct be kept at the same temperature throughout its length the gas becomes attenuated as it reaches the exit pipe, which is fixed at the end opposite the retort lid. Excessive heat would also cause the destruction of some of the ammonia, and for these reasons it is necessary to graduate the heat of the duct by means of suitable brickwork, so that whilst the temperature at the inlet end is a bright cherry-red heat (1,700°—1,800° F.), that at the outlet end (for about one-third of the total length) is a dull red (1,200°—1,300°). Neither the shortening of the duct nor the taking away of the gas from the centre of the duct do away with the necessity for this graduated heating. The ascension pipe from the duct is provided with a water jacket to check the deposition of carbonaceous or pitchy matter, and is connected on to the main by a bridge pipe. At the bottom of this ascension pipe is a lid that can be removed periodically for cleaning purposes.

Thirty-five mouthpieces are now worked at Widnes on this system and the gas supplied to the town consists of two-thirds ordinary gas and one-third Dinsmore gas. It is found that this mixture is quite equal to ordinary gas both as regards its permanency and travelling power, no naphthalene stoppages having been noticed. The extra cost of erecting the Dinsmore plant is 7*l.* per mouthpiece, and the yield of gas is increased in quantity about 10 per cent. and in quality from 4—5 candles. The quantity of tar gasified amounts to about 4 galls. per ton of coal carbonised. By means of this process it has been found possible to dispense with the use of cannel altogether at the Widnes works, and a mixture of 75 per cent. of Arley coal together with 25 per cent. of Arley slack, which mixture is delivered at 7*s.* 4½*d.* per ton, has been found to yield 9,600 cub. ft. of gas of 19-candle power, per ton, one-third of the gas being carbonised by the Dinsmore process, as above stated. The mixture of coal and cannel formerly employed cost 11*s.* 9*d.* per ton and yielded 10,600 cub. ft. of gas of 18-candle power per ton. Deducting the lower value of the coke from the coal now employed (1*s.* per ton), and making due allowance for the increased cost of the plant, depreciation in value of and lower yield of tar and increased heating required for the retorts worked on the Dinsmore system (about 5 per cent.), the total saving through the adoption of this process will amount this year to 1,758*l.* 13*s.*, a sum equal to 4½*d.* per 1,000 cub. ft. on the quantity of gas sold. In this estimate no account is taken of the increased illuminating power of the gas (from 18—19 candles), which can be put down at least at 528*l.* The following statement gives full details as regards the relative costs of the Dinsmore and the ordinary process of gas making:—

STATEMENT SHOWING THE WORKING BY THE ORDINARY PROCESS ONLY.

	£	s.	d.	Cub. Ft.	Cub. Ft.	£	s.	d.
Coal 8,981 tons, or 85 per cent., at 11s.	4,339	11	0	Gas produced, at 10,500 per ton = 112,000,000 at 2s.	11,200	0	0	
Cannel 1,585 " 15 " " 16s.	1,268	0	0	Tons Coal. Cwt. Coke.				
10,566				Coke produced, 10,566 × 8'247 = 4,356 tons coke, at 11s.	2,395	16	0	
Average per ton, 11s. 9d.	6,207	11	0	Tons Coal. Galls. Tar.				
To balance 9,990 9 0				Tar produced, 10,566 × 12'27 = 636 " tar, at 29s.	922	4	0	
	16,198	0	0	Sulphate of ammonia 110 " " at 12s.	1,680	0	0	
					16,198	0	0	

This mixture will give 18-candle gas.

STATEMENT SHOWING THE WORKING WITH TWO-THIRDS ORDINARY AND ONE-THIRD DINSMORE PROCESS.

	£	s.	d.	Cub. Ft.		£	s.	d.
Coal, 11,653 tons; average per ton, 7s. 4½d.	4,297	0	11	Gas produced, at 9,611 per ton = 112,000,000 at 2s.	11,200	0	0	
Cub. Ft. Cub. Ft.				Tons Coal. Cwt. Coke.				
Dinsmore, 37,500,000, at 10,300 per ton = 3,621 tons coal				Coke produced, 11,653 × 8'247 = 4,805 coke, "				
Ordinary, 74,700,000, at 9,300 " = 8,032 "				less 5 per cent. on one-third = 74 = 4,731 tons, at 10s.	2,365	10	0	
Extra cost of carbonising 1,087 tons, at 2s. 3d.	122	5	9	Tons Coal. Galls. Tar.				
5 per cent. interest on additional capital outlay, 245/.	12	5	0	Tar (ordinary) 8,032 × 11'27 = 445 tons, at 29s.	645	5	0	
	4,431	11	8	" (Dinsmore) 3,621 × 7'0 = 124 " at 19s. 8d.	121	18	8	
To balance	11,749	2	0	Sulphate of ammonia = 154 " at 12s.	1,848	0	0	
	<u>16,180</u>	<u>13</u>	<u>8</u>			<u>16,180</u>	<u>13</u>	<u>8</u>

This mixture will give 19-candle gas.

1s. per ton on 10,566 tons, the value of raising	£	s.
quality from 18 to 19-candles	528	6

This mixture will give 19-candle gas.

	£	s.	d.
To balance by ordinary process 9,990 9 0			
" " one-third Dinsmore process 11,749 2 0			
Balance in favour of the Dinsmore process 1,758 13 0			

The Dinsmore process is not applied to the whole of the retorts in use in order to allow of the regulation of a proper proportion between the quantity and illuminating power of the gas and the quantity of the residual products.

The cost of labour is somewhat less, the yield of ammonia slightly greater than when gas is made in the ordinary way.

The following table, giving the composition of pure Dinsmore gas, compared with that of one-third Dinsmore gas, is taken from a report on the process by Mr. Wm. Foster, M.A. :—

TABLE GIVING THE CHEMICAL COMPOSITION OF SAMPLES OF GAS MANUFACTURED AT THE WIDNES GAS WORKS BY THE DINSMORE PROCESS.

[All quantities are expressed in volumes per 100 volumes.]

Description of Gas.	Crude Dinsmore Gas, made Nov. 12, 1889. Lighting value by "G" Argand, after Purification, 21'8 Candles; sp. gr. '424 (dry air = 1).	Purified Dinsmore Gas, taken from Experimental Holder Nov. 11, 1889 (Gas made the previous day). 11'66 Candles; sp. gr. '428.	Town Gas, made Nov. 11, 1889. Illuminating Power, 18'66 Candles (one-third is Dinsmore gas); sp. gr. '420.
Carbonic acid gas (CO ₂)	Volumes per 100 Vols. of Gas. This includes (2'75) H ₂ S after purification.	Volumes per 100 Vols. of Gas. 0'23	Volumes per 100 Vols. of Gas. 2'09
Heavy hydrocarbons	5'30	6'76	4'37
Carbonic oxide (CO)	7'78	8'10	8'14
Marsh gas (CH ₄)	40'24	40'34	33'39
Free hydrogen	46'06	43'98	51'16
Free nitrogen	0'60	0'59	1'10
	99'98	100'00	100'55
Carbon density	2'85	2'96	3'7 (5)
Heavy hydrocarbons			
Hydrogen density	6'08	5'80	6'3
Heavy hydrocarbons			
Volumes of oxygen used per 100 vols. of gas	130'6	130'5	120'3
Volumes of carbonic acid gas produced per 100 vols. of gas	63'12	68'44	58'7

The illuminating value of the Dinsmore gas and also its specific gravity is given in the following table, drawn up by Mr. Foster:—

TABLE GIVING THE SPECIFIC GRAVITY AND ILLUMINATING VALUE OF DINSMORE GAS.

[The candle power is reduced to standard temperature and pressure.]

Date.	Specific Gravity of Gas; Dry Air taken as Unity.	Illuminating Burner used, "G" Argand.	Power of Gas in Burner used, No. 4 Flat-Flame.	Sperm Candles. Burner used, Standard "London" Argand.
1889.		Consumption —5 cb. ft. per Hour.	Consumption —5 cb. ft. per Hour.	Consumption —5 cb. ft. per Hour.
November 9.....	.. ..	21'00	.. ..	.. ..
" 9.....	*435	21'72	.. ..	.. ..
" 10.....	*431	21'00	.. ..	.. ..
" 10.....	*436	22'40	20'70	.. ..
" 10.....	*428	.. ..	.. ..	.. ..
" 11.....	*428	22'30	.. ..	.. ..
" 11.....	*419	21'27	19'28	.. ..
" 12.....	.. ..	21'00	.. ..	.. ..
" 12.....	*424	21'80	20'00	.. ..

As regards the tar obtained by the Dinsmore process of carbonisation, it was found to contain 10·3 per cent. of water and 3·6 per cent. of light oils, whilst the tar as supplied from the works, where gas consisting of one-third Dinsmore gas was furnished, contains 4·1 per cent. water and 6·2 per cent. of light oils. Mr. Foster states that there is no doubt that the increased illuminating power of the gas produced in this process is in a great measure due to the rendering of some of the more volatile portions of the tar permanently gaseous, but he does not attribute it entirely to this.

A discussion ensued in which the Chairman, Messrs. Thompson, G. E. Davies, Parnell, Glover, King, Norman Tate, McDonald, Dr. Naef, and Dr. Kohn took part, the meeting closing with a cordial vote of thanks to Mr. Carr.

Meeting held at Victoria Hotel, Manchester, on December, 1889.

MR. IVAN LEVINSTEIN IN THE CHAIR.

SECTIONAL COMMITTEES OF CHAMBERS OF COMMERCE.

BY IVAN LEVINSTEIN.

IN opening this session, it is not my intention to bring before you, as has been done sometimes on previous occasions, a statement of the general progress or special applications of the science with which we are more intimately connected. We now possess such a quantity of excellent scientific and technical literature, both in English and German, accessible to every student interested in these subjects, in which all new facts and the matters bearing upon them are carefully reported and systematically arranged, that it appeared to me unnecessary to occupy your time with a retrospect of the progress achieved in chemistry and technology during the past twelve months. I thought that the short time at my disposal might be more usefully employed in briefly referring to certain questions, which, although outside of the immediate range of science, have yet an important bearing on the development of industries in which we are all more or less engaged.

Those who are thoroughly conversant with the details relating to these industries in both England and Germany cannot close their eyes to the fact that the progress which is at present being made by our great rivals is greater as regards development and expansion than our own. Various reasons have been assigned for this fact; amongst others the superior technical education of our Continental competitors. No doubt this question of technical education is one of great importance, but thanks to the efforts and labours of some of our most eminent educationalists, this question is now fully appreciated and understood by the people of this country. A considerable number of new technical schools have been established, and the movement is still going on, and before long we may be able in Manchester to boast of one of the largest and probably best equipped technical institutes in this country or elsewhere. We may therefore safely leave this matter in the able hands of those who have hitherto taken such a prominent part in the movement, and of those to whom the management of the various educational institutions has been confided.

In my opinion, however, we must not *only* look to superior technical education as a means of developing these industries,

Manchester Section.

Chairman: Ivan Levinstein.

Vice-Chairman: Edw. Schunck.

Committee:

J. Angell.

G. H. Bailey.

R. F. Carpenter.

G. E. Davis.

H. Grimshaw.

Harold B. Dixon.

J. Grossmann.

P. Hart.

A. Liebmann.

Sir H. E. Roscoe, M.P.

C. Truby.

D. Watson.

Hon. Local Secretary:

J. Carter Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

SESSION 1890.

Jan. 7th:—

Dr. J. B. Cohen. "Communications from the Owens College Laboratory."

Mr. J. A. Wilson. "The Rates of Distillation of Acetic Acid."

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

but we must also keep in view the necessity of making the public more thoroughly acquainted with their importance, and thus interest the mercantile class generally in the removal of any possible burden or disadvantage under which they may be labouring.

The rate of expansion of the chemical industries is a true gauge of the rate of progress and development of many other industries; yet, strange to say, the chemical and allied industries, and the value to the community of a skilled chemist, are comparatively less thought of and appreciated in our own than in any other European manufacturing country. No doubt our merchants and traders have been influenced to a large extent in the appreciation of the importance of those industries by the value of our export in chemicals and similar products compared, for instance, with the value in cotton goods; but even then we might have reasonably presumed that those industries ought to have at least received their proportionate share of attention. Such, however, has not hitherto been the case. But I go further than this, and am of opinion that it would be quite fallacious to estimate the importance of these industries by the exact amount of wages paid to the workpeople, or by the exact amount of the value of their exports. In estimating their true value we must bear in mind that in some measure, and often very materially, they assist or even bring about the export of some of our staple productions. It is, therefore, the interest, not only of those engaged in these industries, but of all classes of the trading community, and, not least, of those engaged in our staple branches, to encourage their development and assist in removing such disadvantages as may operate to prevent their free and untrammelled growth and expansion. The export, for example, of our bleached, dyed, printed, finished, and sized goods depends in no small degree on the good quality and cheapness of chemicals and dyes and similar products.

Only recently some facts came under my notice which prove how matters apparently very trivial may exercise an influence on the export of our cotton goods. Some two or three years ago a certain red colouring matter was introduced amongst the Turkey-red and other dyes in Lancashire and Scotland, not as a substitute for Turkey-red, but as a new colour, possessing the advantage of being, if not so fast, at any rate more brilliant and far more easily applicable to the colouring of cotton fibre. For a time a very good trade was done with India in the yarns coloured with this dye. This trade has now almost entirely ceased, for the reason that an enterprising firm sent one of its representatives to India, introduced this colouring matter over there, and showed the native dyers its ready applicability to cotton. A loss has thus been inflicted not only on some of our dyers, but also on certain manufacturers of these special yarns.

Again, let America only abolish the duties on chemicals, drugs, and dyes, and I have no doubt that she will at once become a formidable competitor in at least some classes of cotton goods, not only in certain foreign markets, but probably even in our own home market.

It cannot therefore be too often repeated, that in estimating the true value and importance of these industries, the influence which they exercise on the development and success of other industries must be taken into account. It was with the object of securing a better appreciation and representation of the needs and requirements of the chemical and allied industries, that at the very commencement of the present year I recommended, in an article in the New Year's issue of the Chemical Trades Journal, the establishment in our Chambers of Commerce of sectional committees to be selected from experts possessing a special knowledge of the various industries and trades carried on in the neighbourhood, to whom all questions of public interest connected with those special industries should be referred for consideration; that these committees should then hand in to the Board of Directors a report upon any question thus submitted, together with their recommendations, such reports to be published in the Journal of the Chamber and elsewhere, if deemed of sufficient interest and importance.

On the 18th of January a well attended meeting of gentlemen interested in the Chemical and allied industries

was held at the Victoria Hotel in this city, to consider the desirability of attaching to the Manchester Chamber of Commerce a sectional committee representing those industries. At this meeting the following resolution was passed unanimously:—

"That it is desirable that a committee be attached to the Manchester Chamber of Commerce, charged with the duty of representing the interests of the Chemical and allied industries, such section to be subject to the supervision of the Board of the Chamber."

A Memorial was drawn up and adopted by this meeting, and a deputation appointed to wait on the Board of Directors to express the views of the meeting. This deputation, representing the industries connected with Dyeing, Printing, Bleaching, Paper-Making, India-Rubber, Chemical Engineering, Chemicals, Coal-Tar Products, Colours, Dyes, Pharmaceutical Preparations, Drugs, Oils, and other allied industries, was received by the Board on January 28th this year, and, after a lengthy discussion, the late President, Mr. Gaddum, assured them that the Board of Directors would do everything in order to further their object. On this assurance, a committee, representing the Chemical and allied industries, was elected and at once set to work. A number of meetings was held to draw up objections to the Revised Classification and Revised Schedules of Railway Rates and Charges, and also a classification was suggested of chemical and similar goods based on rational commercial and scientific principles, and the objections and suggestions were lodged by the Chamber in due time with the Board of Trade. Unfortunately, however, it was found at the time that the rules of the Chamber did not provide for the establishment of such local sectional committees.

This difficulty was eventually overcome by the resolution passed on the 4th November at a special general meeting of the Chamber, and which resolution has been confirmed on November 27th, by which the establishment of such local sectional committees was sanctioned.

Now this result, which I believe will be of the greatest benefit, not only to the industries located in this neighbourhood, but to those all over the country, is primarily due to the efforts of the Manchester Section of the Society of Chemical Industry, and I would suggest that all the sections of our influential and representative Society should endeavour to get chemical sections established in connexion with their Chambers of Commerce, where such do not already exist.

It is a matter of satisfaction to me to announce that under the new rules a strong committee representing the Chemical and other allied branches of manufacture and trade in this neighbourhood has been formed, and approved of by the Board of the Manchester Chamber of Commerce. It will be in the power of this committee to render considerable assistance in the development of the Chemical and allied industries in the district, and in making Manchester not only the most important centre in England, but in the whole world. That such an achievement is within the bounds of possibility, and even of probability, must be obvious if we consider, firstly, that Manchester, or Greater Manchester, is already the largest consumer of chemicals, drugs, and dyes of any city in the world; secondly, that the principal materials are close at its door; thirdly, that its already favourable geographical position will be still further enhanced by the Ship Canal.

There will be a great deal of work awaiting this committee, and the question whether our patent laws in their present form are best calculated to assist the development of our industries may probably form an important subject for its consideration. This question ought to be regarded as a purely economic one, and as lying entirely outside of party politics, because the principle of granting patents is and has been recognised by all parties, fair traders as well as free traders; and however obnoxious it may be to many people, no better means have yet been devised of rewarding inventors and stimulating the inventive faculties of the people generally, than by granting such monopolies. But, as desirable as it is to reward the inventor for that which he has really invented, and which has been ascertained by experiment to be a *bonâ fide* invention, by granting to him, for want of something better, a monopoly of production and sale for a

number of years, there ought to be sufficient safeguards and restrictions for preventing the abuse of the privilege, otherwise the very object for which patents were really established in this country would be defeated, viz., that of benefiting industry. That this was the principal object of the founders of these laws is evident from the original Act of 1653, wherein it is stated that such privileges or letters patent are only granted provided "that they be not contrary to the law nor mischievous to the State by raising prices of commodities at home or hurt of trade or generally inconvenient." These laws have been extended, altered, and amended from time to time, and must necessarily be further amended in the future in such a manner as to adapt and fit themselves to the progress of discovery and of science, and its application to the arts, trades, and manufactures. Experience has been gained in the practice of these laws in our law courts for more than 200 years, and the wants and requirements, both of inventors and of those who are engaged in trade, have been argued and considered, with the result that a large number of precedents have been established, which have also no doubt been effectual in some instances in providing certain restrictions for preventing the abuse of privilege and protecting the interests of inventors.

Unfortunately, however, all this experience has been gained almost exclusively in connexion with mechanical cases, and comparatively only very few chemical cases have been established: moreover, in the establishment of these the law and the precedents have frequently to be strained in order that conclusions might be drawn from the latter, and that the law might be adjusted to chemical cases. These difficulties are daily increasing, in consequence of the rapid progress made in the domain of chemical science, and the equally rapid application of the new discoveries to the arts, trades, and manufactures. For example, such expressions as isomerism, homologues, or even as chemically analogous bodies, chemical equivalents, and chemical combinations were absolutely unknown quantities to the founders of our patent laws, and are probably yet so to most of our legislators and eminent judges. Small as these matters may appear to outsiders it is in the legal interpretation and application of the meaning of such words and similar expressions that the greatest confusion and bewilderment must necessarily prevail in the minds of those who have to decide such cases, when searching for precedents in decisions given in mechanical cases, where clever counsel and shrewd professional experts can add confusion to confusion, and thus prevent justice being done to either inventors or alleged infringers, as the case may be. There are moreover many other points in our present patent laws and in their applicability to chemical inventions which will deserve careful attention; for instance, the examination of patent specifications before granting provisional protection, the opposition to the final granting of patents, the extent to which amendments are permissible in chemical patents, &c., after the final specification has been granted. The new committee may do, therefore, most valuable work in endeavouring to suggest amendments which shall make our patent laws properly applicable to the wants of modern chemistry and prevent the abuse of privilege, so that equal justice may be meted out alike to true and *bonâ fide* inventors and to the industries at large. I freely state my opinion that the patent laws, in their present form, are not by any means in harmony with the spirit of the original Act or statute, which is fair and just to all, and are not only hurtful and inimical to the development of the chemical industries in this country, but also to native inventive talent engaged in chemical research. It is, however, not the object of this brief address to go into minute details, but I shall have pleasure in furnishing the new sectional committee of the Manchester Chamber of Commerce with material and facts in support of my assertion.

Other questions will also no doubt deserve the careful attention of the new committee, such, for example, as the correct classification of chemical products, based on some rational principle, in lieu of the present haphazard and in many respects absurd system adopted by railway companies: the question of packages, distribution and sampling of goods, uniform methods of analysis of commercial products,

abolition of duty on pure alcohol and pure wood-nap'tha used for manufacturing purposes, fire insurances, comparative tables of inflammable and combustible substances, publication of consular and other reports concerning these industries, &c.

In addition to these more or less purely commercial chemical questions, special attention ought also to be paid, amongst other things, to the dyeing of fancy coloured yarns. This trade, which formerly was chiefly carried on in Scotland, has been transferred, within the last few years, to a large extent to Manchester, and promises to become an important feature of our local trade, principally in fancy yarns exported to India. In view of the fact that this committee includes some of our leading dyers, it may safely be assumed that certain rules will be proposed to the Board to guide the trade in determining such points as shrinkage of yarns in dyeing, counts and weights made up by dyers, weights of bundles of dyed yarns, average length per hank of coloured yarn, &c.

The Society of Chemical Industry and its various sections, by co-operating with the sections of our Chambers of Commerce representing the Chemical and allied trades, will be in a position materially to aid and assist the latter in their arduous and important labours, and whilst our Society will continue its excellent work in disseminating technical knowledge and information amongst its members, the sectional committees of the Chamber of Commerce will look after their commercial interests, and endeavour to protect the legitimate rights of all traders.

I sincerely hope that the step in advance thus taken by the Board of the Manchester Chamber of Commerce will lend a new impetus to the development and expansion of industries in which Great Britain, as long as it adheres to the principle of free trade and supported by her natural resources, must and will take the lead of every nation on the globe.

DISCUSSION.

Dr. SCHUXER pointed out that the great difference between English and Continental systems was well exemplified in France, where novelties were not left to individuals to investigate, but were at once taken in hand by the Chambers of Commerce. He had in his library a little work on Chinese green, which was published by the direction and at the expense of the Chamber of Commerce of Lyons. Treatises such as this were of great value. He hoped that the sectional committees referred to by the Chairman would in a similar manner be able to order reports on such new products as might from time to time be met with.

Mr. GEORGE E. DAVIS said, as one who had taken some part in the formation of sections of the Chemical and allied industries in the Manchester Chamber of Commerce, he was surprised to find how very few chemical people there were on the list of members. When they looked for supporters in order to bring the matter before the Board in such a way as to ensure their proposals being entertained, they had to enlist the services of outsiders in order to secure a hearing. If any good was to be done the chemical manufacturers of the district must understand that they were important factors in the matter, and that not only their support but also their attendance at meetings would be required. With regard to the patent laws, it was only such committees as it was proposed should be formed by the Chamber of Commerce that could tackle this question. This was borne out by the fact that the patent laws committee of the Society of Chemical Industry actually had a clause before them impressing the Government of the day with the necessity of fixing a time within which a patent must be worked when taken out by foreigners abroad, but there were such conflicting interests at stake that this clause was struck out altogether. Thus they need not hope for any amendment until the question became purely a commercial one.

Mr. H. GRIMSHAW thought that before chemical manufacturers in the district could expect any advantage to result from these sectional committees of the Manchester Chamber of Commerce, they would require to become members of the Chamber. The reason chemical manufacturers had not hitherto associated themselves with the

Chamber was simply that it did not appear to be of any service to the chemical trades. The Chambers did not offer any encouragement to any trade to associate itself with it except the cotton trade, which of course was fully represented, owing to the fact that Manchester was the great centre of that particular industry. Seeing that in that district there were perhaps a greater variety of industries than in any other, excluding perhaps the Metropolis, he thought the Manchester Chamber should have a greater number of these sectional committees than any other Chamber in the kingdom. Perhaps the point of difference alluded to by Dr. Schunck between the work done by the Chambers of Commerce in this country and those abroad arose from this very fact, namely, that we had not these sections of specially qualified men to make exhaustive reports on special branches of industry. With regard to the subjects to be taken up by this new sectional committee of the chemical trades, the Patent Laws as affecting chemical industries in particular deserved the first consideration, inasmuch that at the present time they were in a very chaotic state in several important points. In many respects they actually favoured the foreigner at the expense of the Englishman, in so far that they gave him a monopoly in this country without in any way binding him to work his patent here, and in this respect a radical change was required. The next most important matter for consideration would be the railway rates and charges on chemical products, as it was quite impossible for any one except those engaged in the trade to develop a proper classification of chemical goods.

The view generally taken by outsiders as to the importance and magnitude of the chemical trade was not altogether a fair representation of the immense amount of chemicals which were used in this country and exported in the various forms of dyes on cotton goods and yarns; the pigments in paper, the chemicals introduced into india-rubber goods; the ingredients of the size and finish on cotton, woollen, and silk goods, &c. All these chemical products were omitted in the statistical summing up of the chemical products produced in and exported from this country.

The establishment of these sections of Chambers of Commerce would vitally affect the trade of this country in the future for good. They were periodically alarmed by a contemplation of the returns showing the increase made by foreign countries in the chemical and other trades, and it would be the work of proper Chambers of Commerce through their sections to justify or to minimise these fears. For his own part he thought that when they had done all they possibly could, they should not have the same leading position that they had enjoyed in the past, they should not lead to the same extent, and they could not expect to retain such a pronounced advantage for ever; but by using their facilities to the utmost and by seeing that they were at all events as fair to themselves as to outsiders, they should still keep in the front rank in the commercial battlefield.

He hoped that the members of the Society of Chemical Industry would do all they possibly could to support the Chamber of Commerce by becoming members and by making their presence felt when those matters affecting the trade were brought forward for discussion.

Dr. GROSSMAN said, as the Chairman had pointed out in his address, it seemed a strange thing that so many law-suits which involved technical questions should be decided by judges and argued by counsel who knew nothing of chemistry. At the same time they need not expect any reform in these matters so long as the legal element was so strong in Parliament. It seemed to him that these sectional committees might settle most of these disputes at much less expense.

Mr. ELIJAH HELM, Secretary of the Manchester Chamber of Commerce, said the idea of forming sectional committees had long been entertained by many members of the Board, and the desire had grown. It had been felt that the Chamber with all its traditional influence and experience—and it had had a great deal of experience—should be more widely useful considering the enormous expansion and multiplied variety and complexity of industries in the great district of which Manchester was the centre. They knew

how great had been the difficulties which had to be surmounted before the arrangements which had been made could be carried out, and it now rested with the members of the various industries to assist the Board by joining the Chamber and giving it the advantage of their experience.

He gleaned from what had been said that one of the most pressing questions affecting their own department was that of the reform of the patent laws, and he thought he might venture to say that if some definite line of policy was suggested by the committee it would receive the hearty support of the Board. They had a good case, and it had been made more forcible by what had been said that night. One other subject which had been referred to was the frequent law-suits and the expenses of litigation. The Chamber had tribunals which had already at little cost decided trade disputes, some of which had been referred to them by the law courts; and when their sectional committee started work the tribunal could be strengthened by the addition of competent members especially conversant with each branch of trade, to whom these special questions might be referred. Certain bye-laws would have to be framed for the regulation of the sectional committees and the organisation committee of the Board are meeting this week for this very purpose. They would, therefore, see that no time was being lost in meeting their wishes.

The CHAIRMAN, in reply to Dr. Schunck, stated that the organisation of the Chambers of Commerce on the Continent was very different to that of our own Chambers, and it was the knowledge of this fact which led him to suggest the formation of sectional committees in our own Chambers, which would be able to deal with questions appertaining to special trades others than cotton, such as chemical and similar products, metals, food-stuffs, &c. He had endeavoured to point out that the chemical industries could not be judged solely by a standard of pounds, shillings, and pence, but by the influence which they exercised in the development of other trades, and he ventured to rely on the hearty co-operation of the members of the Manchester Section of the Society of Chemical Industry with the new section of their Chamber of Commerce.

Newcastle Section.

Chairman: T. W. Stuart.

Vice-Chairman: P. P. Bedson.

Committee:

Alfred Allhousen.
G. T. France.
G. Gatheral.
John Glover.
T. W. Lovibond.
John Pattinson.

H. R. Procter.
B. S. Procter.
W. W. Procter.
W. L. Rennoldson.
C. H. Ridsdale.
J. E. Stead.

Hon. Local Secretary and Treasurer:
Dr. J. T. Dunn, The School, Gateshead.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held in the College of Science, Thursday,
December 5th, 1889.

MR. T. W. STUART IN THE CHAIR.

ON THE DETERMINATION OF MINUTE QUANTITIES OF ALUMINIUM IN IRON AND STEEL.

BY JOHN E. STEAD, F.R.C.

SINCE the discovery that aluminium or ferro-aluminium when added to molten steel and iron greatly improves their flowing properties, producing castings practically free from honeycombs, the iron and steel analyst has been called

It is no wonder that the estimation of sulphur in pyrites, a commodity of which annually at least two million tons are got, at least one million of which is sold by analyses, should be very carefully treated. Although the value of pyrites has so much declined since, some years ago, Messrs. Chance first proved the possibility of recovering the entire sulphur of alkali waste, yet the sums involved in this trade, owing to the immense quantities concerned, are very large, and warrant the demand of accuracy in establishing the sale price of any large parcel of pyrites.

For a number of years the methods of decomposing pyrites for analysis by fusion with alkaline carbonates, nitrates, and so forth, have been in most laboratories replaced by decomposition in the wet way, employing the mixture first proposed by me, namely, three or four parts of nitric acid of sp. gr. 1·4 to one part of strong hydrochloric acid. This operation is much more easily carried out than the decomposition by fusion in the dry way; it succeeds with ordinary care even in the hands of less experienced chemists, who would not obtain sufficiently accurate results by the process of fusion, with its concomitant risks of loss by spurning in getting the mass out of the crucible, &c. It takes altogether only about half the time of that required for an analysis in the dry way; no platinum crucibles are spoiled, and no chance of error is introduced by the sulphur contained in coal-gas. The fact that the decomposition in the wet way leaves untouched the sulphur of barium sulphate and, apart from a very slight quantity, that of galena, is precisely a recommendation of it in comparison with the dry method, which estimates also the useless sulphur of the first-mentioned minerals.

This, no doubt, explains the preference shown by most practical chemists for the decomposition of pyrites in the wet way. As practised universally before, and very frequently even now, that method certainly contains a source of error in the large quantity of iron present. It had long been known that it is hardly possible, when precipitating barium sulphate in solutions containing iron, to obtain a precipitate free from the latter, and tedious prescriptions were made for purifying such precipitates after ignition, which, I am bound to say, could not be carried out by any but very skilled operators without incurring mechanical losses, and which, moreover, rarely succeeded in their object. I have shown in one of my former publications (*Zeits. Anal. Chem.* **19**, 419) that it is quite possible to get the iron out of the precipitate in the wet state by means of energetic treatment with strong hydrochloric acid; but this causes the dissolution of somewhat considerable quantities of barium sulphate which can be recovered only by circuitous and lengthy methods.

Fresenius (*Zeits. Anal. Chem.* **19**, 53) has treated the point in question somewhat in detail. He states that by the wet method as carried out according to prescriptions in my "Treatise of the Manufacture of Sulphuric Acid and Alkali" results were obtained about 1 per cent. lower than by the (lengthy and troublesome) dry method described by himself, which he ascribes to the solubility of barium sulphate in ferric chloride. He certainly neglected to take into account the fact, pointed out by me both before and after, that the dry method includes the sulphur of heavy spar and galena, purposely left out by the wet method; this would no doubt have reduced the real difference between his and my method to a much smaller figure. But I do not doubt that there *is* such a difference, for my own very careful experiments, described in the above-mentioned paper, did show an average error of 0·18 per cent. in the wet method as practised *then*, in comparison with the results obtained by the improved process which I had worked out in consequence of Fresenius' objection, and which consists in removing the iron by means of ammonia previously to precipitating the sulphur, and operating in such manner that no trace of sulphuric acid is left in the ferric hydrate, and that the analysis is detained only about an hour by this additional operation, as we shall see hereafter.

The cause of the error incurred in the presence of salts of iron has been fully investigated by Jannasch and Richards (comp. the abstract of their paper in this Journal, 1889, p. 819), and has been satisfactorily explained by them. They have, however, arrived at a very misleading conclusion, namely, "that 'Lunge's method' is not sufficiently accurate, and that the dry way prescribed by Fresenius should be employed for all purposes requiring scientific precision." Jannasch and Richards had made a serious mistake in conducting that part of their investigation which refers to a comparison between the methods of Fresenius and my own. They had entirely overlooked the fact that I had, nine years before them and in a paper quoted by themselves (the same which I have mentioned above), modified my method in the above-

mentioned manner, so as to do away with all objections to the wet way of decomposing pyrites by removing the iron by precipitation with ammonia. It is this which is commonly known as Lunge's "new method," which is contained in the "Alkali-Makers' Pocketbook," and which has been adopted in Germany as binding between buyer and seller; but upon *this* method, having omitted to notice it, Jannasch and Richards did not make one single experiment. On the contrary, after I had drawn Professor Jannasch's attention to this fact, he himself tried my "new" method, and expresses himself upon it as follows (*J. prakt. Chem.* [2], **40**, 236):—"By the previous precipitation of the iron at a moderate heat with a slight excess of ammonia, Lunge has rendered his method altogether exact. My attention having been drawn to this fact by Professor Lunge, I have recently employed his method as well as my own with perfectly certain success. The pyrites mentioned in my previous paper, analysed by Lunge's improved method, yielded:—

	Lunge's Method.	Jannasch's Method.
	Per Cent.	Per Cent.
S	52·56	52·63
Fe	45·88	45·79
SiO ₂ &c.	1·03	1·10
	99·47	99·52

"Since Lunge's method of assaying pyrites is in general use for technical purposes, and consequently of great practical importance, it may be interesting to know that its results are completely concordant with those obtained by an altogether different method."

In a paper published in the *Zeits. f. angew. Chem.* 1889, 473, I have described in detail a number of experiments by which two of my students, Messrs. Barbezat and Obregia, working independently of one another, have investigated a special point in connexion with my improved process, namely, the question whether, as stated by me in my paper of 1880, the precipitate of ferric hydroxide can be entirely freed from sulphuric acid or not; in the latter case my process would, of course, be faulty. They found that if the precipitation of ferric hydroxide took place in the way described in Fresenius and practised in many laboratories, that is, boiling the liquid for some considerable time till the smell of ammonia is all but gone, it is unavoidable to leave some sulphuric acid in the precipitate. If, however, the operation was carried on as described by me in 1881, and again in the "Alkali-Makers' Pocketbook," that is, adding a slight but distinct excess of ammonia, and warming gently for a few minutes, till the precipitate had well settled, and filtering at once, the precipitate proved to be entirely devoid of sulphuric acid, and the results of testing agreed perfectly, both with one another, and with tests made by Fresenius' dry method. This is shown by the following table, which includes a number of assays of the same sample of pyrites according to my old method, that is, precipitating the barium sulphate without previous removal of the iron.

	Fresenius' Method.	Lunge's Improved Method.	Lunge's Old Method.
	52·46	52·70	52·38
	52·49	52·41	52·38
	52·31	52·22	51·94
.. .. .	.. .. .	52·26	.. .. .
.. .. .	.. .. .	52·39	.. .. .
Average	52·42	52·40	52·23

From this it can be seen that even my "old" method yields results no more remote from the real percentage than I had found myself in 1880, viz., 0.18 too low. For ordinary purposes the "old" method would seem to suffice. The reason why I and my students obtained with it results so near the true ones is probably this, that we ignited our precipitates in the ordinary way with a Bunsen burner and not excessively long, whilst Jannasch and Richards continued the ignition for a long time and as intensely as possible, thus decomposing a larger proportion of the barium-ferric sulphate contained in the precipitate.

Just because there is some uncertainty attached to this point, and various observers will necessarily get somewhat discordant results with my "old" method, I must strongly recommend the use of the "improved" method whenever important interests are at stake, and especially always when the analyst has to decide upon the value of a parcel bought and sold. I must do this all the more as the loss of time by the improved method need not exceed an hour at most if my further prescriptions are observed, and, as I deem these very useful for the precipitation of alumina as well as for that of ferric hydroxide in all cases, I will briefly point them out here:—

"To the liquid containing iron or alumina add a sufficient quantity of ammonia, free from carbonate, to leave a distinct smell, but avoid an unduly large excess. Warm up, if the liquid has not been hot to begin with, and allow to stand for a few minutes, till the precipitate has fairly settled. Pour off the clear liquid through a filter, and wash the precipitate on to the filter. When the liquid has drained off, wash with boiling hot water, taking care every time to churn up the whole contents of the filter into a paste by directing the jet of water in a suitable manner. Repeat this four or five times, and ascertain in the usual way whether the washing is complete. Provided the filtering paper is of good quality, the filter is lying smoothly against the glass, the funnel tube is always full and the water is boiling hot, the whole operation lasts from one-half to at most a whole hour, and the total bulk of filtrate and washings from decomposing 1 gram of pyrites does not exceed 200 to at most 250 cc., so that no evaporation is needed before precipitating the barium sulphate."

Experiments made quite recently in my laboratory by Mr. Rey have shown that by this *modus operandi* the necessity of igniting the alumina for a long time before the blow-pipe, as prescribed in the text-books, is entirely avoided. This necessity arises in the ordinary method by the fact that the alumina, just as the ferric hydrate, retains some basic sulphate which must be decomposed by prolonged and intense ignition; but when acting upon my instructions, no basic sulphate is retained. It might be supposed that on the contrary some alumina or iron would be dissolved by the excess of ammonia; but apart from the fact that this excess is very slight, it has been pointed out by Fresenius and by Blum, and has been confirmed by Mr. Rey, that in the presence of ammonium chloride no such solution of alumina or ferric oxide takes place.

Glasgow and Scottish Section.

Chairman: R. R. Tatlock.

Vice-Chairman: Wm. Dittmar.

Committee:

G. Beilby.	R. Irvine.
Wm. Boyd.	G. McRoberts.
A. Crum Brown.	E. J. Mills.
J. Christie.	J. M. Milne.
W. S. Curphey.	T. L. Patterson.
D. B. Dott.	E. Smith.
Wm. Foulis.	E. C. C. Stanford.
J. Gibson.	A. Whitelaw.

Hon. Treasurer: W. J. Chrystal.

Hon. Local Secretary:

G. G. Henderson, Chemical Laboratory, University of Glasgow.

SESSION 1890.

Jan. 7th:—

Mr. E. Rodger. "The Salt Mines at Khewra, Punjab."

Mr. T. L. Patterson. "On the Quantitative Estimation of Colouring Matters by means of their Absorption Spectra."

Mr. C. A. Fawsitt. "On the Fixation of Nitrogen."

The Meeting will take place in the Societies Rooms, 207 Bath St., Glasgow, at 8 p.m.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held on Monday, 3rd December, in the Rooms of the Philosophical Institution, Queen Street, Edinburgh.

PROFESSOR CRUM BROWN, D.S.C., F.R.S., IN THE CHAIR.

A CONVENIENT SOLUTION FOR USE IN TITRATING WELDON MUDS FOR MANGANESE PEROXIDE.

BY W. G. M'KELLAR.

A COMMON factor in connexion with the above titration quoted by Bayley and Lomas is:—"When using one cubic inch of the mud for the test, divide the number of grains of protosulphate of iron ($\text{FeSO}_4 + 7 \text{H}_2\text{O}$) oxidised by the MnO_2 by 25.88, the resulting quotient gives the manganese peroxide in lb. per cubic foot."

This factor is merely the reciprocal of the following formula, which is the result worked out from first principles:—

$$\frac{\text{MnO}_2}{2 (\text{FeSO}_4 + 7 \text{H}_2\text{O})} \times 1728 = \frac{87 \times 1728}{556 \times 1} = 0.03862.$$

7,000 7,000

That is to say, 1 grain of protosulphate of iron is equal to 0.03862 lb. of manganese peroxide, when 1 cubic inch has been used for the test.

If, therefore, when titrating mud with a standard iron solution, we make up $1.035 \cdot 2 = (25.88 \times 4 \times 10)$ grains of ferrous sulphate to 10,000 grains of a mixture of 5 parts water and 1 part strong sulphuric acid, each division of this solution will be equal to 0.04 lb. of manganese peroxide per cubic foot, if 1 cubic inch has been under examination. We thus have a solution which reads directly from the burette without the use of a table. Thus,—

50 Div. = 2.00 lb. MnO_2 per cubic foot.

53.25 Div. = 2.13 lb. MnO_2 per cubic foot,

As a perfectly pure iron salt cannot be obtained conveniently, it is advisable in actual practice to make the bichrome standard, which may be got by making up 183.06 grains of bichromate of potash to 10,000 grains fluid. One division of this solution is equal to 0.2085 grains iron.

(0.2588×4) grains iron protosulphate = 1.0352 grs.
 $(\text{FeSO}_4 + 7 \text{H}_2\text{O}) = 0.040 \text{ lb. manganese peroxide per cubic foot.}$

And for the iron solution, using about 1,050 grains of ferrous sulphate per 10,000 fluid grains acidified water, titrating, and then diluting down the iron solution with water till it is equal to the bichrome.

In practice, as the iron solution oxidises, it is advisable to make the solution 0.25 division over strength in 50 divisions, because the strength alters in three weeks' time, about one division per 100. This excess in strength in a mud running from 2.00 to 2.50 lb. MnO_2 per cubic foot would limit the probable error due to the variation of the solution to 0.01 lb., first of all negatively, then, as the solution aged, positively.

The usual method of titration is employed, viz., running in the iron solution till all the mud has dissolved, which requires an excess of from 3 to 5 divisions iron solution; then titrating back with bichrome, deducting the bichrome divisions from the iron divisions and multiplying remainder by 0.04.

The equivalent quantity in grammes, viz., 11.862 grms. bichromate of potash and about 69.4 grms. ferrous sulphate crystal, each made up to 1 litre, would serve the purpose equally well. 1 cc. = 0.04 lb. MnO_2 per cubic foot when using 1 cubic inch of the mud.

DISCUSSION.

The CHAIRMAN pointed out that, quite apart from the chemical bearing of the paper, Mr. McKellar's work showed how much chemists were hampered by the monstrous system of weights and measures in use for commercial purposes in this country. He hoped to live to see the French system adopted generally. We need have no false pride in the matter. We could quite well afford to adopt this, perhaps the most valuable result of the French Revolution, and we could adopt it without any serious revolution in anything else.

Mr. D. B. DOTT said he entirely agreed with what had been said regarding this question of weights and measures. If such a system as the French were adopted it would be much easier for all concerned. It was not generally known that pharmaceutical men had a special difficulty with the present system. By the abolition of the old troy ounce of 480 grains, and hence the compulsory use of the avoirdupois ounce of $437\frac{1}{2}$ grains, they had innumerable calculations which were most inconvenient. The grain never could have been a part of the avoirdupois system. The avoirdupois pound certainly contained 7,000 grains, still the grain was a troy and not an avoirdupois denomination. Confusion had been caused by mixing two different systems.

that the Society's meetings would be of great service to young chemists, but unless the Society took some steps whereby those who were desirous of pursuing technical chemical work might obtain the requisite knowledge and practice, the benefit of the meetings alone to young chemists would be *nil*. He did not profess to be able to formulate a plan, but had mentioned the matter in the hope that discussion would follow, as no doubt many others members of the Society were fully alive to the want. Their excellently conducted Journal, notwithstanding its value both for study and for reference, did not cover the field which the sectional meetings were intended to occupy.

Mr. BOY said that the difficulty to which Mr. Irvine had referred was one which affected nearly all societies of a similar nature. Both the London and Edinburgh Sections of the Pharmaceutical Society had very great difficulty in getting papers, although they met only once a month. This Society had established at their head-quarters in London a research laboratory, whence came the majority of the contributions which were given at the evening meetings last session. To this laboratory students who were sufficiently advanced were admitted, and were allowed to work free of charge, although they were not paid anything. This Section of the Society of Chemical Industry should have no difficulty in securing sufficient papers for their three meetings in Edinburgh during the session.

Mr. DOTT agreed so far with what had been said, but thought the tendency was rather to increase than diminish scientific communications. Apart from secret processes which it was not desirable to publish, there were many chemically interesting facts elicited in the laboratory. One thing he felt strongly upon, there should be no "beating" for papers; rather let there be fewer meetings and the papers be of a higher quality.

The CHAIRMAN said that there were difficulties, which no doubt Mr. Irvine saw, in the way of carrying out his ideas. Scientific interests and trade interests would always tend to clash. Young men must work somewhere if they were to obtain practical results, and even if they themselves had no trade interests their employers were in a different position. Something might be done in laboratories of universities and other schools where chemistry was studied, where it was to be hoped that there were no interests to prevent full publicity. They welcomed discussions as to how the usefulness of the Society and of that Section could be increased; but whether that increase of usefulness came about in the way suggested or otherwise, the thanks of the Society would be due to Mr. Irvine for calling attention to the subject.

Communication.

DISCUSSION ON THE WORK OF THE SECTIONS.

Mr. ROBERT IRVINE referred to a letter which he had received from Mr. Henderson as to the great difficulty of getting original papers for the various meetings of the Section. He had pointed out in reply that it was absurd to expect chemical manufacturers to publish their main processes before the Society. This applied not only to manufacturers, but also to technical chemists employed by them, who were naturally, as a rule, bound down not to divulge the information committed to them. He had hoped

NOTE ON THE BEHAVIOUR OF CERTAIN EXPLOSIVES UNDER PERCUSSION.

BY A. WERNER CROSQVIST, STOCKHOLM.

IN order to ascertain the degree of sensitiveness to concussion of certain explosives in use in Sweden, I have made some experiments on samples of from 0.15 to 0.70 gm. The samples, at a temperature varying between 15 to 22 °C., were placed between steel faces which were then struck by the falling weight, and the following figures in kilogram-

meters and foot pounds give the minimum impact which resulted in explosion:—

	Kilogram-meters.	Foot Pounds.
Nitro-glycerin, fluid.....	0.41	2.8
„ frozen.....	0.80	5.6
„ partially frozen.....	0.27	1.9
Dynamite (72 per cent. nitro-glycerin)...	0.50	3.5
Blasting gelatin (96 per cent. nitro-glycerin)	0.60	4.2
„ (90 per cent. nitro-glycerin, with camphor and nitro-cellulose).....	1.80	12.6
Ammonia powder (ammonium nitrate, nitro-glycerin, and charcoal).....	0.55	3.8
Sebastine (nitro-glycerin, nitrate of soda, and charcoal).....	0.70	4.9
Gun-cotton (dry).....	0.82	5.7
„ with 20 per cent. of water.....	2.30	16.1
Nitro-cellulose, soluble.....	0.72	5.0
Romite (ammonium nitrate, potassium chlorate, naphthaline, and paraffin)....	0.60	4.2
“ Romite Maritime ” (nitro-lactine).....	1.50	13.3
Gunpowder, fired.....	37.50	225.0
Bellite (ammonium nitrate and nitro-benzene).....	62.00	437.0
In copper cartridge:—		
Gunpowder, explosion.....	72.00	507.0
Bellite, neither exploded nor fired at.....	292.00	2077.0

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements in or relating to Apparatus for Evaporating Water, and Heating Feed-Water. E. Paul, Liverpool. Eng. Pat. 14,931, October 17, 1888. 8d.

THE apparatus described in the specification is used for the purpose of evaporating liquids or for heating feed-water, by means of two concentric vessels, the inner one being much shorter than the outer one. The space between forms the steam chamber, the other containing the liquid for evaporation which also circulates through the former by means of tubes. The invention principally deals with the arrangement of and the method of fixing the circulating tubes, and with the automatic regulation of the water supply, for details of which the drawings of the specification should be consulted. There are five claims.—B.

* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Luck, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	3d.
Above 8d., and not exceeding 1s. 6d.	1d.
„ 1s. 6d., „ „ 2s. 4d.	1½d.
„ 2s. 4d., „ „ 3s. 4d.	2d.

Improvements in Apparatus for Calcining, Drying, Roasting or Carbonising Substances or Materials, and Extracting Gases, Spirits, or Acids, or other Products therefrom. R. Cunliffe, Pendleton. Eng. Pat. 15,460, October 27, 1888. 8d.

THE improvements relate to the apparatus described in Eng. Pats. 14,141 of 1886, and 10,723 of 1887 (this Journal, 1887, 814), and consists in arrangements for heating the vessel or retort in which the material is placed. The retort is partially enclosed in a casing, formed of metal plates, between which is a cavity filled with asbestos or other non-conductor of heat. The casing which surrounds the trunnion is also covered with the same material. The retort is heated by a furnace mounted in a frame with wheels which run on rails so that it can be readily withdrawn. A further improvement consists in supplying air to the furnace by a fan, the air from which being conveyed through pipes or cavities around the furnace becomes heated, and then passing through the retort assists in drying the materials—the process being thus effected more thoroughly, with greater rapidity and with a comparatively small quantity of fuel. The valuable volatile products can be collected and condensed in any suitable manner; or if deleterious may be passed through the furnace and consumed.—E. S.

Improvements in Machines for Drying Granular, Fibrous, and like Materials, also Appliances for Cleaning, Bleaching, Damping, Germinating, and Disinfecting. R. Howarth, Rochdale. Eng. Pat. 15,731, November 1, 1888. 8d.

IN one arrangement of this apparatus, as employed for drying granular substances, a rotary horizontal cylinder with perforated circumference is placed within a fixed casing. The cylinder is mounted on a central perforated tubular shaft carried in bearings, the ends of the tube being put in connexion with an exhaust fan. The cylinder is filled with the granular substance to such a height as to entirely cover the perforated central tube in order that the current of air produced by the action of the exhaust fan may pass through the permeous mass before reaching the exhaust channels. There are various valves, shutters, and devices for the proper regulation of the air and for the passage of the drying substances.

In another arrangement, instead of rotary cylinders, inclined stationary channels are used, having perforated walls within a surrounding casing, down which channels the materials pass at regulated speed whilst subjected to the action of the exhaust fans as in the foregoing arrangement. There are two sheets of drawings and eight claims.—B.

Improvements in Apparatus for the Distillation and Liquefaction of Condensable Gases as applied to Refrigerating Apparatus. H. Puplett and J. L. Rigg, London. Eng. Pat. 16,372, November 12, 1888. 8d.

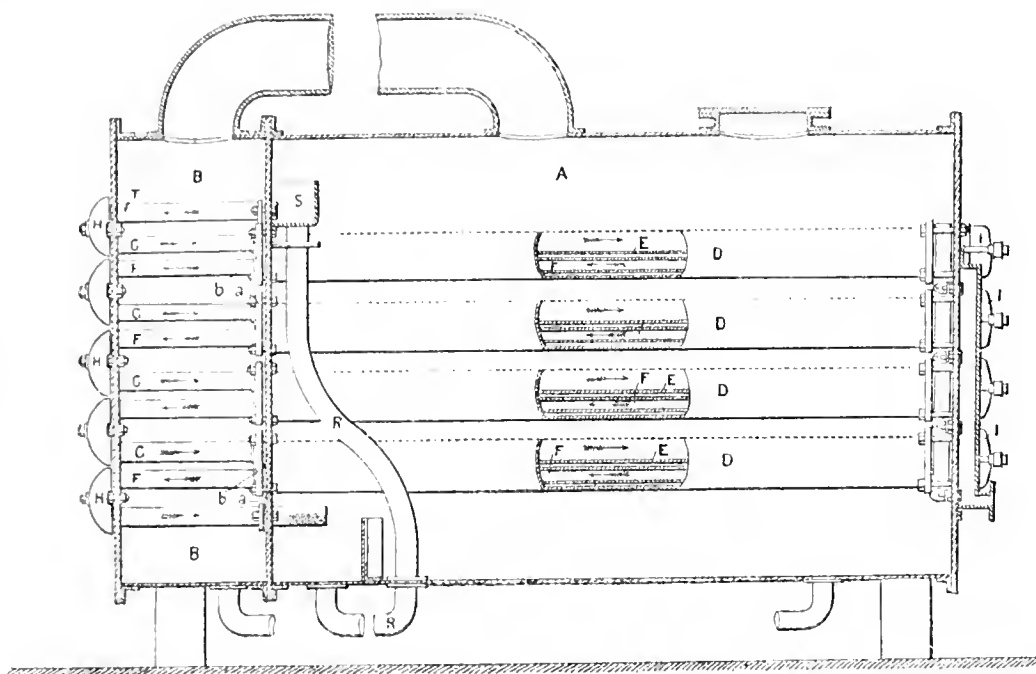
THE improvements consist in arrangements for rendering automatic the evaporation, liquefaction, and circulation of the condensable gases in refrigerating apparatus. The patentees state that hitherto the liquid from the absorber has been returned to the generator by means of pumps, and to avoid the use of these they provide a discharge valve at the lowest point of the absorber, the valve being operated by means of a rocking beam carrying an adjustable balance box at each end. These boxes are governed by a double tumbling basin supplied with a regulated stream of water from any source, and, according as the discharge takes place at either end, the valve is opened or closed, when open allowing the accumulated liquid to gravitate to the generator. Two sheets of diagrams accompany the specification.—B.

Improvements in Apparatus for Evaporating Liquids. T. Slater, London. Eng. Pat. 34, January 1, 1889. 11d.

THE object of this invention is to afford means for the easy repair and renewal of tubular gutters, trays, and similar heating surfaces, in apparatus in which evaporation is carried

on under a vacuum. For this purpose a series of circular tubes D in the accompanying sketch pass through a vacuum chamber A, and are secured in opposite tube plates by means of packing rings *a* and suitable tighteners.

The upper part of the tubes—dotted line in figure—within the vacuum chamber is cut away or left open, and a longitudinal division or tray E inserted and secured steam-tight to the sides of the tube, about midway down. From



one end of the upper half of the double tube so formed a smaller tube G is taken out, passing through the steam chamber B which adjoins the vacuum chamber on that side; and the liquid for concentration enters the system through the tube G from the passages R and S. The lower half of the double tube is traversed by another small return tube F, secured steam-tight into the opposite end of the lower part of the larger tube, and passing freely through the other end and through the steam chamber. This tube, with the assistance of the caps H and I, and the succeeding pipe G, serves as a conduit for the surplus liquid from the evaporating gutter to the next lower one. The steam from the chamber, entering the annular space between tube F and the lower half of tube D evaporates the liquid on the gutter E, whilst at the same time continuing to heat the liquid overflowing to the next gutter. All the pipes can be separately withdrawn and re-inserted, and the system can be extended to multiple-effect apparatus. Three claims are recorded, and three drawings accompany the specification.—B.

A Fluid for Removing and Preventing Incrustation in Steam Boilers. R. Cosslett, Bath. Eng. Pat. 148, January 4, 1889. 4d.

THE fluid is composed of a mixture of a mineral illuminating oil and a mineral lubricating oil, those extracted from coal and shale being best for the purpose. The two oils are mixed together and added gradually to the water in the boiler. The best proportion for use is stated to be half a pint per week of six days for each 10-horse power boiler; double the above, if worked day and night. Foul boilers require an additional quantity until they are clean. In new and clean boilers incrustation is prevented, and where it has been formed, "the oils not having an affinity for the incrustation percolate through the same, and on coming in contact with the heated boiler plates are expanded, thus forcing off the incrustation."—E. S.

Improvements in Means or Apparatus for Removing Impurities from Water in Steam Boilers. R. W. E. Sanderson, Manchester. From J. O'Brien and S. J. Weaver, St. Louis, U.S.A. Eng. Pat. 381, January 9, 1889. 6d.

THE invention relates to improvements in a feed-water purifier and heater for steam boilers described in Eng. Pat. 4342 of 1888, and consists in combining therewith apparatus for removing some or all of the impurities which pass through the purifier and enter the boiler with the feed-water. A circulating pipe enters the boiler at or about water level, and extends inward, terminating, preferably, below the feed-water purifier about water level and over a pipe connected to a mud-drum. Outside the boiler the circulating pipe is provided with valves and taps, and is by preference connected to the mud-drum, which has a valve and blow-off cock. The valves being open, the feed-water circulates from the upper to the lower part of the boiler, and deposits the impurities at the bottom of the drum, from which they may be expelled by closing the valve and opening the blow-off cock. A modification of the invention dispenses with the mud-drum, an enlarged pipe being substituted for it. There are four claims and one drawing.—E. S.

A Process of Manufacturing a New Substance for Removing Incrustation and other Sedimentary Deposits, particularly from Steam Boilers, and for Cleaning other Vessels. M. van Look, Barmen, Germany. Eng. Pat. 5791, April 4, 1889. 4d.

STARCH, to which caramel or other innocuous colouring matter has been added, is dissolved in hot water by blowing steam into the mass, when a quantity of caustic soda, about equal to the weight of the starch, is added. It is claimed that this compound will detach old incrustations as well as prevent the formation of new.—W. L. C.

Improvements in Bag Filters. B. J. B. Mills, London.
From J. Rétif, Lyons, France. Eng. Pat. 6987, April 26,
1889. 6d.

It has been customary in the employment of bag filters to fix them by screws or by tying to the under side of the reservoir or vat in which the liquid to be filtered is contained. The patentee in this specification proposes to suspend them through an opening in the bottom of the reservoir or vat, and shows several devices for making a tight joint between the filter and the vat, which is effected solely by the pressure of the head of the unfiltered liquid.—C. C. H.

An Improved Automatic Filter. J. Leslie, Belfast. Eng.
Pat. 9244, June 4, 1889. 6d.

THE filter consists of an upright vessel, made of any suitable material, fitted with an air-tight cover to withstand internal pressure. To this cover is attached a cage which projects into the filter and is enclosed in a bag securely fastened to it; the bag is coated, preferably on the outside, with a suitable filtering medium. The liquid is admitted under pressure from the supply at the bottom of the filter, passes upwards through a perforated plate at the bottom, and through the filtering bag, and is discharged from a pipe at the top.—E. S.

An Improved Anti-Incrustator for Cleansing Boilers and Pipes and such like. I. M. Coates, Wallington. Eng.
Pat. 11,195, July 11, 1889. 4d.

TWENTY-FOUR parts of common soda are mixed with 3 parts of animal charcoal, and to these are added in succession 4 parts of Fuller's earth, 12 of alum and 5 of Demerara sugar. The mixture is dissolved in water before use.

—W. L. C.

A Certain New and Useful Process for Facilitating Chemical Reactions. H. Bower, Philadelphia, U.S.A.
Eng. Pat. 13,549, August 27, 1889. 8d.

THIS invention is for mechanically facilitating chemical reactions by subjecting two or more substances to be combined to the effect of impact and attrition from opposing jets, with or without the use of a finely-divided solid agent.

For the manufacture of ammonia, hydrogen and nitrogen are mixed in the proper proportions, and as the blast is turned on, finely-divided graphite is added. The gases are then forced, under a pressure of 200 lb. to the inch, through heating coils, and discharged into a vessel in opposing jets, ammonia being formed. The gas is then led into a dust chamber, for deposition of graphite, and finally into an absorber.

The apparatus may be used for two liquids, or a solid and a gas, &c., e.g., steam and sodium chloride, for production of hydrochloric acid; solution of sulphate of soda and milk of caustic lime to form caustic soda; water and neutral fats to produce fatty acids and glycerin; and for the action of carbon, hydrogen, or other reducing agents upon metallic oxides, such as alumina, producing aluminium by the gradual reduction of the oxide. Several other applications are suggested.

—D. A. S.

II.—FUEL, GAS, AND LIGHT.

Studies of Coal Gas. E. St. Claire-Deville. Journ. des
Usines à Gaz, 1889, 13.

AT the experimental gasworks at La Villette over 1,000 experiments have been carried on from 1872—84, with 59 kinds of coal. Each experiment lasted three days, and was made with 36 tons of coal. It was found that the estimation of the benzene by different methods gave very varying results. The author shows that benzene, in many cases, is absorbed by the water in the water joints, and also lost during the determination of carbonic acid by means of a solution of soda, and thus escapes estimation. Water which has been saturated with gas, such as the water from meters, and the reservoirs of gas-holders, yielded, when carefully distilled, 350—400 grms. of benzene per cubic metre, corresponding to about 100 litres of benzene vapour. In consequence of this, the amount of carbonic acid found is always too high by about 1 per cent. From 1883 the carbonic acid has always been estimated gravimetrically, the total amount of heavy hydrocarbons estimated by means of bromine. The benzene was obtained by cooling the gases to -22°C ., the dry gas being passed through two worms, cooled by means of ice and salt, at the rate of about 250 litres per hour. In the first tube most of the products of condensation separate, and in the second, nothing, or only very little. These consist mainly of benzene. From the gases produced from five kinds of cannel coal were obtained 27.7—48.6 grms. of condensation products per cubic metre. In addition to this, there is the benzene vapour which is not liquefied at -22° . The calculated amount is 23.5 grms. per cubic metre. This missing quantity can be obtained by cooling with methyl chloride to -70° to -75°C . This weight, 23.5 grms., is constant for all kinds of gas from bituminous coal—sufficiently constant for all practical purposes. Gas from the gasworks at La Villette yielded, in nine determinations, 36.9—41.8 grms. of products liquid at -70° , of which 22.3 to 23.5 grms. condensed between -22° and -70° .

Cannel coals behave differently, as from them more is deposited at -70° , namely 27.9 grms. There are doubtless here deposited hydrocarbons which do not belong to the benzene series. The various products from the gas at La Villette condensed at -22° , yielded, when submitted to fractional distillation:—between 80° and 90° , 54.5 per cent.; 90° — 115° , 26 per cent.; 115° — 160° , 17.5 per cent.; loss, 2 per cent. The other products liquid at -70° , yielded:— 80° — 90° , 91.76 per cent.; residue, 7.93 per cent.; loss, 0.31 per cent. The total products of condensation were composed of benzene (boiling at 81°C .), 76.39 per cent.; toluene (boiling at 111°C .), 10.74 per cent.; xylene and higher products (boiling points from 139° upwards), 7.22 per cent.; residue in still, 4.66 per cent.; loss, 0.99 per cent. The liquid products contained practically 75 per cent. of benzene.

Paris illuminating gas contained, on an average:—heavy hydrocarbons absorbed by bromine, 5.05 per cent. by volume, of which the aromatic hydrocarbons amounted to 0.95 per cent., and the others to 4.10 per cent. by volume.

The aromatic hydrocarbons were present in this case to the amount of 35.48 grms. per cubic metre (1 litre of benzene vapour = 3.73 grms.). Great variations did not occur in the Paris gas, and the amount of benzene was always very close to 1 per cent. by volume.

Examination of the Coals.—The author divides gas-coals, according to the percentage of oxygen they contain, into five groups, viz., containing from 5—6.5, 6.5 to 7.5, 7.5 to 9, 9—11, and 11—13 per cent. respectively. The varying amounts of oxygen in the different kinds of coal is of considerable influence on the details of the gas-making processes (Bunte, Journ. f. Gasbeleuchtung, 1886, 709), namely, with regard to the formation of carbonic acid, carbonic oxide, heavy hydrocarbons, tar, gas-liquor and also the yield of gas.

The following tables show the composition of the coals, and the effects of increasing proportions of oxygen in them on the manufacture of the gas:—

Class of Coal.	I.	II.	III.	IV.	V.
Oxygen in the coal, not including water or ash	Per Cent. 5.36	Per Cent. 6.66	Per Cent. 7.71	Per Cent. 10.10	Per Cent. 11.79
Oxygen and nitrogen in the raw coal.....	5.83	6.91	7.80	9.71	10.55
Carbon in the raw coal.....	78.47	78.18	76.85	72.93	67.86
Carbon in the coal, not including water or ash	88.79	90.24	89.48	87.48	83.10
Hygroscopic moisture in the raw coal.....	2.17	2.70	3.31	4.34	6.17
Volatile products yielded by the raw coal.....	26.82	31.59	33.80	37.34	39.27
100 kilos. of coal yield.....cubic metres of gas.....	30.13	31.01	30.64	29.72	27.44
" " ".....kilos. of coke.....	71.5	67.6	64.9	60.9	57.8
" " ".....kilos. of tar.....	3.902	4.652	5.079	5.478	5.592
" " ".....kilos. of gas liquor.....	4.584	5.537	6.805	8.616	9.861
Number of litres of gas used for 1 "candle" of illuminating power.....	132.1	111.7	103.8	102.1	101.8
Number of "candles" per 100 kilos. of coal.....	227	278	295	291	269

Also the analysis of the gas shows that it varies according to the amount of oxygen in the coal. As the oxygen increases these results are:—

<i>An increase in—</i>	Per Cent.
Volatile constituents of the coal of ..	26—40
Specific gravity of the gas.....	0.35—0.49
Illuminating power	132—101 (litres per 1 candle).
Carbonic acid.....	Per Cent. 1.40—3.13
Carbonic oxide.....	6.50—0.12
Methane.....	34—37
Heavy hydrocarbons of the fatty series	2.50—4.80
Tar.....	3.09—5.06
Gas liquor.....	4.05—0.10

A decrease in—

Hydrogen	55—42
Coke.....	71.5—57.8
Temperature, obtained by burning the coke in the retort furnaces = 1,330°—1,220°.	

St. Claire-Deville also investigated the other heavy hydrocarbons not belonging to the aromatic series, and found ethylene, propylene and acetylene—the first of these in large quantities. He also examined the illuminating constituents of the gas, and found that, of the total illuminating power of the gas, the heavy hydrocarbons of the fatty series produced 34.2 per cent.; the aromatic hydrocarbons containing 52 per cent. of benzene (down to -22°) 15.9 per cent.; while the aromatic hydrocarbons containing 92 per cent. of benzene (-22°—70°) produced 49.2 per cent.

In the experiments to test the influence of the temperature of distillation upon the formation of aromatic hydrocarbons in gas, it was found that the amount of these increased considerably as the heat rose from dull red to bright red, whilst those of the fatty series did not vary appreciably. Consequently gas obtained at the higher temperature is richer in pure benzene than that obtained at the lower temperature. The investigation into the amount of the hydrocarbons of the aromatic and of the fatty series in the gas showed that in the different stages of the distillation the former rose steadily from the beginning, attained its maximum amount in the second hour, and then sank slowly, whereas the latter was high during the first hour and then fell rapidly till the fourth hour.—E. E. B.

PATENTS.

Improvements in Mantles for Incandescent Lighting and Heating. R. D. Bowman, London. Eng. Pat. 17,866, December 6, 1888. 6d.

FIBROUS material is saturated with "a strong solution of the soluble salts of refractory materials such as the chlorides or

sulphates of calcium, zirconium, magnesium," &c. This material is wound round a parallel mandril and afterwards coated with the oxides of the above metals. On withdrawal of the mandril it may be replaced "by a core of whiting and saturated solution of magnesium sulphate or chloride." —D. A. S.

Improvements in the Purification of Gases. E. Solvay, Brussels, Belgium. Eng. Pat. 18,573, December 19, 1888. 8d.

This is a device for filtering gases from suspended dust or vapour in the vesicular state. The gases are caused to pass through a layer of sand or suitable granular or fibrous substance.—D. A. S.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

A Methyl-furfural and the Corresponding Methyl-pyromucic Acid. H. B. Heill. Ber. 22, 607—608.

ABOUT 12 years ago the author drew attention to the large quantity of furfural (furfural) that is produced by distilling wood at a low temperature (Ber. 10, 936). A fractionation was effected by the use of Hempel's head-tube, so that constant boiling oils were obtained. After repeated fractionation there was obtained in the portion distilling below 205°, besides one boiling at 160°—165°,—that containing the furfural, viz., the fraction boiling at 180°—185°, and also a smaller portion boiling at 185°—190°, whilst those fractions boiling respectively at 165°—180° and 190°—205° became continually smaller on redistillation. After continued fractionation at length a fraction boiling at 184°—186° was obtained, and this chiefly composed the fraction which distilled between 180°—190°. The oil thus obtained gave a marked aldehyde reaction with magenta-sulphurous acid, reduced silver oxide easily on warming, and gave, with sodium bisulphite, a beautiful crystalline compound. The aldehyde recovered from the bisulphite compound boiled constantly at 186.5°—187° (mercurial column in the vapour) under pressure of 756 mm. Since these properties left little doubt that the compound was a methyl-furfural, it was converted into the corresponding acid. This proved to be very similar to pyromucic acid, but it melted at 108°—109°, and dissolved with more ease in water than that acid, also with more ease in benzene and in chloroform. It proved to be methyl-pyromucic acid, and consequently the mother substance was undoubtedly methyl-furfural. The oil boiling at 186.5°—187° proved to be soluble in

30 parts of cold water, and the aqueous solution yielded with ammonia a beautifully crystalline compound melting at $86-87^{\circ}$. With phenylhydrazine methyl-furfural gives a liquid hydrazone, and yields with resorcinol and hydrochloric acid an orange-red, whilst with pyrogallol and hydrochloric acid, a carmine-red condensation product. Acetate of aniline paper is only coloured yellow by its aqueous solution, but later on a deep orange-red colour is developed. The author is examining the methyl-pyroneic acid with a view to elucidating the structure of the methyl-furfural.

On Fucosol. Maquenne. *Compt. Rend.* **109**, 571—573.

THIS product, which is obtained by distilling certain *algæ* with dilute sulphuric acid, was described by Stenhouse (*Proc. Roy. Soc.* **20**, 80) as isomeric with furfural (furfural). The author has prepared this substance from *Fucus vesiculosus*, obtaining about 1 per cent. on the dried *algæ*, and finds that by careful rectification it may be separated into two portions, one boiling at $162^{\circ}-163^{\circ}$, forming about nine-tenths of the whole, and the other, the remaining tenth, boiling at $185^{\circ}-187^{\circ}$.

The former of these is found to be identical with furfural, and the latter to be methyl-furfural, agreeing in all its properties with methyl-furfural as obtained by Heill (*Ber.* **22**, 607, see previous abstract) from wood tar.—A. L. S.

On Formation of Higher Aromatic Hydrocarbons. E. von Boyen. *Chem. Zeit.* **13**, 905.

THE author (this *Journal*, 1889, 273) showed the formation of picene in the distillation of residual paraffin. This, however, is probably derived from hydrocarbons contained therein of high specific gravity and high boiling point.

The author recently observed the formation of picene during the distillation of the last distillate of neutral tar oils containing no paraffin. The distillate freed from creosote by means of alkali and distilled with superheated steam, yielded a viscous oil boiling over 360° , sp. gr. 0.935, of a clear yellow colour which soon darkened. In a few days abundance of yellow granular picene separated; a clear viscous lubricating oil was obtained by refining with acid and alkali.

This oil, containing the true picene former, was treated as in Kellé's process for obtaining retene by heating with 5 per cent. of sulphur (at $200^{\circ}-250^{\circ}$), a strong evolution of sulphuretted hydrogen taking place. The product gave on distillation a viscous, dark-coloured oil of disagreeable odour; in 24 hours picene crystals separated. Thus picene is formed from per- or polyhydrides contained in the neutral tar oils of highest gravity and boiling point by oxidation (either with sulphur or oxygen of the air) at the boiling temperature.

Hard and soft paraffin carefully freed from every trace of oil no longer gave the smallest trace of picene on distilling.

—D. A. S.

Paraffins in Coal-Tar Oils. W. W. Staveley. *Chem. Zeit.* **13**, 1108.

AFTER the distillation of coal tar in large tar stills is complete, and no more heavy anthracene oils flow from the condensers, the author has observed that a small quantity of water together with an oil, lighter than water, drops from the condenser. By the distillation of 20 tons of coal tar several gallons of this oil were obtained. The water accompanying it was blood-red and contained sulphocyanides. The oil when submitted to fractional distillation in Le Bel's apparatus yielded oils distilling at the following temperatures, and having the following specific gravities:—

Boiling Point.	Specific Gravity at 15° C.
$50^{\circ}-55$	0.802
$55-75$	0.815
$75-80$	0.834
$80-81$	0.843

In some tar works during the distillation, injurious fumes are given off which are passed through water contained in receivers and then burnt. In these receivers the author has found large crystals of sulphur and also collected light oils, which when treated with fuming sulphuric acid and subjected to fractional distillation, yielded:—

—	Specific Gravity at 15° .	Boiling Point.
cc.		$^{\circ}$
43	0.763	$55-75$
40	0.732	$75-85$
35	0.726	$85-92$
40	0.725	$92-107$
35	0.731	$107-143$
193		

The author believes that these light oils are present in all portions of the distillate from coal tar, and even from pitch. He considers that they are formed by the dissociation of the vapours during distillation. From anthracene oil (sp. gr. 1.060 and 1.140) the author obtained by fractional distillation—

1.20 per cent. by volume of water containing sulphocyanides.

0.33 per cent. of 40—90 benzene (sp. gr. = 0.874).

0.60 per cent. of 90—160 solvent naphtha.

0.70 per cent. of naphtha (sp. gr. = 0.935).—E. E. B.

On c-Methylpyrrolines. M. Dénstedt and A. Lehne. *Ber.* **22**, 1918—1920. (Compare *Ber.* **19**, 2199; *J. Chem. Soc.* 1886, 1043; and *Ber.* **21**, 3439; *J. Chem. Soc.* 1889, 400.)

CIAMICIAN and Silber (*Ber.* **19**, 1408; *J. Chem. Soc.* 1886, 719) describe the action of acetic anhydride on *c*-methylpyrroline boiling at $140^{\circ}-153^{\circ}$. Their results are usually in unison with those of the authors, but in this case the authors find two isomeric *c*-methylpyrrolines, one boiling $142^{\circ}-143^{\circ}$, the other $147^{\circ}-148^{\circ}$.

For this research these were prepared pure by boiling the corresponding animal oil pyrroline fraction $140^{\circ}-153^{\circ}$ with caustic potash and extracting with ether. This was repeated and the resulting oil fractionated carefully into the fractions $142^{\circ}-143^{\circ}$ and $147^{\circ}-148^{\circ}$.

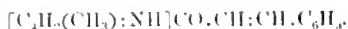
The best method of identifying homologous pyrrolines is by condensation of benzaldehyde with the *c*-acetylpyrrolines to pyrroleimnamyl ketones.

The very crystallisable nature of these compounds and their greater solubility in warm than in cold alcohol enables them to be easily obtained in the pure state.

Both isomeric *c*-methyl pyrrolines were thus treated, one part being heated in a closed tube with two to three parts of acetic anhydride and one part of sodium acetate for three to four hours at 190° ; the product taken up with warm water and subjected to a sharp current of steam. The resinous mass is mixed with animal charcoal and dilute alcohol, boiled with water, the cooled filtrate shaken several times with ether, and the ether residue distilled. Water and acetic acid come over first, and the thermometer thereafter rises rapidly to the constant boiling point of the particular acetyl compound. If it solidifies, separate the crystals and purify the crystals obtained by means of water and dilute alcohol or by redistillation.

Thus the product (if the simultaneously formed *c*-acetyl-*c*-methyl pyrroline be disregarded) is *c*-acetyl-*c*-methyl pyrroline boiling at 240° and melting $85^{\circ}-86^{\circ}$ theoretically as from $147^{\circ}-148^{\circ}$ *a*-methylpyrroline. The research was undertaken solely in hope of getting the same compound. For further identification this was boiled with benzaldehyde and very dilute caustic potash. The condensation succeeded very easily, and a yellow crystalline mass separated in a few minutes from the boiling liquid, the melting point being 193° , and when recrystallised from boiling alcohol this was

confirmed. It precipitated on cooling as sulphur-yellow firm needles. Analysis gave $C_{11}H_{13}NO$ *α*-methylpyrrylcinnamyl ketone, or—



On treating 142'-143 β -methylpyrroline as above, the chief product is an oil boiling at 230°-235°, solidifying in a freezing mixture but liquefying at 25°. By condensation with benzaldehyde the product crystallised in clear yellow plates melting at 156-157°, giving on analysis $C_{11}H_{13}NO$ as above.

Thus it will be seen that the dimethylindole produced (Ber. **21**, 3440) is manifestly not a pure product.—D. A. S.

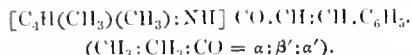
On *c*-Dimethylpyrrolines. M. Demstedt. Ber. 22, 1920—1924.

ALTHOUGH theoretically there should be four α -dimethylpyrrolines, only two have been known till now, namely the α - α' -dimethylpyrroline of Kuorr (Ber. **18**, 1158) and of Paul (Ber. **18**, 2254; this Journal, 1885, 739), and secondly, the α - β' -dimethylpyrroline of Kuorr (Ann. Chem. Pharm. **236**, 317).

Claunician and Weidel (Ber. **13**, 78; J. Chem. Soc. 1880, 403) isolated a *c*-dimethylpyrroline from Dippel's oil identical with the first of those mentioned above, the boiling points and reactions being the same.

The author (Ber. **21**, 3429) showed that from *n*-isopropylpyrroline both *c*-methylpyrrolines could be obtained. To confirm the view that the α and β (α' and β' hydrogen) in the respective pyrrolines is not replaced by an alkyl group, the following research was undertaken:—

From α - β -dimethylpyrroline the condensation product α - β' -dimethylpyrrolylcinnamyl ketone was obtained in yellow shining plates, giving on analysis $C_{13}H_{15}NO$. Its constitution is—



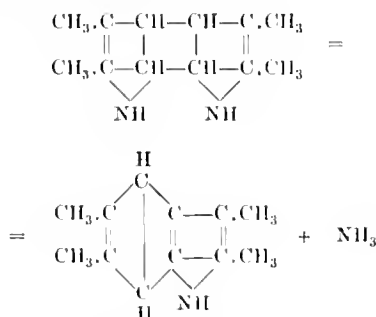
On passing dry hydrochloric acid gas into an ethereal solution of the α - β' -dimethylpyrroline obtained by Knorr's method, needle-shaped crystals were obtained and a brown liquid. The latter was solidified, the ether decanted, and the residue on solution in water gave yellow flocculent precipitates, with platinum chloride and picric acid, both of which were unstable. The salt is a double one of di- or trimethylpyrroline. This compound is also unstable if set free from hydrochloric acid solution by alkali. On distilling with steam it is partly reconverted to α - β' -methylpyrroline, and only near the close of the distillation it distils more slowly, giving yellowish crystalline plates, melting at 45° — 50° , soluble in hydrochloric acid and giving the above reactions. The greater part of the base remains behind in the flask as a dark yellow resinous mass, soluble in ether, but on evaporation of the ether, it is not volatile, and chars on heating. On exposure to air it deliquesces, and becomes in a few hours a dark-coloured resinous mass. Thus no indole compound can be obtained from the aqueous solution of the chloride. On allowing it to stand with dilute sulphuric acid, in two days the colour is dark red, and finally it becomes a brownish-black resinous mass. The acid liquid gives on distillation only traces of α - β' -dimethylpyrroline. Thus also no indole-like body occurs in the distilled product. The resinous mass shaken with ether gives a red amorphous substance on evaporation. This is soluble in dilute HCl. Indoles, of course, though soluble in concentrated HCl, are reprecipitated on adding water.

Dimethylpyrroline from Dippel's Oil.—The author and Zimmerman (Ber. 20, 857), by treating the dimethylpyrroline from Dippel's oil, boiling at 165°, with HCl gas in ethereal solution, obtained an indole. This salt was not completely soluble in water, but the solution, on standing with dilute sulphuric acid for a day, became a brownish-black resinous mass, while the insoluble part was unchanged. By distilling with steam, a clear yellow oil, with the characteristic odour, was obtained, and which distinctly gave all the essential indole reactions. The distillate, shaken with ether, dried with caustic alkali, distilled (on evaporation of the ether) at 283°, corresponded on analysis

to tetramethylindole, $C_{12}H_{15}N$. It dissolved in concentrated hydrochloric acid, and was reprecipitated with water. The picrate was obtained in lustrous garnet-red needles, melting at 100° . The dihydroquinoline was obtained as an oil giving the characteristic odour and reactions, becoming rosened on exposure to air, dissolving in dilute hydrochloric acid and being precipitated from concentrated hydrochloric acid by ferric chloride as the characteristic golden yellow double salt, and giving with mercuric chloride and picric acid yellow precipitates.

This conversion of the dimethylpyrroline, boiling at 165°, from Dippel's oil, renders it probable that both α - α' - and α - β' -dimethylpyrrolines are contained.

The formation of tetramethylindole from tetramethyldipyrroline is as follows :—



Showing α - β 3,4 tetramethylindole or Pr. 2,3 B. 3,4. tetramethylindole.—D. A. S.

On the c-Dimethylpyrrolines contained in Dippel's Oil.
M. Dennstedt, Ber. **22**, 1924—1929. (Compare Ber. **14**,
934; **20**, 1370; **13**, 78; **19**, 1408, 2195; J. Chem. Soc.
1880, 403; and this Journal, 1886, 236.)

In addition to the evidence evinced by the foregoing communication, the author has found another circumstance pointing to the presence of α - β -dimethylpyrroline in Dippel's oil.

On acting on pyrroline and its homologues with acetic anhydride, the acetyl group replaces easily the methine hydrogen; as a rule only two hydrogen atoms at most are replaced in this way. And Ciamician has by a series of careful and laborious experiments shown that only the carbon next the nitrogen enters with the acetyl group into the compound. On treating with acetic anhydride and sodium acetate in a sealed tube at 190°, taking up the product with warm water and distilling, an *n*-acetylpyrroline comes over. The residue in the flask is shaken with ether, and the ethereal residue distilled, the thermometer eventually rises to 250°, the entire mixture distilling at 250°—260°. The product, a yellow-coloured viscous oil, has no longer the *n*-acetylpyrroline smell, but rather that of *c*-acetylpyrroline. It cannot, however, be solidified in a freezing mixture.

The *silver salt*, $\text{AgC}_5\text{H}_{10}\text{NO}$, was prepared as a white crystalline precipitate, darkening on exposure to light.

The *Dimethylpyrryl-cinnamyl ketone*, $C_{15}H_{14}NO$, crystallises from boiling alcohol in yellow plates or needles, melting at 166° .

Thus the existence of α - β -dimethylpyrroline in animal oil is probably proved, which does not of course exclude α - α' -dimethylpyrroline and the 171° boiling α - β' - and the yet unknown β - β -dimethylpyrroline, which seem worth seeking for.

The author and Zimmerman (Ber. **19**, 200) collected the 170°—171° pyrroline fraction and the 155 fraction, from the latter of which they supposed β - β -dimethylpyrroline could be obtained. The following research disproved this.

The 154°–156° fraction was carefully obtained, but proved to be a mixture of 117°–148° α -methylpyrroline and of 165° dimethylpyrroline.

The *c*-acetyl- α -methylpyrroline melted at 85°–86°, the respective cinnamyl ketones at 193° and 166°.

The 171°—172° fraction gave on analysis figures equal to trimethylpyrroline, $C_7H_{11}N$.

The *cinnamyl ketone* crystallised in clear yellow plates, melting at 142° , analysis gave $C_{16}H_{17}NO$, trimethylpyrrol-cinnamyl ketone. The author admits the evidence of trimethylpyrroline in the 170° – 172° fraction is, however, not so clear as that of Ciamician and himself (Ber. **14**, 1001), when from the higher boiling point pyrrolines, the fractions 181° – 182° , 186° – 190° , and 190° – 193° gave a similar $C_7H_{11}N$, and further a *c*-isopropylcinnamyl ketone of the same melting point, 142° was obtained, isomeric with the above compound, but not identical.

Dr. Fock examined the respective crystals, and submitted a report showing the compound in question was in rhombic prisms, the angles measuring $74^{\circ} 52'$, while the angle of crystals of *c*-isopropylcinnamylpyrroline measured 70° , a marked difference of $4^{\circ} 52'$, and establishing the individuality of each ketone.

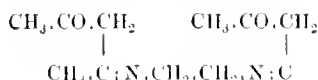
The author concludes with reference to the imperfect nature of the chain of evidence, owing to the impurity of the original substance.—D. A. S.

IV.—COLOURING MATTERS AND DYES.

On the Action of Diamines on Diacetones. A. Combes. Compt. Rend. **103**, 1252–1255.

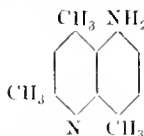
REFERRING to his previous investigations on the action of the fatty and aromatic diamines on diacetones, of the type of acetylacetone, and the conversion of these products into quinoline derivatives, the author continues his work on these bodies. The action of ethylene diamine, *m*-phenylene diamine, *m*-cresylene diamine, and benzidine on acetylacetone have been studied.

On mixing one molecule of ethylene diamine and two molecules of acetylacetone a strong reaction takes place, and the mixture becomes hot, with elimination of water and formation of a white crystalline mass which melts at 111° C. Distilled in vacuo it yields a body having the following formula:—

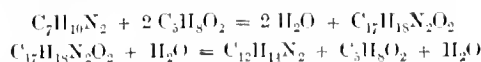


The hydrogen atoms of the radicle $\text{CO} - \text{CH}_2 - \text{C} = \text{N}$, which behaves as an acid, can be replaced by metals, for instance by copper, yielding the compound $C_{12}H_{13}N_2O_2Cu$. Mineral acids in an aqueous solution split up the compound into acetylacetone and ethylene diamine, but by the action of hydrochloric acid in alcoholic solution, a dihydrochloride may be obtained.

The action of *m*-cresylene diamine (m. p. 99°) on acetylacetone and the subsequent treatment with sulphuric acid did not yield phenanthroline as anticipated, but amido-trimethylquinoline, melting at 191° .



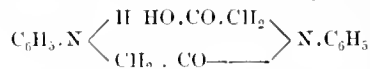
In this case only one molecule of acetylacetone acts upon one molecule of the diamine—



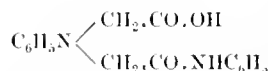
Platino and mercurio double chlorides and chromate of the quinoline base were prepared.

From the amido-quinolines a new class of colouring matters has been prepared.—O. J. S.

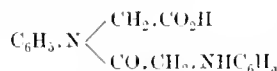
On Piperazines. C. A. Bischoff. Ber. **22**, 1774–1777. REBUFFAT describes an acid which, according to him, is—



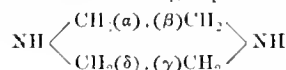
This formula, however, the author asserts belongs to a body obtained from piperazine. Abenius prepared another compound to which he ascribes the same constitution. Comparative studies have, however, shown that Rebuffat's acid is—



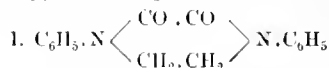
whilst Abenius's acid is—



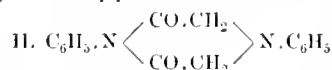
The author further proposes to represent the position of the carbon atoms in the following way:—



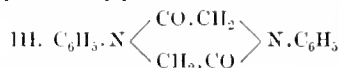
and to call a methylene-group, in which two hydrogens are replaced by oxygen, an *Ac*-group. For instance:—



Diphenyl- α - β -diacipiperazine



Diphenyl- α - δ -diacipiperazine

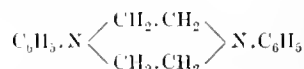


Diphenyl- α - γ -diacipiperazine

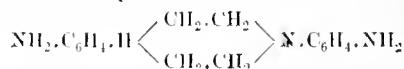
—A. L.

On Hydrated Piazines of the Aromatic Series. C. A. Bischoff. Ber. **22**, 1777–1783.

DIPHENYLPYPERAZINE was first obtained by Hofmann by the action of ethylenbromide on aniline. The yield is, however, very poor. The author improved the method by using equivalent molecules of ethylenbromide and aniline, and adding so much dry sodium carbonate or acetate as is necessary to fix the hydrobromic acid produced in this reaction. The yield was 80 per cent. The melting point of the pure base is 163.5° C. Its constitution is—



Nitrous acid forms a nitroso product, which on reduction yields a diamido compound—

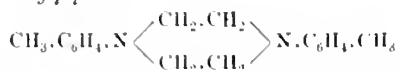


Diazo compounds combine with diphenylpiperazine and form colouring matters. The product formed by coupling diazo-benzene sulphonic acid with it is a yellow powder, dyeing wool and silk a pure yellow. The diazo compound of α -naphthylamine sulphonic acid is a tetrazo colour which dyes wool and silk a claret red.

If *p*-diamidodiphenylpiperazine be diazotised and conjugated with naphthylamine and naphthol-sulphonic acids, colouring matters are obtained which dye unmordanted cotton directly. The combination with naphtholdisulphonic acid (*R*-salt) forms a beautiful blue violet.

By the action of benzyltrichloride or diphenylpiperazine a green colouring matter similar to Malachite green was obtained.

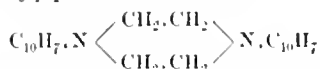
Diorthotolylpiperazine—



melts at 174° C., and crystallises in needles from alcohol.

Diparatolylpiperazine forms prisms from benzene, melting at 187°—188° C.

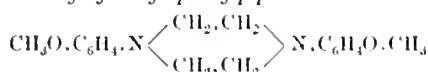
Di- α -naphthylpiperazine—



forms prisms from chloroform, melting at 265° C.

Di- β -naphthylaminepiperazine had not so far been sufficiently purified for analysis.

Diparamethylhydroxydiphenylpiperazine—

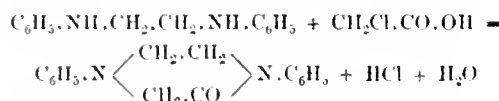


obtained from paranisidine and ethylenebromide, melting point 233° C.

Dipara-ethylhydroxydiphenylpiperazine melts at 218° C. —A. L.

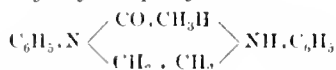
On Mono-acipiperazines. C. A. Bischoff and O. Nastvogel. Ber. 22, 1783—1786.

By the action of monochloroacetic acid on ethylenediphenyl diamine diphenylmono-acipiperazine was obtained—



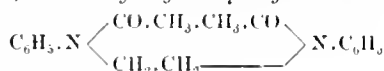
It was necessary to add as much sodium acetate as is required to neutralise the hydrochloric acid formed by the reaction in order to obtain a good result. The action takes place at 160°—170° C. The substance melts at 148° C., and is soluble in most solvents with the exception of water.

Mono-acetylthylenediphenyldiamine—



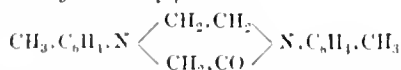
melting at 128° C., and *Diphenylpiperazine*, were obtained as by-products.

By the action of one molecule of acetic anhydride on ethylenediphenyldiamine at 120°—130° C., *Mono-acetylthylenediphenyldiamine* (m. pt. = 128°), *acetanilide*, *diphenylpiperazine*, and *diacetylthylenediphenyldiamine*—



melting at 158° C., were formed.

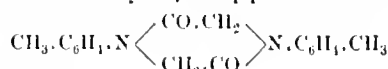
Diparatolylmono-acipiperazine—



melting at 168.5° C., was prepared like the analogous phenyl compound. —A. L.

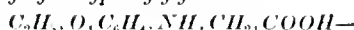
α - γ -Diacipiperazines. C. A. Bischoff and O. Nastvogel. Ber. 22, 1786—1792.

100 grms. of monochloroacetic acid, 120 grms. of sodium acetate in crystals, and 100 grms. of orthotoluidine were mixed, and heated on the water-bath until all was melted. Then 120 cc. of water were added and the mixture heated until the layer of oil ceased to increase, and a drop solidified on cooling. The tolylglycine, $\text{CH}_3 \cdot \text{C}_6\text{H}_4 \cdot \text{NH} \cdot \text{CH}_2 \cdot \text{COOH}$, melts at 149°—150° C. When heated in a retort to 140°—150° C. in a current of hydrogen until water ceases to be formed, no evolution of carbonic acid was perceptible. The temperature is then to be increased to 220° C. A light yellow mass is formed, which when mixed with ether is changed into a white powder. By dissolving it in chloroform and precipitating with alcohol the piperazine was obtained in a pure state. Orthoditolyl- α - γ -diacipiperazine—



melts at 160° C.

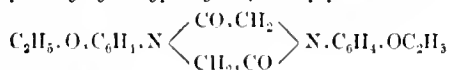
Para-ethylhydroxyphenylglycine—



is obtained from phenetidine hydrochloride and monochloroacetic acid in aqueous solution. It melts at 163° C. If heated rapidly it decomposes with much more considerable evolution of carbonic acid than if heated slowly. The following products are formed on heating this compound.

Paraethylhydroxymethylaniline, $\text{C}_2\text{H}_5 \cdot \text{O} \cdot \text{C}_6\text{H}_4 \cdot \text{NH} \cdot \text{CH}_3$.

Diparethyldiethoxyphenyl- α - γ -diacipiperazine—

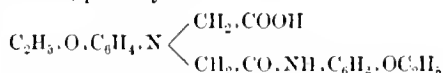


melting at 265° C.

Glycolyldi-ethylhydroxyanilide—



and an acid, probably—

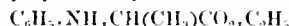


A method is given for the separation of these substances, for which the original must be consulted. —A. L.

Some Homologues of Diphenyl- α - γ -diacipiperazine.

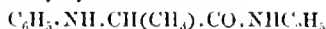
O. Nastvogel. Ber. 22, 1792—1795.

Alpha-anilidopropionic ethylether—



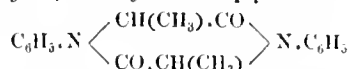
obtained by the action of alphas-bromopropionic ether on aniline. Its boiling point is 272° C.

Alpha-anilidopropionic anilide—



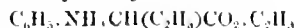
Melting point = 126° C.

Diphenyl- α - γ -dimethyl- β - δ -diacipiperazine—



melts at 180°—181° C., and was prepared by the action of acetic anhydride on alpha-anilidopropionic acid. A second isomeride, more easily soluble in ether, and melting at 147°—148° C., was obtained, the constitution of which has yet to be ascertained.

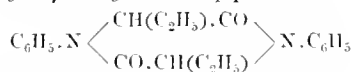
Alpha-anilidobutyric ethylether—



It boils at 278° C.

Alpha-anilidobutyric acid was prepared by saponifying the ether. It melts at 139°—140° C.

Diphenyl- α - γ -diethyl- β - δ -diacipiperazine—



was prepared like the analogous compound before described. It melts at 260° C.—A. L.

On Diphenyl- α - γ - and α - δ -diacipiperazine. A. Hausdörfer. Ber. 22, 1795—1804.

On heating 2 mols. of aniline with 1 mol. of chloracetic acid on a saltwater-bath, the following products were isolated:—

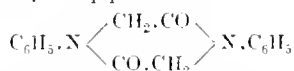
Phenylglycine.

Phenylimidodiacetic acid $\text{C}_6\text{H}_5\cdot\text{N}:(\text{CH}_2\cdot\text{CO}\cdot\text{OH})_2$. The latter melts and decomposes at 150°—155° C.

An acid, $\text{C}_6\text{H}_5\cdot\text{NH}\cdot\text{CH}_2\cdot\text{CO}\cdot\text{N}(\text{C}_6\text{H}_5)\cdot\text{CH}_2\cdot\text{COOH}$, melting at 211°—213° C.

Phenylglycine anilide, melting at 111·5° C.; and

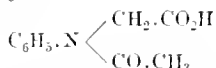
Diphenyl- α - γ -diacipiperazine—



melting at 263° C.

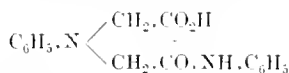
If equal quantities of aniline, chloracetic acid, and dehydrated sodium acetate be heated in the oil bath with inverted condenser at 110°—120° C. for half an hour, and for 3—4 hours at 140°—150° without the inverted condenser:—

Acetylphenylglycine—



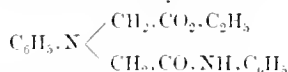
m.pt. = 192°—193° C., an acid $\text{C}_{16}\text{H}_{16}\text{N}_2\text{O}_3$ melting at 211°—213° C., and identical with the one above described; *Phenylglycine anilide*, m.p. 111·5° C.; and *Diphenyl- α - γ -diacipiperazine* are obtained.

If equal molecules of aniline and chloracetic acid be heated with ordinary sodium acetate *Phenylglycine* and *Phenyl-imido-diacetic acid* are obtained. By heating the latter gradually with the molecular proportion of aniline to 170°—180° C., *Phenyl-imido-diacetic acid mono-anilide* is formed:—



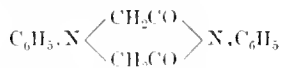
(m.pt. = 218° C.).

Molecular weights of phenylglycine anilide and chloracetic ether heated with dehydrated sodium acetate produce phenyl-imido-diacetic anilide ethylether—



melting at 121°—122° C.

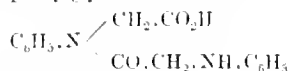
Diphenyl- α - δ -diacipiperazine—



was obtained from phenylglycine anilide, chloracetic ether, and sodium ethylate.

Needles, melting at 152°—153° C.

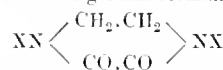
Some more derivatives: Bromoacetylphenylglycine and Phenylglycine phenylglycine—



are described.—A. L.

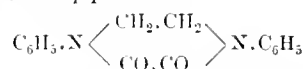
α - β -Diacipiperazines and some abnormal Reactions in the Formation of Piperazines. C. A. Bischoff and O. Nastvogel. Ber. 22, 1804—1808.

Diacipiperazines of the general formula—



were obtainable by the action of oxalic acid on the secondary bases $\text{XXH}\cdot\text{CH}_2\cdot\text{CH}_2\cdot\text{NH}\cdot\text{X}$. Thus:—

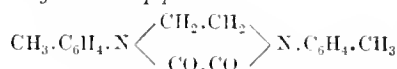
Diphenyl- α - β -diacipiperazine—



was obtained by the action of oxalic acid on ethylenediphenyldiamine at 200° C., and formed colourless plates melting at 258° C.

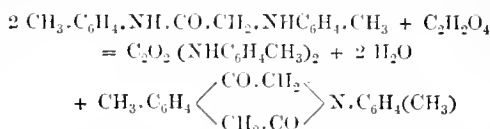
The homologous body—

Diorthotolyl- α - β -diacipiperazine—



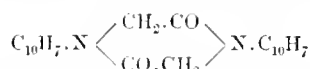
($\text{CH}_3:\text{N}$ in both nuclei = 1:2). It melts at 183·5°—184° C.

By the action of oxalic acid on paratolylglycine toluidide, diparatolyl-diacipiperazine was obtained amongst other products—

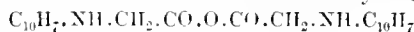


Oxalic acid acting on malonyldianilide produces more complicated substances. Malonic ethylether forms with ethylenediphenyldiamine diphenylpiperazine.

Monochloracetic acid combines with α -naphthylamine when mixed at the ordinary temperature, and forms an addition product melting at 90° C. When heated an amorphous body was obtained with the approximate formula—



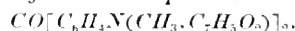
α -naphthylglycine, $\text{C}_{10}\text{H}_7\cdot\text{NH}\cdot\text{CH}_2\cdot\text{CO}_2\text{H}$, is formed by thoroughly mixing the base, monochloracetic acid, and sodium acetate and heating to 100° C. It crystallises from alcohol, and melts at 198°—199° C. When heated in an atmosphere of carbonic acid to 230° C. an anhydride—



is formed, melting at 268°—269° C.—A. L.

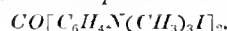
On some Derivatives and Reactions of Tetramethyldiamidobenzophenone. M. Nathansohn and P. Müller. Ber. 22, 1875—1901.

Dibenzoyldimethyldiamidobenzophenone—



Equal parts of tetramethylbenzophenone and benzoylchloride were heated in the oil-bath to 190° C. The colour of the mixture changed through blue and green into dark red. Methylchloride escaped abundantly as a gas. After three hours the reaction appeared to be finished. The red mass was powdered, the excess of benzoylchloride removed by washing with sodium carbonate solution, and the residue was crystallised from alcohol. Light-brown plates were obtained, melting at 102° C. Excess of benzoylchloride produced the same body. Attempts at saponification proved fruitless. The production of the corresponding acetyl-compounds by the action of acetylchloride was not successful.

Tetramethyldiamidobenzophenone methyl iodide—



The ketone was heated for four hours with an excess of methyl iodide and methyl alcohol. The product of the reaction when crystallised from alcohol yielded thin light yellow crystalline scales melting at 105° C., with difficulty soluble in cold alcohol and cold water, but easily dissolved by these solvents when hot. On heating this methyl iodide-compound to 150°, methyl iodide distils over and the original ketone remains.

Reduction of the Ketone by Sodium amalgam.—*Tetramethyldiamidodiphenylcarbinol* $[(CH_3)_2N.C_6H_4]_2CH.OH$.—This carbinol crystallises in colourless prisms from ether and benzene, and melts at 96° C. Soluble with a blue colour in hot alcohol and glacial acetic acid, to a colourless liquid in benzene and ether. The hydrochloride, the platinum double salt, and the pterate are described.

Tetramethyldiamidodiphenylcarbinol methyl iodide—
 $CH[C_6H_4N(CH_3)_2]_2OI$

crystallises from hot alcohol in colourless plates, melting at 195° C., and decomposing at 240° C., methyl iodide being evolved. It is little soluble in cold, but abundantly in hot alcohol and water. Its preparation is the same as that of the corresponding ketone compound.

Tetramethyldiamidodiphenylmethane—
 $CH_2[C_6H_4.N(CH_3)_2]_2$

was obtained by distilling the ketone with 10 times its weight of zinc dust in an atmosphere of hydrogen. The distillate melted after purification and crystallisation at 90° C.

Tetramethyldiamidotetrabromobenzophenone—
 $CO[C_6H_2Br_2N(CH_3)_2]_2$

was prepared by treating the glacial acetic acid solution of the ketone with bromine. It melts after purification at 172° C., and is easily soluble in hot alcohol, but with difficulty in benzene and ether.

Tetramethyldiamidonitrobenzophenone—
 $(CH_3)_2N.(NO_2)C_6H_3.CO.C_6H_4.N(CH_3)_2$

This compound was obtained by adding to a solution of the ketone in concentrated sulphuric acid the molecular proportion of sodium nitrate. After heating for a few hours on the water-bath the mixture was poured (after cooling) into water containing ammonia; a yellow precipitate was formed. This, after recrystallisation, melted at 144° C. The compound is easily soluble in hot alcohol and benzene, with difficulty in cold alcohol and benzene and in ether.

By reducing this compound with stannous chloride and hydrochloric acid—

Tetramethyldiamidobenzophenone—
 $CO \begin{cases} C_6H_3NH_2.N(CH_3)_2 \\ C_6H_4.N(CH_3)_2 \end{cases}$

was obtained, melting at 82° C., soluble in boiling alcohol and benzene. The pterate and platinum double salt were prepared.

Condensation products of Tetramethyldiamidodiphenylcarbinol—

$[(CH_3)_2N.C_6H_4]_2CH.C_6H_4.NH_2$

Tetramethyltriamidotriphenylmethane—

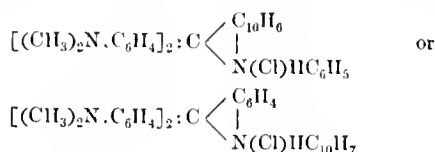
This base was prepared according to the method of the Badische Anilin und Soda Fabrik. Recrystallised after purification from alcohol, it forms small white needles melting at 65° C., soluble in alcohol, ether, and benzene. The hydrochloric acid salt, the platinum double salt, and pterate are described. Its benzoyl compound—

$[(CH_3)_2N.C_6H_4]_2CH.C_6H_4.NH(C_7H_5O)$

was prepared by heating it with benzoic anhydride at 150° C. It forms small plates, nearly colourless, melting at 128° C., soluble in hot alcohol and benzene, with difficulty soluble in

ether. The methyl iodide compound, $CH[C_6H_4.N(CH_3)_2]_2I$, was obtained in the usual way, and melts at 172° C. It is soluble in alcohol and hot water, but nearly insoluble in ether and benzene.

Victoria blue B. was prepared by mixing 10 parts of tetramethyldiamidobenzophenone, nine parts of α -phenyl-naphthylamine, and seven parts of phosphorus oxychloride. A reaction takes place, which is finished by gradually heating to 110° C., and keeping up this temperature for 15 minutes. The colouring matter was purified in the usual way, and finally crystallised from a mixture of benzene and alcohol. It is easily soluble in hot water and alcohol, with difficulty in benzene, and very little in ether. Its formula is probably either—



Caustic soda precipitates the free base as a black substance melting at 95° C., which could not be crystallised. Its formula is $[(CH_3)_2N.C_6H_4]_2C(OH).C_{10}H_6.NH.C_6H_5$. The platinum double salt and pterate were prepared in the usual way. On reducing the Victoria blue solution with zinc dust and hydrochloric acid, the *leuco compound* was obtained. On addition of excess of caustic soda a light blue flocculent precipitate, $[(CH_3)_2N.C_6H_4]_2CH.C_{10}H_6.NHC_6H_5$, is formed, melting at 125° C., which could not be crystallised. Its pterate and platinum double salt are described.

Victoria blue IV. R. is a condensation product of tetramethyldiamidobenzophenone with methylphenyl- α -naphthylamine. Its preparation is the same as that of the above-described compound. Its formula is $C_{34}H_{34}N_3Cl$. The free base was obtained by precipitation with sodium carbonate as a black substance which, after redissolving and precipitation, acquired finally a brick-red colour. It melted at 77° C. It is with difficulty soluble in benzene, easily in alcohol. The leuco-base was prepared in the same way as before described. It could not be crystallised, though soluble in alcohol and ether. It is sparingly soluble in benzene.

Victoria blue B. was treated for six hours with concentrated hydrochloric acid at 230°–250° C. On opening the tube a gas, methylchloride, escaped. The contents of the tube consisted of a dark-brown liquid and a black resinous substance. The liquid was diluted with water, and then caustic soda added. A light grey precipitate was formed, from which, by treatment with steam, dimethylaniline was separated. The solid residue was purified by repeated solution in cumene, and precipitation with petroleum spirit. Its formula is $C_{23}H_{18}N_2O$, and its constitution is expressed by either the formula $NH_2C_6H_4.CO.C_{10}H_6(NH)C_6H_5$ or $NH_2C_6H_4.CO.C_6H_4(NH)C_{10}H_7$. It melts at 92° C.

Victoria blue B. was further distilled by itself, with soda lime and with zinc dust in an atmosphere of hydrogen. In all cases dimethylaniline and a dark yellow oil boiling at 330°–335° C. were formed. The latter product is probably naphthylphenylamine. This compound is described as a white body melting at 60° C., and forming an acetyl compound melting at 114°–115° C. The authors succeeded in preparing the same acetyl derivative from the substance they obtained, which must, therefore, be considered as identical with phenyl- α -naphthylamine.—A. L.

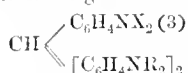
Syntheses in the Oxazine Series. L. Knorr.

See also under XX., page 1004.

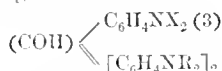
PATENTS.

Improvements in the Production of Green and Bluish-Green Colouring Matters. O. Imray, London. From the "Farbwerke vormals Meister, Lucius, and Brüning," Höchst, Germany. Eng. Pat. 14,822, October 15, 1888. 8d.

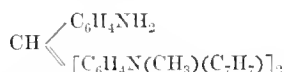
This is an extension of the Eng. Pat. 12,796 of 1888 (this Journal, 1889, 701), and describes the sulphonation of *m*-amido-leuco bases of the general formula—



and their subsequent oxidation into colouring matters. The same colouring matters are obtained by sulphonating the corresponding carbinols—



The following examples are given of the two methods. 30 kilos. of *m*-amidotetra-ethylamidotriphenyl methane are dissolved in 150 kilos. of sulphuric acid containing 20 per cent. of SO_3 . The temperature of the melt is raised to 90° – 100° until a sample dissolves to a clear solution in a 3 per cent. solution of ammonia. The whole is then converted into the calcium or sodium salt. In the case of compounds like *m*-amido-dibenzylidimethyldiamidotriphenyl methane (*i.e.*, with benzyl or phenyl, &c. in the amido group)—



the sulphonation is performed at 60° , and continued until a sample dissolves easily in water and gives a violet solution with dilute ammonia. The oxidation is effected by means of the peroxides of manganese, lead or barium, together with a mineral acid. The colouring matters obtained are copper-red powders with a metallic lustre, easily soluble in water. Excess of a mineral acid turns the solution green. Cold caustic soda or boiling dilute ammonia, or soda, does not destroy the colour, and the blue solution only turns violet on boiling with caustic soda. Wool and silk are dyed in an acid-bath a bluish-green shade, and the shades are very fast. The carbinols are sulphonated as follows, and then yield the same dyestuffs. 20 kilos. of *m*-amido-tetra-ethylamidotriphenyl carbinol are dissolved in 100 kilos. of monohydrate and heated to 70° – 80° , until soluble in ammonia with a pure blue colour. The melt is then converted into the calcium or sodium salt.—T. A. L.

The Manufacture or Production of a New Sulphone or Diethyl Sulphone Methyl Ethyl Methane. B. Willcox, London. From the "Farbenfabriken vormals Friedrich Bayer and Co.," Elberfeld, Germany. Eng. Pat. 16,333, November 10, 1888. 6d.

The three following methods are given for the production of the new sulphone which is a substance melting at 76° , crystallising from water in shining laminae. It is slightly soluble in cold water, but more readily in hot water, alcohol, ether or benzene. It is odourless and has a slightly bitter taste.

1. Methyl ethyl ketone is added to the calculated quantity of ethyl mercaptan and dry hydrochloric acid gas passed through the mixture. After standing some hours it is poured into water, the oil which separates dried over calcium chloride and rectified. It boils without decomposition at 198° – 203° , and is converted into the sulphone by oxidation with permanganate mixed with a small quantity of acid. When the permanganate is decolourised the solution is boiled down and filtered, when the sulphone crystallises out on cooling.

2. Dry hydrochloric acid gas is passed through a mixture in molecular proportions of acetaldehyde and ethylsulphhydrate. The condensation product boils at 186° – 188° , and is converted by oxidation into diethylsulphone methyl

methane. This crystallises in shining prisms melting at 75.5° , and is readily soluble in water and other solvents. Seven parts of the product are dissolved in 20 parts of water, 2.5 parts of solid caustic soda and 5 parts of ethyl iodide are then added, and the whole boiled for an hour with an inverted condenser. On cooling the solution, diethylsulphone methyl ethyl methane separates out.

3. Propionic aldehyde in equivalent quantity may be employed in place of the acetic aldehyde mentioned in (2). The condensation product is an unpleasantly smelling oil boiling at 190° – 200° . The diethylsulphone ethyl methane therefrom melts at 77° , and is converted into diethylsulphone ethylmethyl methane as described above, methyl iodide being used in place of the ethyl iodide there mentioned. (This Journal, 1889, 610.)—T. A. L.

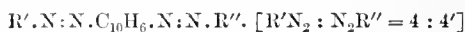
A New Manufacture of Dyestuffs. C. D. Abel, London. From the "Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 17,333, November 28, 1888. 6d.

By heating two molecules of *m*-xylydine or ψ -cumidine with two molecules of sulphur, sulphuretted hydrogen is given off and bases containing sulphur are obtained which can be diazotised and combined to form dyestuffs with phenol and its homologues, resorcinol, resorcinol ethers, orcinol, naphthol, dihydroxy-naphthalene, phenylene diamine, toluylene diamine, chrysoidines, Bismarck Brown, naphthylamine and its alkyl derivatives and their sulphonic or carboxylic acids. As some of these combinations are scarcely soluble in water the patent describes the sulphonation of the sulphur bases and subsequent diazotisation and combination with amines or phenols. The quantities given for the preparation of the sulphur bases are: 40 kilos. of *m*-xylydine are heated with 10 kilos. of sulphur so long as sulphuretted hydrogen is given off. The melt is allowed to cool slightly and is then poured into sulphuric acid diluted with an equal bulk of water. The sulphate of the new base separates in yellow flakes. 20 kilos. of this are dissolved in 125 kilos. of hydrochloric acid of 12° B. and poured into 1,000 litres of water. 14 kilos. of sodium nitrite in 50 litres of water are then added and the whole poured into an alkaline solution of α -naphthol disulphonic acid. The solution is then boiled and the dyestuff precipitated by means of salt. The colouring matter dyes unmordanted cotton a red shade.

These dyestuffs are higher homologues of the primuline series (A. G. Green, this Journal, 1889, 383). (See also P. Jacobson, Ber. 22, 330–335; L. Gattermann, this Journal, 1889, 275 and 608; W. Pfützing and L. Gattermann, this Journal, 1889, 608; R. Anschütz and G. Schultz, Ber. 22, 580–586.)—T. A. L.

Manufacture of Bluish-Black Colouring Matters. S. Pitt, Sutton. From L. Casella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 18,425, December 17, 1888. 6d.

According to Eng. Pat. 9214 of 1885 (this Journal, 1886, 427), the patentees have a process for preparing azo dyestuffs of the formula—



The present invention describes the substitution of other naphthol and naphthylamine mono- and disulphonic acids and also of dihydroxynaphthalenes and their sulphonic acids for the naphthylamine and naphthol sulphonic acids known at the time of the patent 9214. (1.) In place of the naphthylamine sulphonic acids previously used the following are employed: β -naphthylamine sulphonic acid F, Eng. Pat. 12,908 of 1886 (this Journal, 1887, 725), β -naphthol- δ -sulphonic acid, Eng. Pat. 8265 of 1887 (this Journal, 1888, 431), or the amido acids obtained by heating with ammonia the naphthol disulphonic acid of Ger. Pat. 38,281 or the α -naphthylamine- δ -sulphonic acid of Ger. Pats. 40,571 and 45,776. (2.) For the naphthol sulphonic acid it is proposed to use instead naphthol sulphonic acid F, Eng. Pat. 12,908, naphthol mono- and disulphonic acids S, Ger.

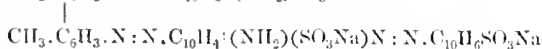
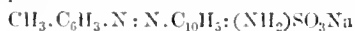
Pat. 40,571, naphthol sulphonic acid, Ger. Pat. 38,281, or 6-naphthol-5-disulphonic acid, Eng. Pat. 8265. (3.) The naphthols can also be replaced by dihydroxynaphthalenes and their sulphonic acids (Griess, Ber. **13**, 1959). Ger. Pats. 41,931, 40,893, and 12,261. The tetrazo derivatives mentioned in Eng. Pat. 9214 can also be combined with amines alone and give dyestuffs.—T. A. L.

Production of a New Violet Dye or Colouring Matter. T. R. Shillito, London. From J. R. Geigy and Co., Basel, Switzerland. Eng. Pat. 2941, February 19, 1889. 4d.

TWENTY kilos. of gallamide and 30 kilos. of nitroso-dimethylaniline hydrochloride are heated in a solution of acetic acid. The colouring matter separates in small greenish crystals. It dissolves in water and alkalis with a violet, and in acids with a red colour. For printing purposes it is converted into the sodium bisulphite compound and in dyeing as well as in printing requires a chromium or other mordant.—T. A. L.

Improvements in the Manufacture of Mixed Azo Colours. H. H. Leigh, London. From R. G. Williams, Albany, U.S.A. Eng. Pat. 12,767, August 13, 1889. 6d.

WHEN one molecule of a tetrazo-compound is combined with one molecule of a naphthylamine or its sulphonic acid, an insoluble intermediate compound is obtained. A new class of these intermediate bodies is obtained by combining one molecule of a naphthalene-azo-naphthylamine or sulphonic acids of the same with one molecule of a tetrazo-compound, and reacting on them with another molecule of an amine or a phenol. 25 lb. of sodium naphthienate are dissolved in 50 galls. of water, and 30 lb. of hydrochloric acid of 22° B. are added. The mixture is cooled with ice and diazotised with 7 lb. of sodium nitrite in 35 lb. of water. 25 lb. of sodium naphthionate and 15 lb. of sodium acetate in 20 galls. of water are then added, and the reaction is complete when the whole forms a clear bright scarlet solution. This product is allowed to react on tetrazo-ditolyl (from 32 lb. of tolidine sulphate and 14 lb. of sodium nitrite) in presence of sodium acetate. When combined 25 lb. of sodium naphthionate in 60 galls. of water are added. The colour is formed very slowly and the reaction is complete when the dye tests show no improvement. The whole is then boiled, sufficient caustic soda added to convert the dyestuff into its sodium salt, precipitated with salt, filter-pressed, and dried. It dyes unmordanted cotton a bright red in an alkaline or soap bath, producing shades similar to Benzopurpurin 4B. The formula of the compound is—



The several constituents can be varied according to well-known methods.—T. A. L.

Improvements in the Manufacture of Indigo by the Application of Electricity. F. Hughes, London. From E. J. McDonald, Champaran, Bengal. Eng. Pat. 13,636, August 29, 1889. 8d.

A PROCESS for passing an electrical current through an indigo vat during the beating process, by which it is claimed that the yield and colour of the indigo are increased to an appreciable extent. The specification contains a drawing of the vat.—T. A. L.

Manufacture of New Derivatives of Tannin and Catechin and of Colouring Matters obtained therefrom. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran, Bâle, Switzerland. Eng. Pat. 15,360, September 30, 1889. 4d.

By reacting with the nitroso derivatives of the tertiary aromatic amines on tannins, catechol ("catechin") and gallic acid, colouring matters have been obtained to which

the name *Gallocyanines* was given. Their preparation is described in the specification No. 4899, 1881. The present invention describes the preparation of new gallocyanines by reacting with the nitroso derivatives of tertiary aromatic amines on the products obtained by condensing tannin and "catechin" with primary aromatic amines. The preparation of "gallonaphthylamide" is described. One part of tannin is dissolved in three parts of fused naphthylamine and the melt gradually raised to 150°–180°. A slight ebullition indicates the end of the reaction. The mass is then allowed to cool, and whilst still hot is run into petroleum spirit or other solvent when the gallonaphthylamide remains undissolved. Colouring matters are obtained herefrom by the action of nitrosodimethylaniline hydrochloride as mentioned above. The products are scarcely soluble in ordinary solvents, and have to be employed as bisulphite compounds, when they dye mordanted fibres violet shades.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

PATENTS.

An Improved Process and Composition for Extracting Oil from and Cleaning Cotton-Waste. W. Mitchell and S. Picard, London. Eng. Pat. 17,628, December 3, 1888. 6d.

See under XII., page 991.

Improvements in Washing Wool and in Treating and Utilising the Washings. H. W. Langbeck, Loughton. Eng. Pat. 66, January 2, 1889. 6d.

See under XII., page 991.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

The Dyeing of Cotton-Valvet. E. Lindinger, Wollen und Leinen-Industrie, 1889, 9, 721.

THE goods are first singed and then boiled with a 0.5 or 1 per cent. solution of soda; after rinsing they are ready for dyeing.

White.—The goods are further treated in the jigger with bleaching solution, soured and washed.

Pure White is obtained by bleaching as above, and afterwards passing the goods through a weak soap-bath containing a little Methyl violet or a red shade of Soluble blue.

Pale Grey is dyed in several ways. Böhm's silver-grey paste is applied with alum and acetic acid. A more usual plan consists in mordanting with gall-nuts or tannic acid, fixing with copperas and dyeing with Methylene blue and a little alum. With stronger baths sumae- or logwood-extract is also added, *Medium* and *Dark Greys* being obtained. Dark shades of grey are also obtained by grounding the cloth with Caehon de Laval, rinsing, dyeing with Benzoazurin and passing through a bath of copper sulphate.

Pink.—Fine shades are produced with Rhodamine and alum on cotton mordanted with tannic acid and an antimony salt. Safranin in an alum bath, and Rose bengale or Ploxine in a borax bath, also give nice shades. A fast pink is dyed with K. Ochler's Fast pink G.

Bright Red is dyed with Brilliant congo in a potash-soap bath. A very fiery shade is obtained with Crocein scarlet in an alum bath, but the dye is not fixed. Magenta dyed on the tannic acid mordant yields a bluer shade of red.

Bordeaux.—The cloth is dyed with Benzopurpurin, Brilliant congo, or Diamine red, and, for a full red tone, topped with Safranin or Magenta, or with Diamine blue, Violet black or Benzoazurin for a darker shade. Scarcely so fast are the shades obtained by dyeing with Magenta and Bismarek brown or Chrysoidine on cotton mordanted with tannic acid and antimony, and saddening with Neutral blue, logwood, or Methyl violet.

Dark Bordeaux is obtained by grounding either with Cachou de Laval, catechu and bichrome, sumae and iron or logwood, and an alumina or tin mordant, rinsing, and dyeing either with Brilliant congo and Diamine blue, followed by a topping with Magenta, or with Magenta, Bismarek brown, Neutral blue or logwood, after mordanting with tannic acid, if some form of that body has not been already applied. Of these dyestuffs, those of the substantive class alone yield shades fast to rubbing.

Buff is dyed with Brahma orange or with Chrysamine R. in a soda-soap bath.

Orange is obtained with Brahma orange, Toluylene orange, or Mikado orange in an alkaline bath.

Pale Brown.—A ground colour is dyed with Cachou de Laval or Catechu, the cloth being further dyed with a mixture of brown and blue dyestuffs of the substantive class, such as Cotton brown A and Benzoazurin 3 G. The shade is considerably brightened by subsequently dyeing with Bismarek brown or Auramine. **Dark Browns** are obtained in a similar manner on a darker ground. The darker the shade the greater the necessity for topping with Bismarek brown.

Yellow.—A delicate shade is obtained with Auramine in an alum bath. Chrysamine in a sodium phosphate bath yields a *Chrome Yellow*.

Olive.—The cloth is grounded with sumae and bark, fixed with copperas and alum, and dyed with Auramine, Bismarek brown and Methylene blue or a basic green.

Green is dyed (in an alum bath) with a basic green dyestuff on cotton mordanted with tannic acid, shading being effected with Methylene blue or Auramine.

Dark Greens are dyed in the same way as the light greens after bottoming the cloth with sumac and bark, fixed with copperas and alum.

Pale Blue is dyed with Methylene blue in an alum bath.

Darker Blues are obtained with Victoria blue or a mixture of Methylene blue and violet on cloth mordanted with tannic acid or previously dyed in an alkaline bath with Benzoazurin G.

Navy Blue is produced by dyeing with Benzo-black-blue or Violet black in an alkaline bath, and topping with Methylene blue or violet.

Mauve.—A pure Methyl violet such as Poirrier's mauve 250 N should be used. The finest shade is obtained by preparing with oleine (in the proportion of 1 to 20) or resin-soap, drying, fixing with alum and then dyeing. Gall-nuts or tannic acid can be used to mordant only for darker shades. Dark shades are dyed on a tannin-antimony mordant, brighter ones on a tannin-tin mordant saddened with logwood or Neutral violet.

Prune is obtained by bottoming with Cachou de Laval, then mordanting with tannic acid or sumae, fixing with an antimony salt, and dyeing with a basic violet. A very fast prune is dyed with Violet on cloth previously dyed with Violet black.

All the dyeing operations are conducted in the dye-jigger. —E. B.

A New Chrome Mordant Process. G. Saget. Monit. Scient. 1889, 983.

HITHERTO chromic acid has been reduced on the woven fabric by Koechlin's hyposulphite of soda process. The author finds that the reduction can also be effected by hydrosulphurous acid.

Cloth treated with potassium bichromate and dipped into calcic hydrosulphite becomes at once green, and the chromic oxide then attracts the colouring matter.

On the large scale the goods are padded with a mixture of 100 grms. of sodium bichromate, 900 grms. of water, and 100 cc. of a 10 per cent. solution of tragacanth, dried in the dark, and then passed for a minute through a calcium hydrosulphite bath at 40° C. The bath is prepared by adding to 80 litres of water and 6 kilos. of caustic lime a solution of zinc hydrosulphite which has been obtained by the action of 4 kilos. of zinc dust on 40 litres of sodium bisulphite of 30°. The hydrosulphite acts slowly in the cold, but immediately at 40° C.—W. M.

PATENTS.

Improvements in Apparatus for Printing Textile and other Fabrics. J. and A. S. Young, Ramsbottom. Eng. Pat. 18,263, December 14, 1888. 6d.

This invention relates to the construction of a "duplex" printing machine. The cloth to be printed passes downwards between two "transfer" rollers covered with india-rubber or an elastic composition. The pairs of engraved copper rollers are mounted in the same plane and at opposite sides of the "transfer" rollers. These "transfer" rollers receive the colour from the engraved rollers, and deliver it to the cloth as it comes into contact with them. Suitable arrangement is made for washing the transfer rollers after they have given their impression so that they are caused to present a clean surface to the engraved rollers after each revolution. Any convenient number of colours may be printed.—E. B.

An Improved Process of, and Apparatus for Dyeing Cotton-Yarn. H. Recker, Zittau, Germany. Eng. Pat. 18,780, December 22, 1888. 8d.

This is a continuous process for dyeing cotton warps aniline black, and finishing the same.

The warps are passed through a tank of boiling water, squeezed by a pair of rollers, and passed through a bath of aniline hydrochloride till thoroughly saturated, then they are again squeezed and dipped into a solution of potassium chromate. They next pass in a zig-zag fashion over a system of rollers contained in a tower of an inverted U shape, in which they are oxidised for about 45 seconds by hot air, which enters at the bottom, and leaves the top of the tower through a discharge pipe. After the black has been oxidised in this manner, the yarn is washed, dressed, dried and beamed, the whole of the operations being conducted continuously as is shown in the drawing which accompanies the specification.—E. B.

Improvements in and connected with Vats or Apparatus for Dyeing, Washing, Bleaching, Scouring, or Mordanting Fibrous Materials. F. A. Blair, Galashiels. Eng. Pat. 2743, February 16, 1889. 8d.

At a little distance above the bottom of the vat there is placed horizontally a partition which is raised in the middle in the form of a cone. At the upper part of the cone there is fixed a vertical pipe into which is fitted an upper telescopic pipe, closed at the top, but with perforations at or near the same. The horizontal partition is also perforated. Two steam-pipes are placed beneath the horizontal partition and cone. One of the steam-pipes is perforated, the other terminates in a jet-nozzle directed up the central vertical pipe. The fibrous material to be operated upon is placed in the vessel around the central pipe, or it may be placed, instead, in a cage of which the partition cone and the central pipe form part and which can be lowered into or raised out of the vat.

The central steam-jet, when used alone, causes the liquid in the vessel to pass up the central pipe and become sprayed out at the top, whence it percolates down through the fibrous materials. The other steam-pipe is used for heating purposes and may be replaced by a steam-jacket or an external fire. Drawings of different modifications are attached to the specification.—E. B.

VII.—ACIDS, ALKALIS, AND SALTS.

New Method of Preparing Nitrites of the Alkalis. G. A. Le Roy. *Compt. Rend.* **108**, 1251—1252.

THIS method is based on the reaction which ensues when barium sulphide is heated with an alkaline nitrate, barium sulphate and the nitrite of the alkali being formed, according to the following equation:—



The finely powdered barium sulphide is carefully mixed with the nitrate and heated to redness in an iron dish, stirring the mixture well. As the reaction takes place rapidly, it is well to add some barium sulphate in order to avoid too much decomposition. The melt is treated with water and the nitrite separated by filtration.—O. J. S.

PATENTS.

Improvements in the Manufacture of Chlorine. T. Parker and A. E. Robinson, Wolverhampton. *Eng. Pat.* 17,367, November 29, 1888. *4d.*

Tetrachlorides of iron and zinc obtained in the galvanising and pickling of iron are electrolysed, the chlorine evolved being collected and utilised in any known way. The electrodes may be of carbon or platinum, or the negative electrode may be of the metal forming the base of the salt electrolysed. The chloride solution, which may contain from 10 to 50 per cent. of chloride, is, if acid, first neutralised, preferably by an alkali.—S. G. R.

Improvements in Generating Carbonic Acid Gas. F. Foster, Hoxton. *Eng. Pat.* 17,569, December 1, 1888. *8d.*

THE generating vessel is made in two portions, an upper and a lower, which are in communication by means of a pipe closed by a valve. Passing through both parts is a stirrer. In the upper vessel is placed the mixture of whitening and water or other material from which the carbon dioxide is to be evolved. After thorough mixing this is run into the lower vessel, where there is an inlet syphon pipe for the acid and an exit tube for the carbon dioxide. The gas is washed and passed into a gas-holder, and in order that the spent liquors may be run out of the lower portion of the generator without the introduction of air, a branch pipe connects this with the gas-holder, so that carbon dioxide may be passed back again in the required quantity. (This *Journal*, 1888, 749.)—S. G. R.

Improvements in the Manufacture of Phosphorus. T. Parker and A. E. Robinson. Wolverhampton. *Eng. Pat.* 17,719, December 5, 1888. *4d.*

THE inventors take meta- and ortho-phosphoric acids or their salts and mix these with rather more than the theoretical quantity of carbonaceous matter, such as crushed coke. The mass is placed in an electric furnace and the resulting vapours of phosphorus condensed in water or in some other of the ordinary ways.—S. G. R.

Improvements in obtaining Chlorine. A. Campbell, London, and W. Boyd, Glasgow. *Eng. Pat.* 18,956, December 11, 1888. *4d.*

INSTEAD of passing hydrochloric acid into water or water containing manganese peroxide in suspension, it is passed into a solution of manganese sulphate, to which peroxide of manganese has been added. "The quantity of peroxide taken is sufficient, not only to cause the evolution of about one-third of the chlorine, as in the ordinary process, but also, with the aid of sulphuric acid which is added at this stage, to cause the evolution of a further large proportion of chlorine." The solutions which contain gradually increasing amounts of the sulphate, owing to frequent

additions of peroxide, are concentrated, and the separating manganese sulphate fished out. This is dissolved in water and treated with ammonium carbonate, the resulting carbonate of manganese being converted into peroxide by known methods.—S. G. R.

Improvements in the Concentration of Sulphuric Acid, and in the Apparatus employed therefor. G. Veitch, Crieff. *Eng. Pat.* 7901, May 11, 1889. *8d.*

THE glass retorts used are flat-bottomed, and made either of Bohemian or best English glass. They are arranged one above another on a stepped terrace placed within a fire flue and so connected by means of suitable tubes that the acid, which is fed in at the upper end in a constant stream, travels through the whole series and passes out, highly concentrated, from the lowest. The flue is tapered, the fires being placed at the lowest and widest end, and narrowing upwards. All the retorts can be easily seen and hence a breakage can be at once remedied. The necks of the retorts pass into a flue and are kept covered by asbestos millboard to shield them from draughts. The specification is illustrated by drawings.—S. G. R.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

New Recipes for Sèvres Porcelain. H. Hauhart, Sprechsaal, **22**, 368.

THE new porcelain at Sèvres is made of a body and glaze similar to those discovered by Salvétat at Sèvres in 1855. The porcelain contains:—

	Parts by Weight.
Silica	64—71
Al ₂ O ₃	29—23
KNaCO ₃	7—6

Salvétat's figures were almost the same:—

	China Porcelain.	Sèvres.	Sèvres.
	Parts by Weight.	Parts by Weight.	Parts by Weight.
SiO ₂	69	70	67
Al ₂ O ₃	23	26	26
K ₂ O	3	4.5	3
Na ₂ CO ₃	3	..	..

Salvétat made use of a glaze containing a high percentage of lime to increase its durability, whereas Lauth (the recent director at Sèvres) prefers the same amount of lime as is found in Chinese glazes:—

	Chinese Glaze.	Lauth's Glaze.	Salvétat's Glaze.
SiO ₂	68	66.5	51.5
Al ₂ O ₃	12	14	10
CaO	14	15.5	32
KNaO	6	3.6	5

The new porcelain, compared with the hard porcelains produced by the author, admits of more extensive decoration by means of coloured high temperature glazes.—E. E. B.

Defective Tin Glazes. Sprechsaal, 22, 370.

WHEN the white enamel cracks on drying and does not become smooth when re-baked, the contraction on drying must be diminished by fritting the materials strongly and melting them. If the enamel do not melt sufficiently easily it must be mixed with more lead oxide.—E. E. B.

Porcelain Pastes and Glazes for Table Services. Sprechsaal, 22, 477.

PASTES.

A.	Parts by Weight.
Kaolin from Zettlitz	45
Felspar	15
Quartz	35
Marble	5
	100

B.

Kaolin from Zettlitz	49
Felspar	25
Sand from Tiefenfurt, Silesia	35
	100

GLAZES.

A.—Soft.

Felspar	30
Sand	32
Calspar	6
Broken pottery, biscuit ("Glückscherben") ..	29
Kaolin from Zettlitz	10
	100

B.—Hard.

Felspar	3
Chalk	25
Quartz	25
Broken pottery, glazed ("Glattscherben") ..	25
" " biscuit ("Glückscherben") ..	20
Kaolin from Zettlitz	2
	100

—E. E. B.

Alumina Lustres. Sprechsaal, 22, 577.

If vitrifiable colours be mixed with lustres the colours of the surface glaze acquire a very characteristic enamel-like appearance. They can be applied in a thick pasty condition, but are fired in the usual manner.

For this purpose alumina lustres is specially suited as, like lead, zinc and bismuth lustres, it is colourless and iridescent and allows the colour on the under surface to be visible through it. The alumina lustre is prepared by adding a solution of resin soap to a warm solution of alum. The alumina resinate thus produced is dried on a porous plate, and this, dissolved in oil of turpentine, constitutes the lustre.

—E. E. B.

Refractory Clays from Mähren. Hecht. Centralbl. f. Glasindustr. u. Keramik, 4, 212.

THE following samples of clays and argillaceous slates were obtained from Briesen in Mähren and were found to be abnormally refractory. They consisted of 99.7 to 93.7 per cent. of hydrated silicate of alumina, $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$; 0 to 2.8 per cent. of quartz, and 0.3 to 3.5 per cent. of felspar. They were markedly basic in character and their compositions were:—

—	a.	b.	c.	d.	e.
SiO_2	45.61	44.87	43.48	46.13	73.42
TiO_2 .....	..	..	..	0.16	..
Al_2O_3	59.31	59.76	59.43	36.24	19.60
Fe_2O_3	1.13	1.14	1.61	1.26	0.55
CaO	0.37	0.76	0.22	0.60	..
MgO	Trace	Trace	Trace	0.12	Trace
K_2O	0.06	0.67	0.34	0.85	0.21
Loss on ignition...	13.25	12.95	15.26	14.68	6.66
	100.33	100.15	100.34	100.04	100.44

Fire-resisting capacity (corresponding with Seger's cones):—

	Nearly 35	Nearly 35	Nearly 35	34	33–34
--	-----------	-----------	-----------	----	-------

a. and b. were sampler of clay, c. and d. argillaceous slates, and e. millstone-grit.—E. E. B.

Preparation of Lustrous Metallic Surfaces on Glass and Glazed Ceramic Ware. S. Reich and Co. Deutsche Töpfer- u. Ziegler-Zeit. 20, 330.

AN aqueous solution of silver nitrate is mixed with a paste which when heated in a muffle at a low temperature will not fuse to the glass or porcelain, but can be readily detached from it. Suitable pastes may be made from chalk, earth, lamp-black, sulphur, madder lake, manganese dioxide, and oxide of iron. During the heating in the muffle the silver passes from the paste to the surface of the glass or porcelain, the paste is then carefully removed and the article heated gently for a few minutes in a reducing atmosphere, preferably in carbonic oxide. An adherent lustrous metallic coating is produced which in transmitted light appears light yellow to dark green white, while the lustre varies in appearance from that of silver to greenish gold. Three parts of paste are used for one part of silver nitrate. Chloride or sulphide of silver may also be used, the former imparting a greenish and the latter a yellow colour like the nitrate.—E. E. B.

Application of Colours under Glazes. Thonwaaren Ind. 1889, 3, 155.

FOR specially valuable designs and painting, colours under glazes should be applied mixed with oil. This involves, however, a special treatment of the article to enable the painted parts to take the glaze subsequently. For ordinary ware the colour can be applied mixed with a little gum tragacanth, gum arabic, or even glycerol, so that the colour may adhere to the body of the article sufficiently firm to avoid being washed away when the glaze is applied.

—E. E. B.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Efflorescence of Salts from Clay. Thonind.-Zeit. 13, 422.

THE mould-like crust which is often found on red bricks after they are burnt is produced in the process of drying and is due to the efflorescence of sulphate of lime or sulphate of magnesia. The efflorescence in the form of wart-shaped crystals can only be noticed on the unburnt bricks by means of a lens, and consequently usually escape detection at this stage.

Even in continuous kilns in which the fuel gases are more completely cooled than in the other systems the efflorescence takes place. The steam, sulphurous acid, sulphuric acid, and ammonium sulphate—when coal is used as fuel—play upon the surface of the bricks and form compounds which creep to the surface. The defect can only be remedied by carefully maintaining the temperature of each freshly charged chamber at 40° – 60° C.—E. E. B.

X.—METALLURGY.

Progress of Metallurgical Science in the West. R. Pearce. Eng. and Min. J. 48, 268–269.

THE author describes the process of copper smelting as carried out at the Argo works, and mentions that in former years, before care was taken in the assortment of ores, it frequently happened that the first matte contained a large quantity of lead in place of iron. An analysis of such a matte is as follows:—

	Per Cent.
Copper	32.03
Lead	26.60
Iron	9.50
Zinc	4.29
Silver	1.92
Gold	0.05
Sulphur	21.70
Insoluble residue, &c.	3.58
	<u>99.67</u>

Two analyses are given, showing the difference in composition of the upper and lower portions of a large tap of about seven tons of this matte. The former was of a very close texture, while the latter was crystalline and vesicular, the section of the mass being about 12 in.

	Upper Portion.	Lower Portion.
	Per Cent.	Per Cent.
Copper	38.6	31.0
Lead	18.9	37.1
	Oz. per Ton.	Oz. per Ton.
Silver	543	760
Gold	8.4	13

The objection to a matte so rich in lead lies in the fact that a still richer and a more fusible compound is formed which works its way into the hearth of the furnace. It is found in crystalline plates, and corresponds closely to the formula $5\text{Cu}_2\text{S} + 4\text{PbS} + \text{Fe}_2\text{S}_3$, and contains 2.5 per cent. of silver. At present the amount of lead in the first matte is nearly always under 10 per cent.

The first matte is worked into white metal containing 700 to 800 oz. of silver per ton, 10 oz. of gold, and 60 per cent. of copper, which metal is then treated for silver. It is crushed and passed through a six-mesh sieve, roasted for 24 hours, then ground fine and passed through a 60-mesh sieve, and again roasted to convert the silver into sulphate for extraction by the Ziervogel process. The presence of foreign metals interferes with the working of this process. Thus, arsenic, antimony and bismuth form insoluble compounds with silver, in consequence of which the quantity of the latter in the residues is increased. The residues from a fairly good matte contain about 40 oz. of silver, 10 oz. of gold per ton, and 55 per cent. of copper as oxide. They are worked up with pyrites into a rich matte, which is then

partly worked with the production of bottoms containing the gold and silver. The following is an analysis of bottoms:—

	Per Cent.
Copper	60.04
Lead	33.61
Arsenic	0.44
Bismuth	0.40
Iron	0.08
Zinc	0.15
Gold	0.54
Silver	1.35
Sulphur	1.68
	<u>98.29</u>

The power of the copper bottoms to remove the gold and silver from the matte is increased by the presence of the above impurities.

The silver which is obtained by precipitation with copper after the Ziervogel treatment generally contains an amount of cuprous oxide, together with some small scales of copper. These are removed by prolonged boiling with water containing a little sulphuric acid, into which air is injected by a small steam jet, after which the silver is melted into bars of an average fineness of 999.

The author states that at Montana the calciners are being replaced with great success, owing to the expense of labour and fuel, by capacious revolving cylinders, and again, from the long period the process of Bessemerising copper mattes has been in use, he believes its success is assured.—A. W.

The Manufacture of Aluminium from Cryolite. P. P. Bedson. British Association, Section B., Newcastle Meeting, 1889.

AFTER enumerating the principles of the various methods of obtaining aluminium the author proceeds to describe Netto's process as carried out by the Alliance Aluminium Company at Wallsend. On the large scale 200 lb. of cryolite are melted with the same weight of salt in a reverberatory furnace. When the fusion is complete, which is in about an hour and a half, the molten mass is run into a previously warmed iron converter, where it is subjected to the action of 40 lb. of sodium. The latter is added and allowed to act in portions of 5 lb. at a time, and each portion as it is introduced is forced under the surface of the fused material by means of a "dipper," consisting essentially of a slightly concave circular sheet of iron studded with holes. The first dipping is attended with violent action and the production of white fumes consisting chiefly of sodium fluoride, which, however, decrease as the further additions of sodium are made. When the operation is complete the bulk of the slag is poured off, and the last portion together with the aluminium is run into an iron vessel. The separation of the bulk of the slag in this way is essential, as otherwise the aluminium would redissolve in the slag during cooling. With a pure cryolite about 10 lb. of practically pure aluminium would be obtained from this charge, and the slags produced would contain:—

	Per Cent.
Sodium fluoride	about 40
" chloride	43
Cryolite	15
Metallic aluminium	0.75

A difficulty attending the use of cryolite is the presence of impurities, which vary in amount from 1 to 3 per cent., and consist chiefly of iron and silicon compounds. Advantage, however, is taken of the fact that these compounds are reduced by the sodium before the cryolite. With this view the dipping operation is divided into two, one-third of the sodium being used in the first and the remainder in the second, with the result that a metal containing 98 to 99 per cent. of aluminium is obtained from the second operation. The best quality of aluminium is obtained by "double dipping" in clay crucibles instead of in the iron converter. The metal obtained by "single dipping" averages from 95 to 97 per cent., while first metal from the "double dipping" process contains from 90 to 95 per cent. of aluminium.

An important factor in this manufacture is the regeneration of cryolite from the sodium fluoride of the slag by heating the latter with aluminium sulphate (this Journal, 1889, 713). Previous to this operation the 0.75 per cent. of aluminium in the slag may be removed as aluminium bronze by melting with metallic copper.

The sodium is manufactured by pouring fused caustic soda in a regulated stream over heated charcoal, the arrangement and apparatus being such that the carbonate of soda which is formed, together with the undecomposed caustic, drains from the charcoal into the bottom of the retort, whence it is removed. By this means the decomposition takes place at a lower temperature, which enables cast-iron retorts to be used instead of those of steel or wrought iron. The mixed carbonate and caustic is known as soda slag, and is sold to paper manufacturers and others, or may be recausticised. The following are the amounts of the materials necessary for the production of one part by weight of sodium:—

10 parts of caustic soda.
1.2 " cast iron for the retorts.
12 " coke.
1.5 " charcoal for reduction.

This quantity produces nine parts of soda slag containing about 60 per cent. of Na_2O .—A. W.

The Robert-Bessemer Steel Process. F. L. Garrison. Iron and Steel Institute, Paris meeting.

THIS paper contains a description of and some results obtained with the Robert modification of the Bessemer converter. This modification differs from the ordinary converter in having one side flat, while the tuyeres pass horizontally through this side some distance from the base. The tuyeres are likewise arranged obliquely to the central vertical axis, so that when the apparatus is at work the blast enters the metal obliquely and only a few inches below its surface, with the result that a rotary motion is given to the bath. The average pressure of the blast is about 4 lb., and the height of metal above the tuyeres only from 10 to 15 centimetres. The blow is conducted in three successive stages of tilting; the first stage lasts from seven to eight minutes, and is carried on with only a small height of metal above the tuyeres; the second stage, with the tuyeres deeper, lasts three to four minutes, and the final about two minutes. Ferro-manganese is then added. The converters are small, not exceeding three tons in capacity.

General analyses are given of the metals used and produced both by the acid and basic treatments; there are also tables showing the mechanical tests of some samples of metal produced by this process, but only average analyses are given with the latter.

The author, in his concluding remarks, states that the idea of raised tuyeres is not new, though when Bessemer blew air into the metal near the surface he obtained an abnormal amount of slag and brown smoke with a large loss of iron. The loss of iron in the present instance is stated by the inventor to be only about 12 per cent. under normal conditions, and from 13 to 18 per cent. with a basic lining. Finally, the author finds it difficult to believe that a complete and uniform circulation of a bath of such a heavy metal can be maintained with only 4 lb. of blast, though he has seen most excellent material produced in this converter.

—A. W.

On the Influence of Sulphur in Zinc Smelting. A. Voigt. Zeits. f. angew. Chem. 1889, 571—573.

IN calculating the waste which occurs in zinc smelting, sulphur is accredited with playing an important part. Now it is true that excessive loss of zinc occurs when furnace products, roasted blends, and ores poor in zinc, are employed, but the assertion that the presence of sulphur is the cause of this is not based on experiment. B. Kerl states ("Grundriss der Metallhüttenkunde," 1881, 436) that one atom of sulphur (= 32) holds back one atom of zinc (= 65), and that the sulphur in the roasted material is present as sulphide or sulphate. The author has also detected the presence of traces of free sulphur. Now the sulphates present in roasted blends mainly consist of calcium sulphate and a little lead sulphate, only traces of zinc sulphate being found. The roasted material contains on an average 7 per cent. of sulphur, of this 0.5 to 1.3 is present as sulphide; the rest as sulphate. Now this could account for a loss of about 14 per cent. of zinc which ought, however, to be found in the residual ash of the smelting as zinc sulphide. This is, however, not the case, for on extracting these residues with caustic alkali it is found that most of the zinc is present as oxide, only a very small portion being present as sulphide. The rest of the sulphur found is present as calcium and iron sulphides.

The author has carried out a number of analyses on average monthly samples of the residues from the smelting of blends and blast-furnace products, especially determining:—

A. The total amount of zinc.

- (1.) Zinc present as oxide (extracted by means of soda lye).
- (2.) Zinc present as sulphide (by difference).

B. Total amount of sulphur.

- (1.) Sulphides soluble in concentrated acetic acid.
- (2.) Sulphides soluble in hydrochloric acid.
- (3.) Sulphur present as sulphates (determined in only one or two cases).

No. of Sample.	Total Zinc.	Zinc extracted by NaOH.	Difference.	Total Sulphur.	Soluble in Acetic Acid.	Difference.	Sulphur present as Sulphates.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
I.	3.66	2.4	1.26	3.91	0.91	3.00	..
II.	3.33	2.10	1.23	4.52	..	..	0.21
III.	3.12	1.99	1.13	4.49	..	..	..
IV.	4.17	2.86	1.31	3.88	0.86	2.87	0.15
V.	5.33	3.21	2.12	3.41	0.79	2.62	..
VI.	5.20	3.75	1.45	3.67	0.77	2.90	..

In II. and III. the sulphur compounds soluble in acetic acid were not determined as the residues to be tested had been contaminated.

The results it will be seen do not bear out the contention that one atom of sulphur holds back one atom of zinc. Most of the sulphur seems to be combined with iron (and possibly with manganese) and with calcium. It cannot be asserted that the sulphur in the blends is particularly harmful, for the analyses of a residue from the smelting of

a calamine containing 1.09 per cent. (but not as zinc sulphide), with a reduction cinder containing 1.23 per cent. of sulphur, gave the following results: 2.50 per cent. of zinc, of which 1.98 per cent. was present as oxide and 0.52 per cent. as sulphide; 2.65 per cent. of sulphur, 0.86 per cent. of which was present as calcium sulphide. These results do not differ much from those obtained above. There is no reason therefore to look upon the sulphur in the blends as exerting a specially harmful influence.

Many calamines contain more or less gypsum and traces of zinc sulphide (Schwefelkies), e.g., calamine samples contained 0.52—0.91—4.7 per cent. of sulphur.

The blast-furnace products, too, contain from 1.5 to 3.0 per cent. of sulphur when they are used for smelting purposes, e.g., samples of the latter contain 1.9—2.5—1.55—2.97 per cent. of sulphur.

Finally the reduction cinder contains sulphur, e.g., 1.21—0.98—1.15 per cent.

Blende is more difficult to smelt than calamine, but this can be due to other causes than the fact that it contains more sulphur.

Temperature no doubt plays an important part, and it therefore seems important to take into account what influence the acidity or basicity of the minerals present exerts on the reduction of the temperature at which they melt and form a good slag. Further, the author adduces evidence to show that the reduction cinders from different sources cause a greater or less loss when employed with the same material, so that it would be useful to carry out investigations on the quantitative effect of cinders.

—F. W. T. K.

Fusing Point of Blast-Furnace Slags. P. Gredt. Stahl. u. Eisen. 1889, 9.

THE results of these experiments are of importance for both the iron and pottery industries. For the economical working of a blast furnace the melting point of the slags which are formed is of consequence, as these ought to melt in the furnace at the same temperature as the iron. If they melt at a lower temperature they will combine with some of the iron, and if at a higher temperature a waste of fuel takes place. The formation of a suitable slag must therefore be carefully regulated by the addition of various gangues and fluxes in definite proportions. The slags obtained from a blast furnace in good working order consist almost entirely of silica, alumina, lime and magnesia, together with small quantities of alkalis and iron.

The author obtained the requisite materials as pure as possible, and made them up with pure dextrin into tetrahedra resembling Seger's cones. Two series of slags were prepared in this manner:—In Series I. the amount of silica was kept constant and the proportions of lime and alumina varied from no lime to no alumina, whilst in Series II. the cone with the lowest melting point in Series I. (No. 11) was taken as the basis and the lime in it gradually replaced by magnesia. In this manner the temperature of formation of slags containing silica, lime, magnesia and alumina in every proportion was ascertained. From such experimental data a slag can be compounded to melt at any desired temperature.

—E. E. B.

PATENTS.

Improvements in the Hardening and Tempering of Steel. H. W. Wallis, London. Eng. Pat. 14,332, October 5, 1888. 4d.

INSTEAD of using a bath of oil or water, &c., the patentee employs a bath of sodium or potassium, or an alloy of sodium and potassium. The sodium or potassium, or the alloy, is melted and heated to the temperature which is most suitable to the degree of temper or hardness to be given to the articles.—T. L. B.

Improvements in the Dipping Process for Depositing Metals upon Iron and Steel. A. Lévy, Paris, France. Eng. Pat. 15,698, October 31, 1888. 6d.

FOR *bronzing*, an ammoniacal solution of any salt of copper is poured into a clear solution of a tin salt containing a mineral or organic acid. The clear solution obtained constitutes the *bronzing bath*. It is used cold, and gives a deposit very adherent, sufficiently thick, and not spoiling in any way the polish of the object it covers.

A good yellow bronze may also be obtained by first tinning the objects in a boiling solution of salt of tin

containing oxalic acid, and then placing them "in a red copper bath of ordinary composition," but rather poor in copper.

Before *gilding* and *silvering* it is necessary to coat the objects with copper as described; they may then be dipped in well-known gilding or silvering baths. The same results may be obtained by previously nickeling instead of coppering.

Nickeling is carried out by first coppering or tinning, as above described, and then placing in a bath of simple or complex nickel salt, and more especially of chloride of nickel, to which is added sal-ammoniac and sea salt. The higher the temperature of the nickel bath the better and more rapid are the results; at the boil less than a minute is necessary to obtain a sufficiently thick deposit of nickel.

Besides the process itself the invention consists of the general method dependent upon the contact of two metals, iron and copper, or iron and tin, for example, which contact serves to effect, without the aid of an external current, the deposit of a third metal—not a substitution of a third for one of the others. Thus *gilding* and *silvering* may be effected by nickeling and then dipping in the gilding and silvering baths.

Deposits of *cobalt* and *aluminium* may be obtained in exactly the same way as nickeling is performed. Eight claims are made.—T. L. B.

Improvement in the Treatment of Quartzose or Siliceous and Sulphuretted Ores containing Gold, Silver, or Copper. H. B. Fulton, Kirkintilloch. Eng. Pat. 16,499, November 14, 1888. 8d.

INSTEAD of treating the ores in two operations, first calcining them and then melting with fluxes, the whole process is performed in one operation, and after it has been commenced the use of fuel is entirely dispensed with. The ores must be added in the proportions necessary to effect (1) combustion; (2) the formation of a metallic regulus; and (3) the formation of a fusible slag. The smelting is performed in a blast furnace preferably closed at the top, fuel being used at first to raise it to the required temperature before adding the charge, which must contain sufficient sulphide to render the addition of more fuel unnecessary. Superheated air is used for the blast.—E. E. B.

An Improved Method of Coating Iron or Steel Plates with Copper and other Comparatively Non-oxidisable Metals. G. Prout and D. Murray, London. Eng. Pat. 17,269, November 27, 1888. 4d.

THE iron or steel plate is heated to a temperature of 2,000° F. or thereabouts, and the surface then sprinkled with borax, rosin, or other suitable flux; the requisite quantity of copper in the molten state is then brought on to the plate, which is then passed between rolls heated to a temperature somewhat below the melting point of the coating metal. The rolling is continued until the coating metal undergoes solidification. Any suitable furnace may be employed for heating the plates or for melting the copper; the rolls may be heated by means of a gas flame. Other metals of a comparatively non-oxidisable character, and adapted for being rolled, may be welded in a similar manner to an iron or steel back, the flux and temperature being suitably varied according to the object to be accomplished.—T. L. B.

An Improved Mode and Manner of Preparing Materials for carrying out the Operations of Smelting and the like. R. Middleton, Leeds. Eng. Pat. 17,373, November 29, 1888. 6d.

THE invention consists in using up (1) small fuel, such as coke and coal dust; (2) small, or dust-like ores; (3) small, or dust-like fluxes; and (4) in thoroughly intermixing among the various particles such other useful materials as may be desired. The material having been brought to a suitable size and condition for passing through compressing machinery is then mixed in the following proportions, say, ore, 48 per cent.; enriching ore, or other agent, 8 per cent.,

fluxing agent, 13 per cent.; fuel, 25 per cent.; pitch, 6 per cent.; the proportions varying according to the nature of the ore, the quality of the materials, the temperature and volume of the blast, and the purpose for which the metal is required. The compound is now made into blocks by compression under a pressure of not less than two tons per square inch, and then stacked.—E. S.

Improvements relating to the Treatment of Nickel and Cobalt. H. H. Lake, London. From P. Manhes, Lyons, France. Eng. Pat. 17,406, November 29, 1888. 6d.

THE impure nickel or cobalt is cast into any suitable form, preferably that of very thin plates, and then heated until the surface of the metal is oxidised. Upon melting the partially-oxidised metal with suitable fluxes metallic nickel or cobalt is obtained, the oxygen combining with the other metals to form oxides which are absorbed by the flux.

—E. E. B.

Improved Method of Extracting Nickel and Cobalt from Ores or Compounds and Apparatus therefor. H. H. Lake, London. From P. Manhes, Lyons, France. Eng. Pat. 17,410, November 29, 1888. 8d.

THE ores are melted and the liquid matte or crude metal poured into a converter previously heated to redness. This is placed in a vertical position and air blown in from the bottom. The combustion of the impurities in the ore causes great elevation of temperature, which is kept up by throwing coke on to the fused mass. As the temperature tends to get lower the converter is inclined so as to allow the air to enter at a higher level. Drawings are given of a converter which will allow the air to enter at any desired height. The metal obtained by the process requires to be purified. (See Eng. Pat. 17,406 of 1888, preceding abstract.)—E. E. B.

Improvements in Methods of and Apparatus for Separating Ores or Metals from Associated Gangue. B. J. B. Mills, London. From T. A. Edison, Llewellyn Park, U.S.A. Eng. Pat. 17,614, December 3, 1888. 8d.

THE finely pulverised ore is made to fall from a hopper, through slots or holes in its base, in fine streams and in its descent is subjected to the action of a gentle air current and a magnet placed at the side of the falling material. The ore falls into an apparatus consisting of various compartments so arranged that the lighter particles are blown into one compartment, and the magnetic particles of ore, being altered in their line of fall by the magnet, fall into another. Non-magnetic iron ores are made magnetic by heating to a white heat, or by partial reduction with carbon monoxide. To separate gold from its ores by this apparatus, the finely powdered ore is subjected to the action of a solution of an iron salt with the electric current, whereby the gold particles become coated with iron, which renders them magnetic. The ore is then dried and submitted to the action of the magnetic separator. Drawings of the apparatus are given.

—A. W.

Improvements in the Method of and Apparatus for Effecting the Separation of Iron or Iron Ores by Mechanical Means from Associated Gangue. B. J. B. Mills, London. From T. A. Edison, Llewellyn Park, U.S.A. Eng. Pat. 17,614A, December 3, 1888. 6d.

LOLITHIC iron ores cannot be concentrated by the magnetic separator of the previous patent (Eng. Pat. 17,614), because when the material is heated to render it magnetic the gangue hardens and cakes on the tablets of richer ore. The separation is effected by crushing the ore through rollers, cleaning the tablets by revolving them in a cylinder with lumps of a harder substance, such as quartz, and passing the mixture through a revolving inclined cylindrical screen of a given fineness. The rich tablets, being of about one size and larger than the particles of gangue, are thus separated from the latter.—A. W.

Improvements in the Method of and Apparatus for Extracting Gold from its Ore by Amalgamation. B. J. B. Mills, London. From T. A. Edison, Llewellyn Park, U.S.A. Eng. Pat. 17,614B, December 3, 1888. 6d.

TO recover the gold from low grade sulphide ores the material is pulverised, concentrated by "vamping," and then treated with weak nitric acid preferably mixed with a little nitrate of mercury. By this means the fine particles of gold which would not previously amalgamate become cleaned and coated with a layer of mercury. The liquor is drawn off, the ore either dried by centrifugal action or washed with water, and the gold then extracted by any convenient amalgamation process.—A. W.

Improvements in the Application of Sulphide of Silver to Metallic Surfaces, applicable to Jewellery and the like. E. A. Billant, Paris, France. Eng. Pat. 17,786, December 5, 1888. 4d.

THE metallic article is placed in a mould into which molten sulphide of silver is then poured, and by this means a firmly adherent coating of silver sulphide is obtained. The whole operation is performed in a reducing atmosphere.—E. E. B.

Improvements in the Preparation and Treatment of Bromine for the Extraction of Gold from Ore or for other Purposes. M. H. Simpson, London. Eng. Pat. 17,930, December 7, 1888. 6d.

THE invention refers more especially to the use of bromine for the extraction of gold in the wet way from materials such as pyrites, tailings obtained in ordinary gold-washing processes, and the like. An alkali, caustic soda by preference, is saturated with bromine forming a hypobromate; this on evaporation forms a powdery material which can be readily transported. Acid sodium sulphate is also prepared. The material to be treated is placed in barrels, moistened with hypobromate solution, and the acid sulphate solution added in proper quantity. Bromine is thus liberated, which then acts on the gold. If necessary a carbonate can be added, and the solvent action of the bromine on the gold increased by the pressure set up from the formation of carbon dioxide.

—S. G. R.

An Improved Method of Coating Iron or Steel with Copper and other Comparatively Non-oxidisable Metals. G. Prout and D. Murray, London. Eng. Pat. 18,218, December 13, 1888. 6d.

TREATS of the coating or facing of iron or steel rods, tubes, castings, forgings and other bodies.

Iron bars are heated to a temperature of about 2,000° F. and sprinkled with borax, rosin, or other suitable flux. They are then plunged into, or passed through, a bath of molten copper or other coating metal, after which they are rolled between heated rolls, as in Eng. Pat. 17,269 of 1888 (see page 987), or in some equivalent apparatus until the coating has solidified, and a smooth finished surface has been obtained. Iron or steel rods, tubes and similar products may be coated in a like manner. Bodies of irregular form such as castings may be coated by heating, as above, sprinkling the surface with flux, and then plunging into a bath of the molten coating metal. Certain of these objects may then be subjected to the action of a press. In coating iron or steel rolls a mould may be made and the roll, heated as before, introduced as a core; the surrounding space is then filled with the coating metal. In lining cylinders, the cylinder is heated, a core introduced and the intervening space filled with the lining metal. The internal surfaces of tubes may be coated by rotating the heated tube, which is at an inclination, and running the molten metal through it. For coating internal surfaces in general the vessels are heated to the necessary temperature and a sufficiency of molten metal is introduced.—T. L. B.

Improvements in Cleaning Tin, Terne, or other Metal Plates, and Apparatus therefor. T. Summers, Gloucester. Eng. Pat. 18,632, December 20, 1888. 8d.

HITHERTO the process of cleaning tin-plate, &c., after tinning, has been carried out by hand. The present invention accomplishes the operation by mechanical means and so permits of hand labour at this stage of the manufacture being dispensed with. The machine consists of two casings each enclosing a pair of vertical revolving shafts; the shafts carry a number of radial wings or vanes, and a central slot is cut in each side of each casing for the ingress and egress of the plate to be cleaned. The casings are filled with bran or equivalent material, and this is agitated by the vanes carried by the revolving shafts. The tin-plate to be cleaned is pushed through the first slot and between the first pair of revolving shafts and is then carried forward, and at the same time cleaned by the action of the bran. Upon leaving the first casing it enters and passes through the second casing, where it undergoes still further cleaning. If friction rollers be used the passage of the plate can be more easily regulated, and it may also be made to travel in the opposite direction to the particles of bran, the cleaning action being intensified thereby. For conducting the plate from the tinning bath to the cleaner a reciprocating carrier is employed worked by a cam, crank or eccentric mounted in the machine. Bran forced from the machine is picked up by elevators and returned to the proper casing. Four drawings are given.

—T. L. B.

Improvements in Apparatus for Use in Decomposing Chemical Compounds, Metallic Salts, and Desulphurising Ores. P. H. Adams and O. T. X. Adams, Chicago, U.S.A. Eng. Pat. 10,991, July 8, 1889. 8d.

Improvements in Apparatus for Use in Decomposing Chemical Compounds, Metallic Salts, and Desulphurising Ores. P. H. Adams, and O. T. X. Adams, Chicago, U.S.A. Eng. Pat. 11,020, July 9, 1889. 8d.

THE object of the patentees is the construction of an improved apparatus for mechanically decomposing chemical compounds and metallic salts, and desulphurising ores or their resulting material, by the action of centrifugal force, when the substances are in a molten condition. (See also following abstract.)—E. S.

Improvements relating to Apparatus for Smelting and otherwise Treating Ores. P. H. Adams and O. T. X. Adams, Chicago, U.S.A. Eng. Pat. 11,021, July 9, 1889. 8d.

THIS patent relates to the process of subjecting molten furnace products to the action of centrifugal force. Drawings of the plant are given from which the essential point appears to be to place the centrifugal machines at a lower level than and near to the furnaces so that the fused materials may be run direct from one to the other through covered conduits.

—A. W.

Improvements relating to the Treatment of Ores containing Lead, Zinc, and other Metals. F. L. Bartlett, Portland, U.S.A. Eng. Pat. 12,322, August 2, 1889. 6d.

COMPLEX ores containing sulphides of zinc, lead, copper, silver, &c., are mixed with an excess of sulphur in the form of iron sulphide, and then with two-thirds by weight of a flaming fuel such as petroleum or bituminous coal. The whole is then burnt on a shallow hearth. The zinc and lead are given off in the form of fume, while the other metals remain behind with part of the sulphur. It is maintained that by thus having an excess of sulphur present the zinc in volatilising does not carry with it any silver, and further that the non-volatile metals are entirely freed from zinc. Again, no sulphuric acid is formed, as it "is destroyed by the action of the hydrocarbon flame and the air which is admitted for this purpose."—A. W.

Improvements in Extracting Metals from Alkaline Solution, Scrap, or Waste Materials. N. M. E. Tenison-Woods, London. Eng. Pat. 13,013, August 17, 1889. 4d.

STRONG alkaline "solutions of oxides of tin and other metals soluble in an alkaline medium, such as zinc, cadmium, lead, and tungsten" are placed in iron vessels (any lead present in the form of plumbate being first removed by the addition of an alkaline sulphate). An iron cage containing scrap zinc, preferably in the form of pieces of refuse galvanised iron from old pails, roofing, &c., is immersed in the liquid which is heated to nearly 100° C. Electric communication is then made between the side of the iron vessel and the zinc in the cage. Nascent hydrogen is liberated on the inner side of the vessel with separation of metallic tin whilst zinc is dissolved from the scraps, leaving metallic iron in a saleable form if galvanised iron has been employed. The zinc is recovered from the solution by passing carbonic acid through it, when bicarbonate of zinc is precipitated. The solution is then re-causticised and used over again.—E. E. B.

Method or Process for obtaining Aluminium. H. J. Allison, London. From "The Great Western Aluminium Smelting and Refining Co.," Denver, U.S.A. Eng. Pat. 13,839, September 3, 1889. 4d.

THE principle of this patent is to act on the aluminium compound with a substance whose elements readily dissociate, yielding one element which has a greater affinity for the element with which the aluminium is combined than the aluminium itself has, liberating also another element which has no affinity for aluminium. Thus fluoride of aluminium or cryolite is fused and acted on in a crucible or other suitable appliance with the sulphide, hydride, "carbohydride," or nitride of silicon or boron, whereby any of these latter compounds dissociate, the silicon or boron combining with the fluorine and releasing metallic aluminium. Alloys can be produced by performing the operation on the surface of the molten metal with which it is desired to alloy the aluminium.

—A. W.

Improvements in and Apparatus for the Manufacture of Soft Back Steel. M. A. Howell, jun., London. Eng. Pat. 14,473, September 13, 1889. 4d.

THE invention relates to the manufacture of plates or flat bars of steel, having one side highly carbonised, and the opposite side practically free from carbon. Such steel is less liable to break or crack while hardening and is more tenacious when in use where great rotary force or heavy blows or strains are required.

Plates or flat bars of soft steel or fine iron in pairs of equal size are placed back to back with a film of clay or other refractory material interlaid between them. They are then clamped or wired together and the several pairs placed "in a receptacle or flask stratified between layers of granulated charcoal." The flask, furnished at one end with an inlet tube and cock, and at the other end with an outlet cock, is placed horizontally in a muffle. When the heat of the furnace has raised the temperature of the flask to a low red heat a current of hydrocarbon vapour is driven over the plates, and when the heat reaches the cherry-red stage the flow of the gas is diminished and the operation continued until the metal has taken up enough carbon.

Finally the cocks are closed, the flask disconnected and allowed to cool in an atmosphere of hydrocarbon. When cool the receptacle is opened and the plates are taken out and forged, hardened and tempered in the usual way.

—T. L. B.

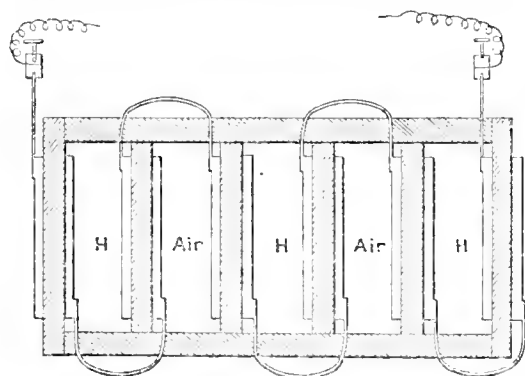
XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Occlusion of Gas in the Electrolysis of Copper Sulphate.
A. Soret. *Compt. Rend.* **108**, 1298—1300.

THE author concludes that electrolytic copper contains only two occluded gases, hydrogen and carbon dioxide, that the former is most abundant, often five-sixths of the whole, especially when the electrolyte is acid; and that when the deposit is not tenacious, it is due to excess of carbon dioxide, which may amount to nine-tenths of the occluded gases when the bath is neutral.—J. M. H. M.

Note on the Development of Voltaic Electricity by Atmospheric Oxidation of Combustible Gases and other Substances. C. R. A. Wright and C. Thompson. *Proc. Roy. Soc.* **46**, 372—376.

THE battery described by Mond and Langer (this Journal, 1889, 550), consisting of a number of plates of porous material coated with platinum black and impregnated with dilute sulphuric acid, and fed with hydrogen and air, though improved in design, is substantially identical in principle with the batteries previously described by Wright and Thompson (*Proc. Roy. Soc.* **44**, 182). The conclusions then arrived at as to the practicability of a battery of the form shown in the figure, consisting of a number of prepared



plates arranged so as to form a series of chambers alternately closed in and filled with hydrogen and open to the air, the connexions being made as indicated, were—(1.) Various causes, such as leakage of gases from one chamber to another, prevented the electromotive force of a battery of n doubly-coated plates from reaching quite as high as n times that obtainable from a single cell. In no case was an electromotive force as high as one volt per cell obtained, even when the currents were very small. With currents of magnitude sufficient to be measured readily with a silver voltammeter, the highest value was only 0.6 to 0.7 volt per cell. (2.) Nevertheless the results were sufficiently encouraging to show that if expense of construction were of no object, then, by employing large plates, currents comparable with those derived from ordinary small primary batteries could be readily produced. (3.) The economical production of powerful currents by the direct oxidation of combustible gases is questionable, chiefly on account of the first cost of the appliances necessary. Generally the same remark applies to all other forms of cell in which oxidation is effected by means of an "aeration plate," whether the energy be due either to the oxidation of a metal (like zinc or aluminium) or to the oxidation of fluids, such as a solution of Schützenberger's sodium hydrosulphite or ammoniacal cuprous oxide. Although they have not yet succeeded in effecting in this way the oxidation of alcohol, petroleum, coal, and such like forms of comparatively cheap sources of energy, yet they do not regard such actions as impracticable.

In the paper "On a New Form of Gas Battery," by Mond and Langer (read before the Royal Society, June 20th, 1889),

experimental results are given which corroborate the previous work of Wright. (See *Proc. Phys. Soc.* **4**, 101; *Phil. Mag.* **77**, 169.)—W. W. H. G.

PATENTS.

Improvements relating to the Separation of Lead from Silver and from other Substances associated therewith. A. Arche, Vienna, Austria. Eng. Pat., 16,821, November 19, 1888. 4d.

CRUDE lead cast into any suitable form, preferably that of very thin plates, is placed in a bath containing lead nitrate (1.5 per cent.) and nitric acid (5 per cent.). An electric current is then passed through the bath, when pure lead is deposited in the form of crystals on the positive electrodes, whilst the silver and other metals are deposited as a black slime on the negative electrodes.—E. E. B.

Improvements in the Manufacture of Chlorine. T. Parke and A. E. Robinson, Wolverhampton. Eng. Pat. 17,367 November 29, 1888. 4d.

See under VII., page 983.

Improvements in the Extraction of Metals from Ores and Slags, and the Débris from Smelting Works and other Manufacturing Works. J. Shears, London. Eng. Pat. 9821, June 14, 1889. 4d.

REFUSE tin slags are finely powdered and fused with caustic alkali. After treating the melt with boiling water, the clear solution, containing alkaline stannate, silicate and tungstate is heated in an iron vessel. On passing an electric current through it, pure metallic tin is deposited on the sides of the iron vessel.—E. E. B.

Improved Composition adapted to Electric Insulators and other Articles and Uses in the Arts and Manufactures. F. Marquard, New York, U.S.A. Eng. Pat. 12,046, July 30, 1889. 6d.

See under XIII., page 992.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

On the Testing of Machine Lubricating Oils. O. Bach. *Chem. Zeit.* **13**, 905—906.

THE present methods of testing the gumming or oxidation of above oils take a long time (several days) by the usual processes.

The author uses the process of Fresenius (*Chem. Zeit.* **4**, 238), with slight modifications.

The oil is heated for 10 hours with oxygen in a sealed tube (about 100 to 125 cc. capacity) in an air-bath; the point of the tube is then broken under a measured volume of water, and from the difference in volume the absorption is calculated. The presence of excess of oxygen after the experiment should be proved with a glowing splinter of wood.

The author gives, amongst others, the following absorptions, 1 grm. of oil being taken in each case:—

	Oxygen Absorbed, cc.
Mineral oils	0.1 to 0.7
" (0.865)	4.8
Lubricating grease	21.8
Cod oil (0.963)	76.3
Roast oil	181.0
Olive oil	144.0
Rape oil	166.0
Cotton-seed oil	111.0
Mineral oil (0.865) with 10 per cent. of cod oil ..	9.4
Oleo-naphtha " " ..	8.6

The admixture of rosin oil or vegetable oils to mineral oils can thus be detected on account of the low oxygen absorption of the latter. Further, the oxygenated oil has only a slight or no acid reaction in the case of mineral oil and a strongly acid reaction in that of rosin oil.—D. A. S.

PATENTS.

Improvements in the Means and Apparatus for Extracting Fat and other Soluble Substances from Materials containing them. M. Bauer, London. From J. Merz, Farnov, Austria. Eng. Pat. 9352, August 5, 1885. Amended July 24, 1889. 8d.

THE emendations are concerned in a clearer description of the invention. (Compare title of original specification, this Journal, 1886, 432.)—O. H.

An Improved Manufacture of Oleaginous Material from Hydrocarbons, applicable for Saponification and other Purposes. H. R. von Dahmen, Vienna, Austria. Eng. Pat. 14,692, October 12, 1888. 4d.

HYDROCARBONS, such as heavy mineral oils, are mixed with from 15 to 25 per cent. of "elain," or oleic acid, or other fatty acids; the mixture is then heated to 60° C., and subjected for half an hour to the action of sulphuretted hydrogen gas, after which it is neutralised with from 1 to 5 per cent. of calcined carbonate of soda; it is then ready for saponification by the usual methods.—W. L. C.

An Improved Process and Composition for extracting Oil from and cleaning Cotton Waste. W. Michell and S. Picard, London. Eng. Pat. 17,628, December 3, 1888. 6d.

THE waste is subjected to hydraulic pressure to extract most of the oil, and then agitated in a bath of boiling water to which is added a solution containing caustic potash and soda, pearl ash, soda crystals, lime, ammonia, cyanide of potassium, borax, turpentine and "benzoline."—W. L. C.

Improved Antiseptic Washing and Cleansing Compounds. J. Ascoug, Handsworth. Eng. Pat. 18,260, December 20, 1888. 4d.

BORAX, a mixture of boracic acid and sodium carbonate, or some other boron compound, is either sprinkled into melted paraffin wax or similar substance, or, if the smell of such be objectionable, the boron compound may be incorporated with any dry or granulated saponaceous compound.

—W. L. C.

Improvements in Apparatus to be Employed in the Manufacture of Soap. G. T. Bishop, London. Eng. Pat. 19,015, December 29, 1888. 6d.

A CYLINDRICAL vessel is heated underneath by a gas burner or otherwise, and within it are plungers carried by concentric or symmetrically arranged rods which alternately approach and recede from each other, for the purpose of thoroughly incorporating the contents. A drawing is given.—W. L. C.

Improvements in Washing Wool and in Treating and Utilising the Washings. H. W. Langbeck, Loughton. Eng. Pat. 66, January 2, 1889. 6d.

THE wool is twice soaked in warm water, not exceeding 110° F., then pressed and dried by centrifugal action. The solution thus obtained yields on evaporation impure potash salts, which may or may not be treated with mineral acids. The wool is then scoured with soap-lye to remove the whole of the fat and the remaining dirt. The emulsion thus obtained is concentrated and treated with dilute alcohol; by this means the soap is removed from the wool-fat and dirt. From the former the spirit is recovered by distillation, while the fat and dirt are separated from each other by a

solvent or by hot pressure. The preliminary soaking in water may be dispensed with, in which case the wool-washings are concentrated and treated with mineral acid, to liberate the fatty acids, or with salt to precipitate the soap and fat together.—W. L. C.

Process for Producing Hard Soap from Vegetable or Animal Fats, a Mixture thereof, and Caustic Alkaline Solutions, without employing Carbonate of Alkalis or Chloride of Sodium. H. Schuster, Leudsiel, Germany. Eng. Pat. 11,660, July 22, 1889. 4d.

A GIVEN weight of the fat to be saponified is mixed with an equal weight of a solution of pure caustic alkali, of not less specific gravity than 35° B. Slow "intermissive" heating is applied to this and the mass becomes spontaneously superheated. In a few hours complete saponification is effected.—W. L. C.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Australian and Tasmanian Sandarach. J. H. Maiden. Proc. Roy. Soc. Tasmania, August 1889.

THE following is a list of resins of different species of Australian pines.

Resins of *Callitris cupressiformis* ("Oyster Bay pine" of Tasmania), *Callitris calcarata* ("Murray-," "Black-," "Red-," "Scrub-," "Cypress pine"), *Callitris columellaris* ("Cypress pine"), *Callitris verrucosa* ("Mountain Cypress pine"). All these resins have an excellent appearance as regards colour and brilliancy. They are almost completely soluble in rectified spirit, while light petroleum spirit dissolves a very considerable quantity. They possess a pleasant aromatic odour, similar to that emitted by ordinary sandarach. When the trees are wounded these resins exude in an almost colourless transparent condition and have a high refractive power. They soften slightly in boiling water and feel gritty to the teeth.—J. W. L.

Analyses of Black Wax for Polishing. F. M. Horn. Chem. Zeit. 13, 831.

THE author received from a Vienna cabinet-maker samples of soft and hard wax for analysis. These when dissolved in turpentine were used as polishes to invest any article with a brown (natural colour), hard, non-sticky, dull glassy surface. They gave on testing:—

	Soft Wax.	Hard Wax.
Melting point.....	68·2°	80·4°
Acid equivalent.....	0·0	0·6
Saponification equivalent	0·0	14·5

The melting point was taken by Pohl's method (Wiener Akademie, Ber. 6, 587). The soft wax was identified as crude cerasin. The high melting point and the above equivalents of the hard wax excluded beeswax, rosin (colophony), and Japan wax, while they pointed to Carnauba wax. Moreover, on heating, its characteristic odour was smelt. According to Valenta the average saponification equivalent of Carnauba wax is 94·8 and the acid equivalent 4·0. The percentage of Carnauba wax in the hard wax is therefore:—

$$\frac{13·9 \times 100}{94·8} = 14·7 \text{ per cent. and } \frac{0·6 \times 100}{4} = 15 \text{ per cent.}$$

or cerasin 85 per cent., Carnauba wax 15 per cent.—D. A. S.

PATENTS.

Improvements in the Manufacture of Material to be Used as a Substitute for Gutta-Percha, Rubber, or Oiled Tissues for Surgical Bandages, Sheeting, and other Purposes. H. A. Schlessinger, London. Eng. Pat. 13,917, September 27, 1888. 6d.

WHEN required for use as a surgical dressing the new material is prepared as follows:—paper made from long, pure, manilla fibre is saturated, in any convenient and expeditious way, with an emulsion of gelatin to which soap may be added. After the excess of the emulsion has been removed by pressure through rollers, the gelatin is fixed by immersion in a bath containing chrome alum, bichromate and an aluminous salt; it is then dried, and afterwards washed with water to remove the excess of the fixing salt. Glycerin either by itself, or as an emulsion with petroleum jelly and mixed, if desired, with an antiseptic, is then applied to the surface, the whole subjected to warmth and the excess of fatty matter removed; the result is a finished material valuable for the above purposes. A common variety, which may be used as a substitute for vegetable parchment, is produced by treating nuzised paper with an emulsion of rosin soap, fatty matter and glue, fixing, rinsing, and drying, as before—C. C. H.

Improvements in the Manufacture of India-Rubber Waterproof Garments. G. C. Mandleberg, H. L. Rothband, and S. L. Mandleberg, Manchester. Eng. Pat. 16,543, November 14, 1888. 8d.

THE india-rubber after dry kneading is soaked for 24 hours in deodorised petroleum naphtha at about "76 degrees of Baum's hydrometer," left in a closed vessel for other 24 hours, stirred occasionally, then passed through rollers, spread on the fabric at a temperature of about 80° F., and the product vulcanised.

The seams of the garments are cemented together by a solution of rubber in the solvent mentioned above, and the finished articles kept at 80° F. until they cease to smell. They may be scented with some volatile perfume.

Deodorised coal-tar naphtha may be substituted for the petroleum product, the chief requirement which either has to satisfy, being that of leaving no smell on evaporation.

An apparatus for preparing and preserving the cementing solution is illustrated and described. It consists of a vessel with an air-tight cap through which passes a vertical shaft furnished with blades for mixing the rubber and its solvent, which are introduced through suitable openings in the side, also covered by caps. By the use of this device waste of the solvent by evaporation is avoided.—B. B.

Improvements in the Manufacture of certain Classes of India-Rubber Goods. J. Caillet, Paris, France. Eng. Pat. 17,417, November 29, 1888. 4d.

INDIA-RUBBER goods of which the surface is exposed to mechanical wear are furnished with a protective coating of some intrinsically hard material such as emery. Taking the case of moulded goods as typical, the patentee coats the interior of the mould with glue or similar adhesive matter, then sprinkles ground emery upon the surface thus prepared, charges the mould with the preparation of india-rubber and vulcanises in the usual way; the heat incidental to the last process causes "the glue to be dissipated," and the article when withdrawn from the mould is found charged as to its exterior with particles of emery. Such a coating is also alleged to afford protection against the heat of the sun.

—B. B.

Improvements in the Preparation of Barytes for Use as a Pigment. M. Williams, Liverpool. Eng. Pat. 382, January 9, 1889. 4d.

BARium sulphate alone or mixed with chalk, pipeclay, alum, alumina, "oyster shell white" calcined bones, "Paris white," whiting, "lime oxides or other metallic substances," is dyed or stained with any suitable colouring matter in its

appropriate solvent; the latter may, if volatile, be recovered by distillation. The pigment thus obtained can be mixed with other pigments or paints to which it has been the custom to add uncoloured barium sulphate without causing the deterioration of their appearance which follows the use of the latter.—B. B.

Improved Composition adapted to Electric Insulators and other Articles and Uses in the Arts and Manufactures.

F. Marquard, New York, U.S.A. Eng. Pat. 12,046, July 30, 1889. 6d.

TEN to 20 lb. of rosewood sawdust, 20 lb. of wood pulp, 1 lb. of extract of logwood, $\frac{1}{2}$ lb. of potassium bichromate, $\frac{1}{2}$ lb. of sulphate of iron, 4 lb. of animal glue, $2\frac{1}{2}$ to 5 lb. of an albuminous substance such as bullock's blood, and any desired quantity of vegetable fibre (suitable to the purpose intended), such as flax, hemp or cotton, are mixed together to a uniform plastic mass and moulded into such articles as the various insulating parts of electric lighting, signalling, and telephone apparatus, picture frames, mouldings, &c., put away to dry and then subjected to a heavy finishing pressure at a temperature of about 300° F. The patentee uses rosewood sawdust because of a resinous oil it contains, which helps in forming a cohesive composition, while bullock's blood is used as a cheap source of albumen and also as a colouring material, logwood and sulphate of iron for the same purpose, and potassium bichromate to render the albumen and gelatin insoluble.

The composition is said to be black, insoluble, hard, a non-conductor of electricity, capable of being cut, worked, and turned, and of taking a high polish.

The proportions may be varied, and all the ingredients need not be used at once.—B. B.

A New or Improved Process for Waterproofing Materials or Fabrics and the like. J. Grunhut, South Shields, E. Gonty and F. B. Gonty, Leicester. Eng. Pat. 14,316, September 11, 1889. 4d.

THE fabric to be waterproofed is treated with a mixture of mineral oil, paraffin wax, and spermaceti; "benzole" may be substituted for the mineral oil, "whale fish bones or any other fish bones" for the spermaceti, and vaselin or stearin for the paraffin wax. A suitable mixture—although others may be used—consists of 4 pints of mineral oil, 1 lb. of paraffin wax, and 3 lb. of spermaceti.—B. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Lime in Tanning Materials. M. Petrowitsch. Zeits. Anal. Chem. 28, 606—607.

A SAMPLE of valonia meal was found to contain 6.36 per cent. of ash containing 0.46 per cent. of lime, whilst an analysis of pure valonia gave 2.55 per cent. of ash with 0.24 per cent. of lime. The former caused large blue-black spots to appear on the tanned leather. It was also found to contain small pieces of the acorns of valonia, and little stones that appeared to be silicates. An analysis of gall-nut meal gave 3.10 per cent. of ash with 0.23 per cent. of lime.—C. A. K.

The Present Condition of the so-called Mineral-Tanning Industry. F. Knapp. Chem. Zeit. 13, 907, 996—997, 1027—1028 and 1058—1059.

A GOOD tanning material should fulfil the following conditions:—

1. It should prevent the skin from drying to a horny mass, by keeping its fibres separate.

2. It should possess a strong affinity for the raw skin, and should be absorbed in large quantity.

3. It should, when dried, be of a pliable and elastic nature, in order that it may not injuriously influence these qualities in the finished leather.

Chromic acid and its salts employed as tanning materials fulfil the first of the above conditions very perfectly, but the second and third very badly indeed. Chrome-tanned leather contains from 4—6 per cent. of chromium calculated as potassium bichromate. In the so-called iron tanning, a basic sulphate of iron is employed. It contains one molecule of Fe_2O_3 to two molecules of SO_3 . It forms with water a reddish-yellow solution, which dries down to a clear varnish. The fibre of the hides is not injured in the least by this compound. It is rapidly absorbed by raw skin, which retains it very well; heavy hides only require 4—6 days to be completely tanned. 100 parts of dry hide absorb 67 parts of iron salt from a solution of 25° B., and 177 parts from a solution of 33° B. The dry leather, therefore, contains 41 per cent. and 61 per cent. respectively of tanning salt. Leather made by this process is, however, not at all pliant, and is very liable to crack. Various plans have been suggested to obviate this difficulty. It was recommended to steep the hides in soap solution after removal from the iron bath. The iron soap formed is a very soft, pliant substance, and it was imagined that thus pliability would be restored to the leather. Practically the process is of little use. Iron and blood together have been used with success in St. Petersburg and in Brunswick. The hides are first steeped in the iron solution for 2—4 days, and then for a similar period in blood. The finished leather contains from 38—44 per cent. of the tanning material, and is at least equal in pliability and durability to ordinary leather. The saving in price of material, quite apart from any consideration of the time required for tanning, is from 40—60 per cent. Lately a new substance has been discovered to be used in conjunction with iron. Its nature has not been divulged, because it will probably be made the subject of a patent. Experiments with it have not as yet advanced beyond the laboratory stage. It possesses a great advantage over blood, in so far that it may be employed mixed with the iron salt. The mixed tanning material is rapidly absorbed by the skin, to which it imparts an agreeable brown colour. The finished leather contains about 43 per cent. of tanning materials, and is equal in pliability to leather prepared with tannin. This method is to be highly recommended because of its cheapness and speed of working. The leather obtained by it is full-bodied and takes grease well. From certain data the author calculates that by this method a saving of at least 90 per cent. in the prime cost of the tanning materials is made, compared with the ordinary tanning method.—H. T. P.

XV.—AGRICULTURE, MANURES, Etc.

Physiology of Tannin. Grundlinien zu einer Physiologie des Gerbstoffs, a Monograph. G. Krauss, Leipzig. 1889.

TWENTY-ONE experiments are given, comprising several hundreds of tannin determinations. In these are included the determinations of the amount of tannin in leaves under the various conditions of light, shade, and darkness, leading to the conclusion that light and CO_2 are essential agents in the formation of tannin in leaves. It was found that the outer leaves of a plant exposed to direct sunlight contain more tannin than the inner leaves. Only green leaves are capable of producing tannin. It is not correct to assume that tannin is a product of the assimilation of chlorophyll, for there are to be found leaves without number which assimilate tannin, though not producing it. For example, the leaves of oak, willow, and alder, though assimilating the elements of tannin in dull weather, do not develop that glucoside. The tannin produced in the leaves passes into the branches and roots, and no experimental evidence exists to show that tannin which has once passed into the rhizome undergoes further change; there is rather an increase of tannin in the rhizome through a production in the dark. As

to the use of tannin in nature, the author inclines to the opinion that its purpose is to protect the leaves producing it, either from being eaten, or from rotting, &c.

Leaves which have fallen contain as much tannin as during their best period of growth; this fact is taken to show that the leaf-tannin is of no value to the plant. The value must therefore be confined to the leaf.

During germination in the dark of seeds containing tannin (as those of oak and horse-chestnut), there is no falling off, but an increase in the amount of tannin.

XVI.—SUGAR, STARCH, GUM, Etc.

Improvements in Sugar Refining. E. O. Lippmann. Chem. Zeit. 13, 993—996.

IMPROVEMENTS in this branch of sugar manufacture are of comparatively recent date. The most important improvements are those of Steffen and Seyfert. These two improved methods are based on the principle of separating the molasses as completely as possible from the cane-sugar crystals. Seyfert's method consists in washing the moist sugar crystals in the centrifugal machine with paraffin oil of 220°—250° boiling point. By this means the molasses are almost completely removed from the cane-sugar crystals; but the purified sugar is not directly fit for consumption, because the oil imparts to it a disagreeable odour. This smell is completely removed by redissolving the sugar and boiling the solution. Solid sugar may be refined by feeding it into the centrifugal machine, either dry or mixed with paraffin oil, previously thickened by dissolving in it solid paraffin. It is then washed with oil as before. The following numbers are given: 100 parts of raw sugar, containing 95.8 per cent. of cane sugar, yielded by the old method, 65.24 per cent. of white sugar, 28 per cent. of after-products, and 6 per cent. of molasses. By the new method, 86.22 per cent., 4.85 per cent., and 8.25 per cent. respectively of these products were obtained; so that instead of 25 per cent. only 4 per cent. of the sugar needed further purification. The clear profit on 100 kilos. of raw sugar was 1.26 to 1.70 marks.

In Steffen's method a more or less pure sugar syrup is employed to effect the separation of the molasses from the sugar crystals. For this purpose the raw sugar or the molasses containing in suspension sugar crystals, is placed in a thin layer at the bottom of a tank, holding about 400—500 kilos., and washed with 16—32 portions of syrup of increasing purity, suction being applied by means of an air-pump. The process requires about 12—16 hours or more, much depending on the quality and evenness of grain of the raw material. An experiment with raw sugar yielded the following results:—1,000 kilos. of raw sugar, polarising 95 per cent. and containing 2.5 per cent. of water and 2.5 per cent. of non-sugars, were washed with 380 kilos. of pure syrup containing 66 per cent. of cane sugar. After making allowance for the sugar contained in the syrup, there were finally obtained 870 kilos. of pure sugar. Of this 71 per cent. = 618 kilos. existed in the dry state, and 28 per cent. = 244 kilos. in the shape of syrup of practically the same degree of purity as the syrup used for washing. In the working of this process it is of importance that the grain of the raw sugar should be as uniform as possible. The saving in cost of production of sugar by this method varies from 1 to 1.5 marks per 100 kilos. of raw sugar employed. The cost of the plant for a factory of average size is stated to be 300,000 marks.—H. T. P.

On Raffinose. Berthelot. Compt. Rend. 109, 548—550.

RAFFINOSE is commonly described as crystallising with five molecules of water. The author, however, obtained another hydrate when crystallising it from dilute alcohol, having a composition corresponding to the formula $\text{C}_{18}\text{H}_{32}\text{O}_{16} \cdot 6\text{H}_2\text{O}$. Under the influence of a good beer yeast raffinose ferments completely, but the author has observed that when a weak

ferment is used, such as some varieties of bakers' yeast, the fermentation stops at the end of 48 hours and proceeds no further even after several weeks. The amount of carbon dioxide, alcohol and remaining sugar are such as would be produced if raffinose were decomposed into a saccharose and a glucose which ferments, or two glucoses which remain unfermented. The unfermented sugar from 100 parts of raffinose possesses a reducing power corresponding to 35.7 parts of glucose.—A. L. S.

Estimation of Salts in Raw Sugar by means of its Electrical Conductivity. Zeits. f. Zuckerind. **39**, 638.

THIS process, which has been recommended by Reichert, has been carefully tested by Landolt, who finds that in its present form it is not sufficiently reliable, while the difficulties involved are so great that it will still require much work before the process can be put on a satisfactory basis.

—W. M.

Occurrence of Raffinose in Factory Products and the Cause of its Presence. Zeits. f. Zuckerind. **39**, 647.

LIPPMANN has made careful analyses of factory products from good normal beets, to confirm his former statement (this Journal, 1889, 632) that raffinose exists in the beets themselves, and agrees with Herzfeld's hypothesis that raffinose is due to a "vegetation process." Herzfeld regards it as still an open question whether raffinose is produced during processes in the factory, for instance, by diffusion at high temperatures, or exists as such in the beet, but he regards the latter supposition as more probable from physiological considerations of the plant life. He also says that the well-known pointed crystals are not characteristic of sugar containing raffinose, as the raffinose is frequently found in the syrup adhering to the crystals, and further that even when containing as much as 4—5 per cent. of raffinose the crystals exhibit no abnormal appearance.—W. M.

Manufacture of Invert Sugar. Zeits. f. Zuckerind. **39**, 738, 740, and 745.

AT the suggestion of Herzfeld, Tummeley and Vier have tried the inversion of cane sugar in aqueous solutions by means of sulphurous acid and carbonic acid under pressure. Tummeley found that sulphurous acid worked well. On a large scale it will be found best to use a solution containing 30 per cent. of sugar, invert it by boiling for half an hour with 1 per cent. of acid in wooden or earthenware vessels, remove the excess of sulphurous acid by boiling, and then dissolve cane sugar in the liquid until the desired degree of concentration has been attained. The small quantity of sulphuric acid derived from the sulphurous acid can be neutralised by the addition of sodium tartrate; the sulphurous acid expelled by boiling can be condensed and used again. Tummeley found that the inversion of a solution containing 16 per cent. of sugar together with 1 or $\frac{1}{2}$ per cent. of acid was complete in 15 minutes.

Vier tested the inversion of sugar with carbonic acid under pressure to check the accuracy of Lippmann's results. He was only able to effect a very slight amount of inversion after heating to 100° a solution containing 20 per cent. of sugar for four hours with carbonic acid under a pressure of nine atmospheres, and the same result was obtained by heating to 65° under a pressure of 13 atmospheres. He concluded that Lippmann had worked with very dilute solutions under special conditions, and had drawn erroneous conclusions as to the inversion of more concentrated solutions.

—E. E. B.

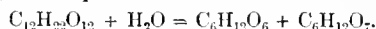
Oxidation of Maltose. E. Fischer and J. Meyer. Ber. **22**, 1941—1943.

WHEN maltose is dissolved in water and acted on by bromine in the cold for one or two days, it is oxidised to an acid which the authors have named *Maltobionic acid*. This may be obtained in a pure state from the above solution by precipitating with basic lead acetate, having first of all

removed the hydrobromic acid and excess of bromine. The precipitate is well washed and the lead removed by sulphuretted hydrogen. The clear solution is evaporated in a vacuum, extracted several times with hot alcohol and the extract precipitated with ether.

An almost colourless syrup is thus obtained, which has a strongly acid reaction. It is easily soluble in water, difficultly in alcohol and insoluble in ether. It does not reduce Fehling's solution, and is very similar to lactobionic acid (this Journal, 1889, 297). The salts are all easily soluble in water but do not crystallise readily; the calcium salt has a composition represented by $(C_{12}H_{22}O_{12})_2Ca$.

On heating maltobionic acid with five times its weight of 5 per cent. sulphuric acid, neutralising with barium carbonate and filtering, a solution is obtained which when evaporated to a syrup and extracted with alcohol leaves barium gluconate; the alcoholic extract contains dextrose which crystallises on concentration, the reaction taking place according to the equation—



The production of maltobionic acid shows that maltose contains an aldehyde group, and the general similarity of the products with those obtained from lactose shows that these two sugars are similarly constituted. The authors consider that maltobionic and lactobionic acids are comparable with arabic acid, which undergoes a somewhat similar decomposition when treated with dilute sulphuric acid.

—A. L. S.

The Reduction of Acids of the Sugar Group. E. Fischer. Ber. **22**, 2204—2205.

THE reduction of the carboxyl group contained in organic acids has hitherto not been effected. The author finds that this reduction is most easily performed in the case of acids of the sugar group. Gluconic acid, in cold aqueous solution, is rapidly converted by sodium amalgam into a reducing sugar, which is probably dextrose. Mannic acid (obtained by Hirschberger and the author by the action of bromine on mannose) yields mannose. Arabic, mannic, and rhamnosic acids, as well as the polybasic acids of the sugar series, are also reduced by sodium amalgam. On the other hand, glyceric, tartaric, and malic acids are not affected. It would seem that the reducibility of an acid is in some way connected with its power of forming a lactone.

—H. T. P.

On Pentacetyl Galactose and Dextrose. E. Erwig and W. Koenigs. Ber. **22**, 2207—2213.

PENTACETYL galactose is obtained similarly to the corresponding dextrose compound (this Journal, 1889, 718) by heating galactose with acetic anhydride and sodium acetate; the product of the reaction is evaporated repeatedly with alcohol until the excess of acetic anhydride and acid is expelled, and then extracted with alcohol. Pentacetyl galactose crystallises from the alcoholic extract in well-defined rhombic crystals. It is different from the gummy pentacetyl galactose described by Fudakowsky (Ber. **11**, 1071), and is therefore distinguished by the name of *crystalline* pentacetyl galactose. Its melting point is 142°. It is more insoluble than the corresponding dextrose compound in cold alcohol; it is fairly easily soluble in hot alcohol, ether and boiling water.

This compound and the corresponding one of dextrose react very similarly with reagents. They easily reduce Fehling's solution on warming; are completely saponified on boiling with dilute sulphuric acid with regeneration of the original carbohydrides; not easily decomposed on boiling with water; do not form phenylhydrazine or similar compounds, and are not attacked by phosphorus pentachloride or oxidised by bromine water. Potassium permanganate or bichromate slowly oxidises them to carbon dioxide and water, but without producing appreciable amounts of fatty acids.

The authors consider that all these reactions tend to indicate that these acetyl derivatives do not contain an aldehyde group, and they discuss their constitutional formulae.

As octaacetyldiglucose is decomposed when warmed with acetic anhydride and zinc chloride with production of pentaacetyldextrose; experiments were made to determine whether octaacetylmaltose undergoes a similar decomposition, but this compound was found to be unacted upon under these conditions. Cane sugar and inulin are quickly inverted when heated with 0.5–1 per cent. zinc chloride solution, and although starch when heated for eight hours with a 5 per cent. solution does not yield bodies which reduce Fehling's solution, yet it is probable that the above decomposition of octaacetyldiglucose is accompanied by simultaneous inversion.—A. L. S.

XVII.—BREWING, WINES, SPIRITS, Etc.

On the Possibility of communicating the Bouquet of a High Class Wine to an Ordinary Wine by Changing the Ferment. A. Rommier. Compt. Rend. 108, 1322–1324.

STARTING from Pasteur's observation that beer fermented with wine yeast smells of wine, the author has succeeded on the small scale in communicating the bouquet of the wines of Champagne, Côte d'Or, and Burgundy to the *vin ordinaire* of the South of France, a poor wine almost without bouquet and containing about 8 per cent. of alcohol. Three lots of the grapes, separated from the stalks, were watered with a small quantity of yeast cultivated from the respective sources above mentioned, then crushed, and the must from each introduced into a large flask with two tubulures, one furnished with a delivery tube dipping under water to conduct away the carbon dioxide, and the other with a tap for withdrawing the fermented juice. A fourth flask contained the juice of the same grapes grown under glass, and therefore containing (according to Pasteur) none of the natural yeast spores; this lot was sown with champagne yeast. The first three fermented in 10 days, the last in 13, at a temperature of 22–28° C. On the third day of fermentation, enough sugar was added to each to raise the percentage of alcohol from 8 to 13 per cent. After fermentation the four samples were drawn off and cleared in well-filled flasks and then bottled; each had a pronounced bouquet of the wine from which the respective cultivation of yeast was obtained.—J. M. H. M.

On the Alcoholic Fermentation of Honey and the Preparation of Mead (Hydromel). G. Gastine. Compt. Rend. 109, 479–482.

SOLUTIONS of honey in many cases undergo alcoholic fermentation very slowly even under the most favourable conditions of dilution, &c. The author finds that the cause of this is that honey does not contain sufficient quantities of nitrogenous and mineral substances for the free growth of yeast; for when ammonium salts and the sulphates and phosphates of potassium, magnesium and calcium are added in suitable proportion to honey which has been sown with yeast, it ferments very readily. The author considers that when the preparation of mead has been successfully accomplished, it has been due to the accidental introduction of the above nitrogenous and mineral substances.—A. L. S.

On the Occurrence of Sulphurous Acid in Beer. F. Pfeifer. Zeits. f. d. gesammte Brauw. 1889, 12, 345.

THE presence of sulphurous acid in beer has generally been attributed to the use of "sulphured" hops; the author, however, finds that only a very small proportion, if any, of the sulphurous acid is due to the hops, but that it is a product of fermentation, and in a fermenting liquid the amount of sulphurous acid increases as the fermentation continues.

—E. E. B.

PATENTS.

Means by which Alcoholic Liquors may be Rendered more Wholesome. E. A. B. Beaumont, Brighton. Eng. Pat. 11,965, October 18, 1888. 4d.

THIS is a proposal to convert beer, porter, wine, spirit, liqueur, &c., into medicines by adding suitable quantities of *Cascara sagrada* or *Rhamnus frangula*.—A. L. S.

Improvements in Treating or Seasoning New and Purifying Old or Foul Casks, Vats, Backs, or other Vessels. H. Hill, Camberwell. Eng. Pat. 15,440, October 26, 1888. 4d.

A SOLUTION containing an alkaline gallate or tannate is used for this purpose. It is prepared either from gallic or tannic acid or some vegetable substance containing them, such as oak and other barks, galls, hops, &c.

A stock solution is prepared of one part of the acid to six of water, or an extract of one of the above vegetable substances of a specific gravity 1.150, combined with one-tenth of its weight of sodium or potassium carbonate.

For use this is diluted with 200–250 parts of water for beer, rather less for wine or spirit casks, and applied hot. The cask is kept hot by means of steam blown in occasionally for two to four days. In the case of foul casks this treatment has to be repeated one or more times.

After emptying and rinsing, the process is completed either by treatment with a solution of chloride of lime (1 oz. to 36 gallons) followed by a solution of calcium bisulphite (sp. gr. 1.030); or with a solution of potassium or sodium permanganate (1 to 250 of water); or with a solution of zinc chloride (1 to 150 of water).—A. L. S.

Improvements in the Purification of Alcohols. C. Philippart, Paris, France. Eng. Pat. 15,794, November 1, 1888. 6d.

IN this invention the well-known property of bisulphites, of combining with aldehydes and ketones to produce compounds insoluble in alcohol, is made use of in order to effect the removal of these substances from alcohol residues and rectified spirit. Any of the common bisulphites may be made use of, or the base may be added first and then a sufficient quantity of sulphurous acid to form the bisulphite. The two products may be separated either by decantation, filtration or distillation. The compounds with the bisulphite may be readily decomposed, either by converting the bisulphite into a normal sulphite by adding sufficient of a powerful base, or by oxidising the sulphite to sulphate, or by replacing the sulphurous acid by a more powerful acid.

—A. L. S.

A New or Improved Non-Alcoholic Beverage. M. H. Beaufoy and J. Cartwright, London. Eng. Pat. 17,914, December 7, 1888. 4d.

THIS beverage may be manufactured as follows:—A sweet wort prepared in the ordinary way from malt is boiled for a short time with an extract of hops, obtained by boiling hops with water. When this is cold, a little burnt sugar is added to colour it and a sufficient quantity of a strong solution of sulphurous acid to prevent fermentation. The mixture is fined with isinglass, and when bright bottled off and aerated as in the manufacture of mineral waters.

—A. L. S.

Improvements relating to the Separation of Mixtures of Ethyl Alcohol and Water from Fusel Oil and other Impurities, and to Apparatus therefor. I. Traube, Hanover, Germany. Eng. Pat. 17,972, December 8, 1888. 8d.

THIS process depends on the fact that mixtures of ethyl alcohol and water may be separated from their impurities by the formation of strata in the liquid, which may be caused by the introduction of certain salts (this Journal, 1889, 812). Among those which may be used are potassium and sodium carbonates, potassium and sodium hydroxides, sodium phosphate, the sulphates ammonium, sodium,

magnesium and zinc, and potassium and ammonium alums. The patentee finds that the success of the process depends on the concentration and temperature of the solutions, on the number of strata which are produced and the special mode in which the same is carried into effect.

The apparatus consists of a series of settling vessels, the upper portion of each being narrower than the body of the vessel; they are fitted with heating coils and suitable connecting pipes which are shown in detail in the drawing accompanying the specification. The vessels are partly filled with an aqueous solution of sp. gr. 1.2 of one of the above mentioned salts (potassium carbonate is found most suitable), which is heated to 40°–78° C. Raw spirit containing 80 per cent. of alcohol is added to the first vessel until an upper stratum of liquid is formed of $\frac{2}{20}$ to $\frac{1}{10}$ of the total volume. If spirit of another strength be used, the strength of the salt solution must be so arranged that the same proportion of water, alcohol, and salt exists in the resulting mixture. The upper stratum being very impure is run off into a special reservoir; a second stratum is then produced in the same manner as the first by adding a further quantity of spirit, the second stratum is used to produce a first stratum in the second vessel, and which when formed is run off into the reservoir containing the first stratum from the first vessel. A third stratum is produced in the first vessel in the same manner as before, this is used to produce a second stratum in the second vessel which is then used to produce a first stratum in the third vessel. These operations are continued until the lower stratum in the first vessel has become sufficiently pure, when it is run into the still; the first vessel is then filled with fresh salt solution and becomes the last of the series.

—A. L. S.

Improvements in the Treatment of Ground Malt for Brewing Purposes, and in Apparatus therefor. H. A. Birrell, Cardiff. Eng. Pat. 18,286, December 14, 1888. 8d.

This invention has for its object the restoration of certain properties, imparted to malt during kiln-drying, which have been lost owing to long storage. This is effected by passing the products of combustion of anthracite coal, cooled to a temperature of 150° F. or thereabouts, through the ground malt when in the hopper over the mash tun. For this purpose the hopper, as commonly used, is fitted with an inner casing of some perforated material, leaving a space between them. Into this space the products of combustion from a furnace burning anthracite coal are forced by a fan, and, passing through the perforated casing, diffuse through the ground malt. It is claimed that this is superior to the method for "retorrefying grist" by hot air at 150° F., as in this case the air is not sterilised by heating to the temperature, whereas in the former case the passage of the air through the fire effectually sterilises it. Drawings of the apparatus are given in the specification.—A. L. S.

Improvements in the Treatment of Alcohols and Alcoholic Liquors for the Purpose of improving their Quality. C. Philippart, Paris, France. Eng. Pat. 18,422, December 17, 1888. 6d.

THE inventor claims that the quality of alcohol, wine, liqueurs, &c. is improved by treatment with oxygen. He gives four alternative methods: (1) passing a continuous current of oxygen or air through the liquid under treatment; (2) passing a continuous stream of ozonised oxygen or air through the same; (3) the addition of oxygenated water or some easily decomposed peroxide ("lead, manganese, &c."); (4) the addition of some stable peroxide which may be decomposed by some suitable reagent producing an insoluble salt, e.g., barium peroxide and carbonic acid.

—A. L. S.

Apparatus for mixing Water with Malt for Supply to Mash Tuns. D. R. J. J. G. Morel, Pas-de-Calais, France. Eng. Pat. 13,451, August 26, 1889. 6d.

THE apparatus is to be fixed over the mash tun and consists of two concentric tubes, the walls of the inner one being pierced with holes. The annular space between the tubes

is in communication with the supply of mashing water, and the inner tube is placed under the mouth of the malt hopper. When the malt is falling through the inner tube, the water is turned on into the outer one, and, issuing in jets through the perforations above mentioned, mixes with the malt.—A. L. S.

Improvements in or relating to the Manufacture of Beer, Ale, Porter, and the like. L. Frisch, Chicago, U.S.A. Eng. Pat. 14,642, September 17, 1889. 8d.

THIS is an improved mashing process when raw grain is employed. By following out the details here given, the inventor states that a better yield may be obtained than by any other known method.

The cereal is mashed with water at about 30° R. in a closed boiler, and steam led in until the temperature rises to about 119° R., the whole being kept well stirred by suitable gear; after standing a short time, the steam is allowed to blow off, and the pressure in the boiler further diminished by a vacuum-pump until the temperature falls to about 59° R. A quantity of malt, containing sufficient diastase to convert the whole of the starch in the cereal, is mashed at about 38° R. and run into the liquid in the boiler, the whole being stirred until most of the starch contained in the liquid has disappeared; the temperature is then raised to about 70° R. by injecting steam, when the whole is led into a large mash tub containing a mash of two-thirds of the remaining quantity of malt to be used for the brew. After complete mixture the remaining one-third of the malt is added, and the mashing finished as usual. Drawings illustrating the method are given in the specification.

—A. L. S.

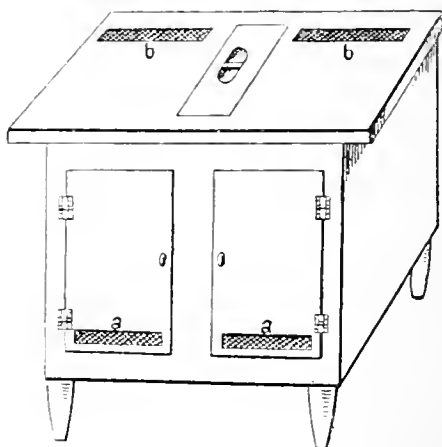
XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A)—CHEMISTRY OF FOOD.

The Decomposition of Food, and its Prevention. W. Hempel. Dingl. Polyt. J. 274, 82–95.

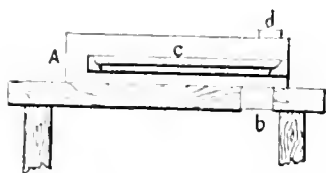
FROM a series of experiments, the author concludes that the three essentials for the perfect preservation of meat are cold, dryness and oxygen. Meat suspended over concentrated sulphuric acid, the drying being further hastened by good ventilation, kept perfectly for five months. Ozone also has a remarkable preservative effect on meat. Meat placed in a well ventilated vessel in which the silent discharge took place continually for 14 days, not only kept during that time, but was perfectly good nine months afterwards, having been exposed simply to the fresh air during the interval. In order to secure the above-named conditions, the author recommends meat safes to be made according to the principle laid down in the sketch, Fig. 1. In this the ice, used as a cooling

Fig. 1.



agent, is kept in a separate compartment, and does not, therefore, make the air damp at all. The safe is ventilated by means of the openings *a, a, b, b*. In the openings *b, b*, are placed frames containing shallow dishes of concentrated sulphuric acid *c, c*, Fig. 2. The air becomes dry and cold as

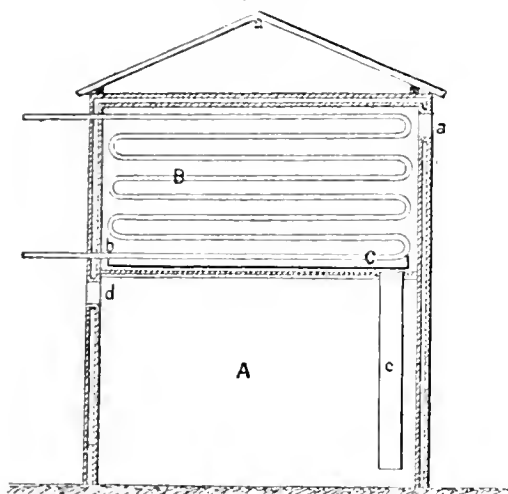
Fig. 2.



soon as it enters the safe from above, and being consequently denser, circulates downwards and passes out at *a, a*.

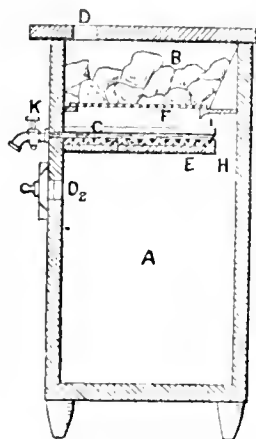
Where much larger safes are required, the air is dried by simply cooling it. Such an arrangement is shown in Fig. 3,

Fig. 3.



in the upper part of which a coil of piping is situated. The fresh air enters at *a*, and being cooled deposits its moisture in the tray *C*, and passes by *b* and *c* into the safe. This is not cooled specially, the cooled dry air maintaining a sufficiently low temperature. After the air passes by *c* into the lower part of the safe, it comes into contact with the moist meat, and, as it takes up moisture, its density is again lowered and the direction of the current changed into an upward one, the air passing out at *d*. Fig. 4 shows the section of another safe on the same principle.

Fig. 4.



A is the space for the meat; *B* the ice compartment; *C* the tray for collecting the water from the melting ice; *D, D*, the ventilators; *K* the tap for drawing off the water. The author finds that of gases, besides ozone, the vapours of nitric acid, nitrous acid, chlorine and chlorous acid, have a wonderfully preservative effect on meat when allowed, in small quantity, to pass with the dry cold air over it. Such meat, after exposure for some days to air containing these vapours, was hung up exposed to the ordinary atmosphere for months, after which it was perfectly sound, though dried up very much.—J. W. L.

PATENTS.

Improvements in the Preparation and Treatment of Extract of Tea. G. Christopher and R. W. Leftwich, London. Eng. Pat. 14,877, October 16, 1888. 6d.

EXTRACT of tea may be prepared by evaporating an infusion of tea to dryness in a vacuum pan. Finely ground, this is mixed with such proportion of dry powdered gelatin that when dissolved in boiling water little or no deposit occurs, nor is the liquid glutinous in character. Such a preparation obviates the injurious effect of tannin on the digestive organs. Lozenges of the mixture of gelatin and extract of tea mixed with powdered sugar may be prepared by well-known methods. If the tea from which the extract is made contain a large quantity of tannin, this may be removed by the addition, at a temperature of 150° F., of a smaller quantity of gelatin than is requisite to keep the resulting tannate of gelatin wholly in solution. Evaporation to dryness is then effected, water added and the whole digested at 135° F.; the plastic tannate of gelatin is removed by filtration, or otherwise, and washed. The extract and washings are finally evaporated to dryness, for use as first described.—C. C. H.

An Improved Preparation to be used as a Substitute for or in Combination with Coffee. E. Edwards, London. From I. Lapeyrère, Mlle de la Réunion, France. Eng. Pat. 14,945, October 17, 1888. 6d.

For the inert or somewhat injurious substances, *e.g.*, chicory, usually mixed with coffee, the patentee substitutes a substance, similar to coffee in composition, known as *Mussaenda-Borbonica*. This may be roasted with the raw coffee berries, and mixed in any proportion with, or entirely substitute, the coffee. The infusion is prepared in the manner coffee is usually prepared.—C. C. H.

Improvements in and relating to the Manufacture of Milk-Powder and Effervescent Beverages. W. Gerbel, Rorschach, Switzerland. Eng. Pat. 1301, January 22, 1889. 6d.

The milk is heated to 100° or 105° F., rennet or tartaric acid added, and the curd so formed separated from the whey in any convenient manner. The curd is finely chopped or minced, and, upon a hearth or in an oven, dried at a temperature of 110° to 120° F. for a period of six hours, during which time it is frequently turned or stirred. After cooling for a similar period it is again heated and cooled, this process being repeated three or four times. It is then ground finely for use. The whey, after separation from the casein, is freed from whey cheese by heat and the addition of tartaric acid, the cheese being added to the casein before its treatment as above described. It is then filtered, mixed with enough grape, cane or milk sugar to generate sufficient carbonic acid gas to give an agreeable flavour, or it may be saturated with carbonic acid gas, as in the production of aerated beverages, and bottled.

—C. C. H.

Improvements in Bread Fermentation. A. B. Lennox, T. Field, and W. Brown, London. Eng. Pat. 11,225, May 3, 1889. 4d.

In place of part of the potatoes ordinarily employed to promote a vigorous fermentation in the yeast used in the making

of bread-stuffs, the patentees use a special form of malt sugar, which they call "Fermentol." In this way they claim the production of a lighter and better bread, with a saving of 25 per cent. of yeast and 50 per cent. of the potatoes usually employed.—C. C. H.

(B)—SANITARY CHEMISTRY.

On Purification of Effluent Water as carried out at the Establishment of W. Spindler at Spindlersfeld. C. F. Göhring. Chem. Zeit. **13**, 851.

ABOUT 10,000 cubic metres (over 2,200,000 gallons) of effluent water from dye and bleach works, sewage, &c., are treated daily in the above establishment. It is first treated by decomposition of the soapy water for recovery of the fat. The water is purified so far by settling in enormous reservoirs, the reactions occurring in the heterogeneous mixture. The coarser filth is thus separated and contains a mixture of iron oxide, tannin, colouring matter, fatty acid, salts, &c. The water, however, is still far from pure, and develops fungi. The average daily analysis of such is: temperature, 20°; colour, blue-black; reaction, acid; smell, like dyewood extract; suspended matter, tannate of iron, extractive, textile fibre, &c. On filtration, brownish-black and containing in 100,000 parts—

Total solids.....	88.0
Fixed residue.....	53.0
Volatile residue.....	35.0
Lime.....	6.52
Magnesia.....	0.81
Ferric oxide and alumina.....	4.42
Sulphuric acid.....	12.67
Chlorine.....	5.11
Nitric acid.....	1.72
Nitrous acid.....	None
Ammonia.....	0.23

The water roughly filtered through gratings is pumped into a lesser mixing basin and treated with milk of lime and magnesium chloride solution, pumped thence to larger settling basins, from which after a time the water is run off. The purification thus effected and that due to the oxygen absorbed during an aëration effected by mechanical means produce a satisfactory result.

Analysis shows temperature 12°; colour, clear reddish; reaction, neutral; smell, none; suspended matter, none.

In 100,000 parts—

Total solids.....	66.01
Fixed residue.....	54.00
Volatile residue.....	12.01
Lime.....	15.72
Magnesia.....	1.04
Ferric oxide and alumina.....	0.17
Sulphuric acid.....	11.84
Chlorine.....	6.55
Nitric and nitrous acids.....	None
Ammonia.....	None
Total hardness.....	17.01
Permanent hardness.....	16.08
Temporary hardness.....	0.21
Oxygen absorbed.....	9.72

Thus the greater part of the ferric oxide and all of the deleterious organic matter has been removed; the water, moreover, no longer develops fungi.

The fatty sludge has a specific gravity of 0.850, and contains moisture 10 per cent., fatty acids 53 per cent., mineral acids, tannin, colouring matter, fibre, &c. This is eventually pressed in a steam press for recovery of the fat.

The sludge from the settlers is dark green with moisture 81 per cent.; combustible and volatile residue, 11.8; ash, 7.2; the latter containing lime, 22.4; magnesium, 10.3; peroxide of iron and alumina, 15 per cent.—D. A. S.

Investigations into the Efficiency of the Sand-Filters in use at the Zurich Public Waterworks. A. Bertschinger. Vierteljahrsschr. d. naturforsch. Ges. in Zürich, **34**, Pt. 2.

SINCE 1886 Zurich has been supplied daily with 20,000 cubic metres of water derived from the lake at a distance of 200 metres from the shore, and conveyed through iron pipes to the filters. These are five in number, two of which are arched over, and the others uncovered; each has a filtering surface of 672 sq. metres. The filtering material rests on a brick grating and consists of the following layers commencing from the bottom: 5—15 cm. of coarse gravel, 10 cm. of garden gravel, 15 cm. of coarse sand and 80 cm. of fine sand. The rate of filtration is regulated separately in each filter.

As soon as the diminution in pressure of the water, due to the resistance of the filter, is 60 to 80 cm., the filter is cleaned by allowing the water to run off and removing the top layer of sand to a depth of 2 cm. as this is found to contain the whole of the mud. The filter is then filled up with filtered water from below and washed by allowing this to overflow. After filtration has recommenced the first portion of the filtrate is rejected. The covered filters require to be cleaned once in 77 days, and the uncovered once in 48 days. As soon as the layer of fine sand has been reduced to a thickness of 50 cm. fresh sand is substituted or more added until the depth is again 80 cm.

Chemical and bacteriological examinations of the water before and after filtration show that:—

1. The sand filtration materially improves the chemical purity of the water.

2. Under normal conditions the filtered water is free from germs, although a few are taken up again in the later stages of the filtration and also after it.

3. The rate of filtration (at least between 3 and 12 cubic metres of water per sq. metre of filtering surface in 24 hours) has no influence on the purity of filtered water, all spores being removed by the uppermost layer of sand.

4. After cleaning the filter, the water which first passes through it is not in a normal condition, but contains many germs, an efficient layer of scum not having had time to collect on the sand though the chemical purity of the filtered water is unaffected.

5. When the filters have not been used for some time the water which first passes through them contains many more bacteria than usual owing to their rapid multiplication in the stagnant water, but the chemical purity of the water is again not materially different from the normal filtered water.

6. No difference exists between the water from the covered and from the uncovered filters, either as regards chemical purity or freedom from bacteria.

Numbers 3 and 6 of the above results are new and of great importance, for the former shows that water can be filtered much more rapidly than has hitherto been supposed (at Berlin the maximum rate of filtration allowed has been 3 metres daily). Further, the belief that open filters remove micro-organisms from water much more completely than covered filters is thus shown to be erroneous.—E. E. B.

The Examination of Potable Waters. H. Fleck. Zeits. f. angew. Chem. 1889, 580.

ACCORDING to the author the following points are essential in a good potable water:—

1. It must be clear, colourless, and odourless. Any sediment from the water may only contain very few micro-organisms. 2. It must give a colourless residue on evaporation. Even if colouration be due to the presence of iron and manganese compounds the water must be looked upon as impure. 3. On being kept for eight days in a closed vessel it must not show brown or green organisms. 4. It should not require more than 2 mgrms. of oxygen per litre, for oxidation. 5. It should not contain more than 0.1 mgrm. of ammonia per litre, and should not become cloudy on being boiled with alkaline silver solution. 6. It should not contain more than 20 mgrms. of chlorine and 10 mgrms. of nitric acid if the amount of ammonia present exceed the above-mentioned limit. 7. It must not contain a trace of nitrons

acid. 8. It may not contain phosphoric acid. 9. It should not show more than 30° (German) of hardness.

In examining the water for sewage contamination, 1 to 2 litres of the water should be evaporated to dryness with a little tartaric acid, the residue extracted with absolute alcohol, the solution evaporated to dryness and the residue moistened with potash lye. If contaminated with organic matter a distinct odour of faeces will be detected.

—F. W. T. K.

Water Filtration. C. Piefke. Zeits. f. angew. Chem. 1889, 580—586.

The conclusions arrived at are briefly as follows:—The purification of water when filtered through sand must not be looked upon as due to absorption or oxidation of the organic matter in it, but to the fact that the sand acts as a mechanical filter and holds back suspended matter and bacteria, which latter exert a fermentative action on the organic impurities in the water. This will explain why fresh sterilised sand exerts no filtering action on the water, whereas a sand filter which has been in use for some time and has got somewhat dirty, especially in the upper layers, purifies the water, providing the rate of filtration be not too rapid for the particular class of sand and the quality of the water undergoing filtration. The upper sand layers retain inorganic sediment, if not too fine, and bacteria; these latter feed on the organic materials in the water, and the products of fermentation and unfermentable matter alone pass through. The deeper layers of sand hinder the passage of sediment and of bacteria, which latter are perhaps somewhat more easily held back owing to their slightly viscous nature, and provided the flow of water through the sand is not too rapid, they are not easily washed away again. Of course, after a certain period, deeper and deeper layers of the filter get more and more contaminated. It is important, therefore, to see that the lower layers of a sand filter, the filtering action of which is more of a mechanical nature, consist of clean sand to start with which should not be allowed to get too contaminated.

There seems very good reason to believe that such organic matter as is left after filtration is innocuous, in so far as it represents fermented material and is, therefore, not liable to further fermentation or putrefaction. The point of greatest importance which has to be noticed is that the rate of filtration should be sufficiently slow for the quality of water to be filtered. The richer in micro-organisms the water is, the slower the filtration should be. If the rate of filtration be carefully attended to, the question of the thickness of sand becomes a point of minor importance, for, with a moderate rate of flow, a layer 0·7 m. thick was found to act all but as efficiently as one 1·4 m. thick, which latter was practically as effective as one 2·1 m. thick, the water moving at the same rate. A rate of flow of 0·1 m. an hour should not be exceeded unless absolutely necessary. With impure waters the rate of flow should be much less.

The "rate of filtration" is measured by the height of the column of water which sinks through the bed of sand in an hour. To determine from this "rate of filtration" what the rate of flow is in the sand itself it is necessary to know the volume percentage of the pores in the sand, *e.g.*, with a "rate of filtration" of 100 mm. an hour and a sand, the volume percentage of which is 25 per cent., the "rate of flow" in the sand itself will be $4 \times 100 = 400$ mm. an hour.

—F. W. T. K.

People Poisoned in 1888.

THE Registrar-General reports that, of the 701 people who were poisoned in 1888, 377 were males and 324 females. Of the males, 260 were in the accidental and 117 in the suicidal class. The former included 172 females, and the latter 151 females. It may be said that one out of nearly every five men, and one out of nearly every four women who commit suicide resort to poison.

The following are the particulars of the poisons which were used with fatal effect, and the frequency with which they were used:—

	Accidental.	Suicides.
Arsenic.....	5	5
Mercury.....	4	1
Lead.....	106	1
Sulphate of copper.....	1	..
Antimony.....	1	..
Bichromate of potash.....	2	..
Iodine.....	1	..
Chloride of zinc.....	2	..
Ammonia.....	5	4
Phosphorus.....	9	11
Sulphuric acid.....	5	6
Nitric acid.....	2	4
Hydrochloric acid.....	6	14
Oxalic acid.....	3	19
Carbolic acid.....	37	64
Acetic acid.....	1	..
Benzoline.....	1	..
Camphorated oil.....	1	..
Opium, laudanum, morphia.....	35	61
Bateman's pectoral drops.....	1	..
Cough elixir.....	1	..
Chlorodyne.....	10	1
Alcohol.....	6	..
Parazoline.....	1	..
Narcotic.....	3	3
Chloral.....	1	2
Colchicum.....	1	..
Belladonna.....	6	2
Prussic acid and oil of almonds.....	2	20
Hemlock.....	2	..
Colocynth.....	1	..
Aconite.....	4	..
Thorn apple.....	1	..
Yew leaves.....	1	..
Fungi.....	2	..
Strychnia, nux vomica.....	4	17
Whinflower.....	1	..
Weed.....	1	..
Meadow crowfoot.....	1	..
Berries.....	1	..
Improper food.....	1	..
Poisonous fish.....	4	..
Liniment.....	5	1
Decomposed fruit.....	4	..
White precipitate.....	..	1
Corrosive sublimate.....	..	1
Salts of lemons.....	..	1

	Acci- dental.	Suicides.
Corrosive acid	4
Paraffin	1
Turpentine	1
Cyanide of potassium	10
Vermine killer.....	..	21
Dynamite.....	..	1
Kinds not stated.....	20	44

By lead-poisoning is meant the disorder which workers in lead factories suffer from. The number was slightly higher than in the year preceding. The principal feature of the above returns is the remarkable increase in the number of deaths from carbolic acid. This is by no means a new fact, for the rate at which people were dying from this poison in the summer of 1888 caused at the time considerable public alarm and an agitation to have the sale of the acid restricted. The figures before us show that the actual number of deaths was 101, as compared with 52 in the year before. With this exception the figures on the list are much similar to the average. Oxalic acid is lower in the suicide class, vermine-killer higher by six, and strychnine by five. Opiates are 10 higher in the same class, and mineral acids on the whole lower. Chlorodyne caused a few more accidental deaths.

PATENT.

Improvements in the Treatment of Towns' Refuse and other Putrescible Matters. A. Bobrownicki, London. Eng. Pat. 13,761, September 24, 1888. 6d.

EXCRETA or domestic refuse as collected by the "Pail System," wet sewage, sludge and the like, are treated by this process in order to render them innocuous and also to partially dry them. The substances named are subjected, in a variety of ways described in the specification, to the action of the products of combustion of fuel or of the distillation of coal, tar, resin and other fuels and hydrocarbons. When the putrescible matter is possibly infected with the germs of cholera, small-pox, or other such diseases, the temperature of the gaseous bodies effecting the treatment may with advantage be as high as 200° C. to 300° C. The injection of the vapours may be effected by means of a fan or blower.—C. C. H.

(C)—DISINFECTANTS.

PATENTS.

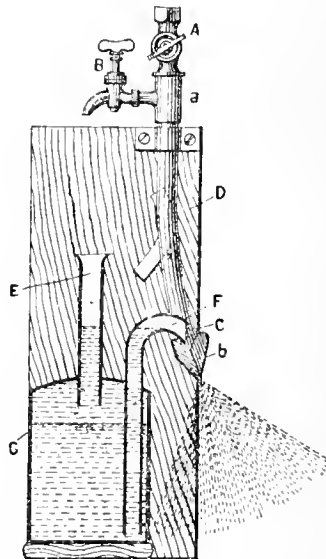
Improvements in Disinfectants and Compounds for the Supply of Sulphur Dioxide for other Purposes. J. E. Reynolds, Dublin. Eng. Pat. 15,676, October 31, 1888. 4d.

THE patentee styles the disinfectants prepared as hereafter described "Thiocamf Disinfectants." Camphor is treated with cooled sulphurous anhydride in a suitable vessel, e.g., a Woulfe's bottle, and the liquid resulting saturated with from 30 to 35 per cent. of its weight of sulphurous anhydride. With this may be mixed various disinfectants, e.g., benzoic and salicylic acids, boracic anhydride or mercuric chloride, oil of eucalyptus, nitrobenzene, phenols, &c. Such a mixture when exposed on a large surface, preferably over a vessel containing hot water, gives off large volumes of powerful disinfectant vapours; the residue is useful for cleansing woodwork.—C. C. H.

Improvements in Apparatus for Distributing Disinfectants. T. Rowan, Weston-super-Mare, and L. Hakeman, London. Eng. Pat. 15,925, November 3, 1888. 8d.

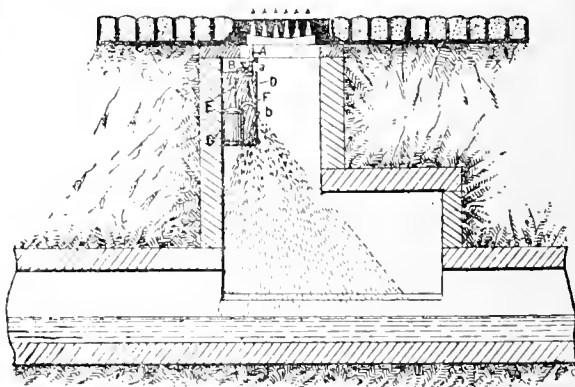
THE accompanying figure shows the construction of the improved apparatus. The stop-cock A is attached to a

Fig. 1.



water-main, and from the end of pipe at C the water issues in jets which impinge on each other and so form a fine spray or mist. The vessel G contains the disinfectant in a liquid form, which is displaced therefrom by a regulated fall of water from tap B; the drops of disinfectant displaced meet

Fig. 2.



the jets issuing at C in the basket b and thus become intimately mixed therewith and well diffused. This form of apparatus is adapted for the disinfection of sewers, and for this purpose is fixed at a convenient distance above the sewer in the manholes usually provided as shown in Fig. 2.

—C. C. H.

Improvements in the Preparation of Antiseptics, Disinfectants, and Sanitary and Bleaching Reagents. C. T. Kingzett, London. Eng. Pat. 15,994, November 3, 1888. 4d.

THE bisulphates of potassium and sodium act as powerful antiseptics and preservatives. If employed in the solid form as powder, crystals or tablets, they are impregnated with five or ten per cent. by weight of "Sanitas oil" or other

similar antiseptic. If used as a solution, five to ten per cent, by weight is dissolved in solutions of hydrogen peroxide capable of yielding five to ten times their volume of oxygen on decomposition. The proportions above given may be varied.—C. C. H.

An Improved Compound or Composition for Developing Ozonised Oxygen. J. E. P. Meyer, Golden, Colorado, U.S.A. Eng. Pat. 16,463, November 13, 1888. 6d.

The patentee's object is a simple mode of preparing ozone in sick-rooms. Dry powdered barium permanganate and sodium bisulphate are intimately mixed in the proportion of 25 per cent. by weight of the former to 16 per cent. of the latter, and an inert body such as barium sulphate may be added to give bulk. If sufficient water be added to a portion of such mixture so as to form a thick syrup, ozonised oxygen will be evolved.—C. C. H.

Preserving Shell Fish for Bait, and Utilising the Shells thereof. J. Hunter, Greenock. Eng. Pat. 16,660, November 16, 1888. 4d.

The fish are removed from the shells, and steeped in an aqueous solution of boracic acid and glycerin. The shells are ground, dissolved in acid, and used as a manure.—C. C. H.

An Improved Antiseptic Compound for Preserving Perishable Articles. W. H. Daniels, Chicago, U.S.A. Eng. Pat. 2858, February 18, 1889. 4d.

This specification describes improvements upon Eng. Pat. 17,843 of 1888. The compound there described consisted of a mixture of sugar, saffraas, sulphur, cinnamon, and potassium nitrate in proportions specified. The improved compound contains sugar and saffraas in about one-fourth the proportion formerly given: Sulphur, 16 oz.; sugar, 1 oz.; saffraas, 1 oz.; cinnamon, 2 oz.; and potassium nitrate, 2 oz. are mixed and ground together so as to form a homogeneous mass. The perishable articles are submitted to the fumes of a portion of the compound ignited in a closed chamber. —C. C. H.

Improvements in Sanitary and Antiseptic Preparations or Compounds. R. Hannan, Glasgow. Eng. Pat. 5984, April 8, 1889. 4d.

Common borax and boracic acid are mixed together in a finely divided state, preferably in the proportion so that when heated at 212° F., and evaporated to dryness, a "quadriborate of soda" will be formed. One part of this is intimately mixed in a grinding mill with 40 parts of a soluble salicylate, preferably sodium salicylate, and an aromatic substance, e.g., camphor, or oil of lavender added. The compound so produced is highly antiseptic in character, and may be used for the preservation of animal food substances and for surgical dressings. Whilst possessing high antiseptic properties it is non-poisonous.—C. C. H.

An Improved Manufacture of Absorbent Fabric. M. Chotzen and O. Silbermann, Breslau, Germany. Eng. Pat. 12,367, August 3, 1889. 4d.

COMPRESSED wadding, impregnated with any antiseptic substance, is enclosed between two sheets of gauze affixed thereto by roller pressure. Flannel, muslin, or thin sheets of paper may be used instead of wadding and gauze. The fabric so prepared is adapted for surgical purposes.—C. C. H.

XIX.—PAPER, PASTEBOARD, Etc.

On Colloid Cellulose, Soluble and Insoluble, and the Composition of Parchment Paper. C. E. Guignet. Compt. Rend. 108, 1258—1259.

FILTER paper washed with hydrochloric and hydrofluoric acids is nearly pure cellulose. Superior cotton may also be used for experiments, but yields more greasy products. Treated with sulphuric acid of 50° B. cellulose yields a transparent gelatinous mass, which does not change, even in the presence of an excess of acid, though is quickly changed into dextrin when heated to 100° C. Pure colloid cellulose is soluble in water, forming a slightly milky liquid, which filters easily and does not become clear, even after standing for days. The solution is dextro-rotatory, and is precipitated by small quantities of foreign matter. Colloid cellulose does not reduce tartrate of copper or sodium, it differs in that respect from the achroo-dextrins. Dried on marble, coated with vaselin, it forms a semi-transparent brilliant film, and plunged into sulphuric acid of 55° or 60° B., it is rendered insoluble, a partial formation of dextrin taking place. Nitric acid produces the same effect upon it as on ordinary cellulose. The properties of colloid cellulose explain some peculiarities in the manufacture of parchment paper. Certain parchments of vegetable origin, which are very thin, are acted upon by boiling water, consisting of colloid cellulose, whereas thicker paper is not affected by the same treatment, undoubtedly owing to a stronger acid being employed in the manufacture of the latter. In both cases colloid cellulose has been produced, but in the second the cellulose has become insoluble. Vegetable parchment seems to consist of ordinary cellulose, the pores of which are filled by colloid cellulose. Amongst the natural products which hitherto have been investigated, none resemble colloid cellulose; pectic bodies, gelatin, &c. distinguishing themselves by essential properties. These bodies are not precipitated by the presence of small quantities of foreign matter, which, however, is the case with colloid cellulose.—O. J. S.

PATENT.

An Improvement in the Manufacture of Rosin Liquor for Paper Makers and others. C. Morfit, London. Eng. Pat. 18,716, December 21, 1888. 6d.

THE patentee uses sodium aluminate as a solvent for rosin in place of the sodium carbonate or hydrate commonly employed. It is stated that the solution thus obtained is not liable to act caustically on the paper, and that the rosin becomes white in the process of preparation, which is as follows:—Six pounds of caustic soda of "72° test" are dissolved in 6 galls. of water heated to 200°—212° F. by open steam; 5 lb. of alumina are added, and the heating and agitation produced by the steam continued until solution is effected, when enough cold water is added to bring the bulk to 10 galls. The clear liquor is drawn off, heated to 200°—202° F. by open steam, 30 lb. of rosin added and the heating and agitation continued until it has dissolved. The liquor thus obtained which is to be called "Comaralyk" is apt to deposit rosin on standing; to obviate this difficulty the solution of sodium aluminate before the addition of the rosin may be diluted with 20 galls. of water, and after the solution of the rosin with a further quantity of 20 galls. of water which must be previously heated to 200°—212° F. This product is to be termed "Lycophil."—B. H.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Report on New Drugs and Fine Chemicals. Merck's Bull. 2 (8), 1889, 61—68.

Amylenhydrate (Kahlbaum) (*Tertiary Amylic Alcohol, Dimethyl-ethyl carbinol*) ($(CH_3)_3(C_2H_5):C.OH$).—This hypnotic possesses a peculiarity shared by several substances of its class, to wit, that its hypnotic action is pure and innocuous, and devoid of accessory or subsequent symptoms when the medicament is of a very high degree of purity; also that the substance has been sometimes erroneously held responsible for untoward effects perceived after its use, but which were altogether due to impurities resulting from inefficient methods of preparation.

The pure carbinol in question is a very mobile colourless liquid, of sp. gr. 0.81, and boiling point $100^\circ C$. When pure it is soluble in 8 parts of water and is miscible with alcohol in all proportions. Its taste is ethereal and yet like camphor, with a cooling, peppermint-like after flavour. For the physiological action of pure Amylenhydrate see the *Therap. Monatshefte* for 1887, July Number, Dr. J. von Mering.

Anemonin is the active principle of *Pulsatilla* (*Anemone P.*). It consists of colourless acicular crystals, melting at $152^\circ C$, very sparingly soluble in water or ether, but easily in warm alcohol. It is a cerebral poison, the lethal action of which proceeds by annihilating the functions of the central nervous system—the effect being preceded and accompanied by spasmodic and paralytic phenomena. This is when large doses are taken. Anemonin cannot be classed as a strong poison. It is useful in bronchitis and asthma.

Monobromide of Gold (Aurous bromide), *Au Br*, forms a yellowish-grey friable mass, insoluble in water. It has been made known as an *Anti-epileptic* of great promise through a treatise of Goubert's (*Journal de Médecine de Bruxelles*, 1889, No. 5). This treatise has been awarded a prize by the Parisian Academy of Sciences. Goubert recommends it as being an epileptic medicament better borne than any other bromine compound known, and it has been used in all varieties of *Hemicrania* and in *Struma ecophthalmica*.

Guaiacol (*Monomethyl catechol*), $C_6H_4(OCH_3)OH$ [1:2] the active principle of wood-tar creosote, is spoken of as the sovereign remedy in *Pulmonary tuberculosis*.

Creosote is, however, a complex substance containing 60–90 per cent. of guaiacol with a remainder composed of the cresols and homologues of other phenols and phenolic ethers. Sahli of Berné in accordance with the tendency of modern medicine to employ *homogeneous substances*, recommended that instead of even the best prepared creosote guaiacol itself should be used. Hence of more recent date guaiacol has been exclusively employed in the treatment of *tuberculosis*. It is necessary then to consider the physical and chemical reactions of pure guaiacol. It is a colourless oily liquid, strongly refractive, with peculiar aromatic odour, and sp. gr. of 1.1171 at $13^\circ C$. It boils at $201^\circ C$, is soluble in 200 parts of water and is miscible with alcohol, ether, and carbon bisulphide. Its alcoholic solution is coloured blue by the addition of a little ferric chloride, whilst a larger addition changes the colour to green. One volume of guaiacol with two of petroleum ether forms a turbid mixture, which remains clear at $13^\circ C$ on addition of six further volumes of the petroleum spirit. One volume of guaiacol with two of carbonate of soda solution yields a clear mixture, soluble in 10 volumes of water and giving a clear colourless solution. One volume of guaiacol with two of potash solution solidifies in a short time to a white crystalline mass.

THE MYDRIATIC ALKALOIDS OF THE SOLANACEÆ.

Bulletin No. 9. 69—76.

A mydriatic drug is a substance capable of producing *Mydriasis*, i.e., dilation of the pupil of the eye.

The mydriatics which have so far gained therapeutic prominence so far are found in plants of the natural order of the *Solanaceæ*, and the active principles in those plants to which the action is due are certain alkaloids existing therein in combination with vegetable acids, and separable therefrom by certain chemical processes. Among the solanaceous mydriatic alkaloids are to be distinguished the class of Homogeneous or simple bases, such as *Atropine*, *Hyosine*, and *Hyoscyamine*, and that of the Heterogeneous, or mixed bases, such as *Daturine*, *Duboisine*, *Syrupy Hyoscyamine*, and *Scopoline*. The latter class comprises natural mixtures of the simple alkaloids of the first class in such ratio of mutual strength as that in which they are found naturally, and present together in various plants, such as *Datura stramonium*, *Duboisia myoporioides*, *Hyoscyamus*, *Scapolia japonica*, &c. To the heterogeneous class likewise probably belongs the newly discovered mydriatic base *Mandragorine* from *Mandragora vernalis*.

The Homogeneous, or simple Mydriatic Alkaloids, so far as they are known, are all possessed of one common empirical formula, $C_{17}H_{23}NO_3$, i.e., they are mutually isomeric, and the chemical distinction between them is based principally on the different forms and behaviour of their double salts with the heavy metals and partly of their fractional derivatives.

Besides the natural solanaceous alkaloids as already named, there is already in wide therapeutic use an artificial mydriatic simple alkaloid, procured synthetically from mandelic acid and tropine (a fractional derivative of atropine); this is—

Homatropine, $C_{16}H_{21}NO_3$. Its formula shows that it is the next lower homologue of atropine, hyoscyne, and hyoscyamine. This close chemical relationship is more than borne out by its physiological similarity to them. The latest chemical researches have established the probability that the three isomerides, atropine, hyoscyne, and hyoscyamine are even more closely related than what the mere condition of *isomerism* would necessitate. With atropine and hyoscyamine this is a settled fact. Whether polymerism is here involved has not yet been ascertained. It has been long known that both atropine and hyoscyamine may be obtained from *Atropa belladonna*, according to the different processes of extraction and isolation employed. Schmidt and Will have moreover established the fact that the hyoscyamine from *Atropa belladonna* may be converted into atropine by keeping it for some time at a temperature above its melting point, or by treating it with a small quantity of alkali.

Notwithstanding, however, the gradual weakening of the bonds connecting these alkaloids by chemistry, the differences hitherto found by physiology are not only fully maintained but even intensified, as the result of recent research.

With atropine, toxic symptoms of the severest kind are liable to arise, but pure hyoscyamine is, according to Gnauck, less toxic than atropine, which it resembles in the general direction of its effects. However a characteristic difference distinguishing it from atropine consists in its action in small doses as a true hypnotic. Hyoscyne likewise gives the effect of atropine and is not followed by the dangerous general symptoms frequently consequent upon treatment with atropine. Hyoscyne is also, like hyoscyamine, an excellent hypnotic. Homatropine, in general direction of effects, corresponds entirely to atropine, but it essentially differs from atropine in the course of its mydriatic effect, which whilst being characterised in its maximal period almost exactly like that of atropine, exhibits a very considerably briefer continuance than the atropine effect.

Atropine.—The pure alkaloid appears in fine, silky, colourless, odourless needles of bitter acid taste. They melt at $113.5^\circ C$, dissolve in 200 parts of cold or 54 parts of boiling water, in $2\frac{1}{2}$ parts of 90 per cent. alcohol or 60 of ether, and are very easily soluble in chloroform and amyl alcohol.

The aqueous solution undergoes rapid change by contact with the air, becoming yellow and acquiring a disagreeable smell, though not losing the toxic character.

The uncombined alkaloid is very little used, the salts, especially the sulphate, being preferred.

Atropine Sulphate ($C_{17}H_{23}NO_3$) $_2 \cdot H_2SO_4$, is colourless and odourless, neutral, easily soluble in alcohol and in water, but less so in ether. It contains 85½ per cent of atropine.

Atropine Valerianate and Atropine Borate are extensively used. The indications and effects are the same as with the sulphate. One individual may be killed by a dose of 0.01 gram of atropine whilst another may recover from the effects of a dose of 0.25 gram, so different is the action in the case of different individuals. The antidotes are emetics such as apomorphine hydrochloride (0.005 to 0.01 gram), chloral hydrate, 3 grms., several times repeated, and also pilocarpine subcutaneously administered, 0.02 gram, several times repeated.

Adonidin.—A glucoside containing 42 per cent. of carbon, 7.5 per cent of hydrogen, and no nitrogen. It is the active principle of *Adonis vernalis*. Opinions as to physiologic action have been hitherto at variance. Gergiejenko of Kasan (Gaz. Lek. 1888, 8, 32) instituted a new series of experiments with it, which show that adonidin acts on cold-blooded animals as a heart poison, whilst in warm-blooded animals it acts toxically on the medulla oblongata.

Adonidin is a hygroscopic, yellowish-white powder, readily soluble in water and in alcohol, insoluble in ether, chloroform, and benzene. When heated above 90° C. it is transformed into a blackish-brown mass.

The tannate is the form in which adonidin is preferably administered.

Eseridine.—It has been stated of this new substance, prepared by Boehringer in a crystalline form, that it partakes only of the therapeutically useful but not of the obnoxious and dangerous properties of eserine. Particular stress has been laid on its possessing only one-sixth the toxic power of eserine. However, Schweber of Prof. Robert's Pharmacological Institute at Dorpat, after a series of experiments, concludes that eseridine possesses no advantages over eserine. The chief drawback to both, and equally shared by them, detracting in fact from the usefulness of the calabar alkaloids generally, is the ready susceptibility of the heart to their action. In short the assertion that eseridine is free from the toxic action of eserine is false. (This Journal, 1889, 413, see *Eserine-Pilocarpine*.)

NEW MERCURY COMPOUNDS.

Bulletin No. 10. 77 to 84.

Soon after the hypodermic method of treatment with mercurial preparations for syphilitic diseases had been amplified, there was shown a desire for a greater choice of mercurial preparations adapted for subcutaneous injection.

Among the mercurial compounds introduced for this purpose, one class is distinguishable by ready solubility in the animal fluids, and consequently for rapid absorption into the system, whilst another is distinguished for slow solubility and for its consequent double mode of action, combining the advantages of acute with those of chronic mercurialisation. Prominent in the latter class are the *Mercurio-phenolide double salts*, which consist of compounds of mercury with the various phenols.

It may be well first to describe the simple mercurio-phenolides which have already been put to therapeutic uses.

I. SIMPLE MERCURIO-PHENOLIDES.

Mercury Phenate (Mercurio-Phenol).—Gamberini first introduced the mercury phenates into therapeutics.

The particular modification of mercury phenate produced as a precipitate by the reaction between solutions of bichloride of mercury and sodium carbonate (phenate) is the one known by the affixed name of Schadeck, its originator. According to the conditions governing the process of precipitation, more or less basic products are obtained, distinguishable by their colours, which vary from greyish-white to yellow and orange. These products are of varying strength of mercury.

Mercurio-Thymol, $C_{10}H_{12}(Hg).OH$ —This has in England been recommended for therapeutic use (*Medical Standard*, 1888, July). It is, like the above-described phenate, a

precipitate, and is similarly obtained from the solutions of sodio-thymol and of mercuric nitrate. Its colour is purplish-green. The formula given is that ascribed by Lallemant (*Ann. de la Chim. et Phys.* 3, 49, 118). It is stated of the basic compound that it lacks permanence.

Mercurio-β-Naphthol is highly praised by E. Bombelon (*Pharm. Zeit.* 1888, 98, 739) for its highly beneficial action, applied externally, in the case of old sores and wounds, eczemas; also internally in typhus. It is a lemon-yellow powder, capable of crystallisation according to Bombelon. It is devoid of odour and taste, and is insoluble in the ordinary solvents. The method of its preparation and its composition are not published.

II. MERCURIO-PHENOLIDE DOUBLE SALTS.

These compound phenolides are distinguished from the various simple phenolides referred to by assuming a clear crystalline form and by their chemical composition, which includes, besides mercury and a phenol, also an organic or inorganic acid as an essential molecular constituent.

Of these compounds the following have been so far introduced:—

Mercury Phenol Acetate.—A well-crystallised salt, appearing in minute colourless needles, collected into spheroidal conglomerations. In other particulars it much resembles the thymol acetate.

Mercury Thymol Acetate.—A very distinctly crystalline salt of constant composition and permanent character; white, odourless, and tasteless.

Mercury Thymol Nitrate and Mercury Thymol Sulphate.—These are similar to the foregoing.

Mercury β-Naphthol Acetate has been recently prepared, and appears as a white crystalline substance, which in its various properties is very much like the thymol acetate and phenol acetate of mercury. (See this Journal, 1889, 566.)

Mercury α-Naphthol Acetate and Mercury Tri-bromophenol Acetate are yellow compounds.

Mercury Resorcinol and Mercury Phloroglucol Acetate have also been prepared. The former of these is yellow. These latter compounds are still undergoing chemical investigation. It can, however, be definitely stated that mercurio thymol acetate has yielded excellent results.

Tertiary Amyl Nitrite (Bertoni's Amylo-nitrous Ether) $C_5H_{11}NO_2$.—This compound was prepared by Bertoni, Professor of Chemistry in Pavia University, as a substitute for ordinary amyl nitrite (*Iso-amylic nitrite*). Its constitution is represented by the formula—



whilst that of ordinary amyl nitrite is—



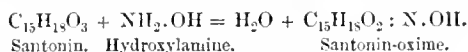
Tertiary amyl nitrite has a weak camphor-like and not disagreeable odour and a taste of peppermint. It boils at about 30° C. With the addition of a trifle of anhydrous sodium nitrate, it may be preserved undecomposed for a long time.

According to Balp and Broglio (*Bolletino Farmaceutico*, 1888, July, 193), the physiological action of tertiary amyl nitrite is the same in kind as that of iso-amylic nitrite, but somewhat stronger in degree and more enduring. It also admits of larger doses being taken by inhalation without danger, and is altogether safer. Given by inhalation it is followed by about half an hour's sleep. Subcutaneous injections can be made of tertiary amyl nitrite by dissolving it in aqueous glycerol.

Caffeine associated with Hypnotics in Heart Diseases.—The conclusions following the experiments of Schröder, and V. Carello and Carno Pecosaro (*Annali di Chim. e Farmacol.* 1889, April, 255), are that caffeine is best associated with paraldehyde, and that with organic heart disease no chloral hydrate must be used, whilst paraldehyde is admissible, being much milder in its action on the heart.

Santonin-orime is stated to be a non-toxic substitute for santonin. The oxime in question was prepared by Cannizaro

by the action of hydroxylamine hydrochloride on an alkaline solution of santonin according to the equation—



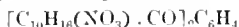
Thus, the oxygen atom of the ketone group in the santonin enters the hydroxylamine, splitting off therefrom a molecule of water and thus forming as a remnant the oxime-group.

According to Coppola (*Répertoire de Pharm.* 1889, 45, 257), santonin-oxime is a well crystallised substance, and is far less easily soluble in the animal fluids than santonin. Whilst being non-toxic, it is stated to be just as efficacious an *Anthelmintic* (killer or remover of intestinal worms) as santonin when given in about the threefold dose of the latter. This fact is explained thus. The vermifugal action of santonin is not at all dependent on absorption of the medicament by the human organism, because the action is to be exercised directly on the intestinal worms during the passage of the undissolved substance through the intestinal canal. But santonin sometimes occasions toxic symptoms in the patient by first inducing intestinal catarrh accompanied by an inordinately large production of lactic acid, which then favours the solution of the santonin and its absorption into the organism. Santonin-oxime, on the other hand, by virtue of its slight solubility and absorbability offers the greatest likelihood among all santonin preparations of accomplishing the removal of the intestinal parasites without injury to the patient.

On some New Artificial Medicinal Compounds. Cocaine and Derivatives, Narceine, Hydrazine, and Musk Substitute. Dingl. Polyt. J. 273, 522—528.

In the Coca leaves there are, besides cocaine, some other amorphous alkaloids which Liebermann has succeeded in converting into Cocaine by first treating them with hydrochloric acid, sp. gr. 1.1—1.2, thus forming Ecgonine, and converting this by benzoyl chloride or benzoic anhydride into cocaine. Böhringer and Söhne prepare cocaine from the methyl- or ethyl-ecgonine ethers by treating them with benzoyl chloride.

Phthalyl-di-ecgonine methylether—



is prepared by the action of orthophthalylchloride on ecgoninemethylether.

Isovaleryl-ecgonine methylether, $\text{C}_3\text{H}_7\text{O} \cdot \text{C}_{10}\text{H}_{16}\text{NO}_3$, was obtained by the action of isovalerylchloride on ecgonine-methylether.

Cocethyline or Homococaine is Benzoyl-ecgonine ethylether.

Phenacetyl-ecgonine methylether—

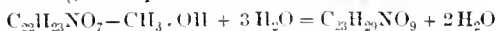


was prepared by the mutual action of equal parts of phenacetylchloride and ecgonine methylether when heated in a flask at 100° for four hours. The melted mass is poured into water, and the ether precipitated with carbonate of soda.

Oxidation of benzoyl-ecgonine and ecgonine with potassium permanganate produce *Cocylbenzoylhydroxybenzoic acid*, $\text{C}_{15}\text{H}_{17}\text{NO}_4$, melting point 230° C. in the case of the benzoyl compound, and *Cocylhydroxyacetic acid*, $\text{C}_8\text{H}_{13}\text{NO}_3$, melting point about 233° C., from ecgonine.

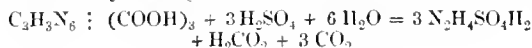
Methyliodide and methylbromide form with cocaine compounds $\text{C}_{17}\text{H}_{21}\text{NO}_3\text{CH}_3\text{I}$, and $\text{C}_{17}\text{H}_{21}\text{NO}_3\text{CH}_3\text{Br}$.

W. Roser prepares *Narceine* from narcotine-methylchloride by treating it in aqueous solution with caustic soda—



Homonarcine is prepared in the same way from narcotine ethylchloride.

Ph. Curtius prepares hydrazine compounds from triazotic-acetic acid by treating it with concentrated acids—

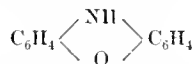


To obtain all the hydrazine even from dilute solutions, they are treated with benzaldehyde, and the insoluble benzylidene hydrazine is reconverted into hydrazine by boiling with dilute sulphuric acid.

Musk.—To form a cheap Musk, A. Baur proceeds in the following way: Toluene is mixed with the halogen compounds of Butane, and the mixture is boiled in a reversed condenser with aluminium chloride. The product of the reaction is distilled with steam. The portion passing over between 170° and 200° C. is treated with fuming nitric and sulphuric acids. The product thus prepared is recrystallised from alcohol and water. The yellowish-white crystals are dissolved in alcohol and a trace of ammonia or ammonium carbonate is added. This liquid has an odour similar to that of musk.—A. L.

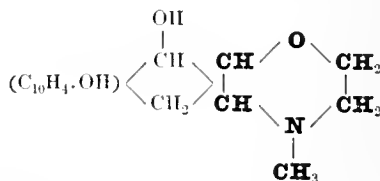
Syntheses in the Oxazine Series. L. Knorr. Ber. 22, 2081—2099.

THE colouring matters derived from the chromogen—

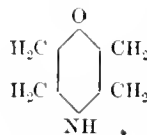


are called oxazines. Widman defines oxazines or azoxines as bodies containing a ring of six atoms: one nitrogen atom, one oxygen atom, and four carbon atoms, which are joined by eight bonds of affinity.

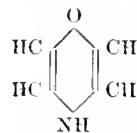
This class of bodies is of greater interest, since the author's studies on morphine have rendered it probable that this important base and other alkaloids may be considered as oxazines. The formula which explains the reactions of morphine best is—



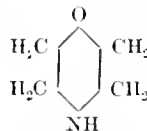
This represents morphine as a derivative of the hypothetical base—



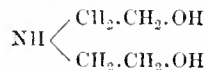
which bears the same relations to the simplest oxazine—



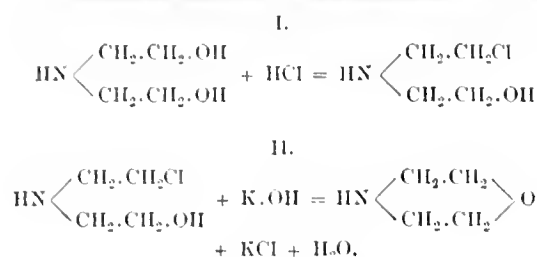
as piperidine bears to pyridine. The experiments to produce such reductions have proved successful, and a base has been prepared—



called by the author *morpholine*. This compound was prepared from dihydroxyethylamine—

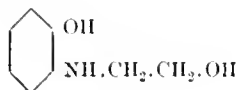


by heating it with hydrochloric acid in a sealed tube at 160° C., the product of the reaction being boiled with caustic alkali. The reaction proceeds in two phases—

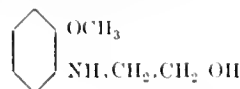


In the same way methylmorpholine and phenylmorpholine were prepared from dihydroxyethylmethylamine and dihydroxyethylaniline.

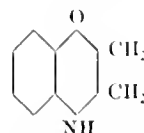
Hydroxyethylamidophenol—



or, better, hydroxyethylanisidine—



produces a base—



which the author terms phenomorpholine.

Of its derivatives, only methylphenomorpholine was prepared from Mulhauser's methylamidine. Wurtz's method by the action of chlorhydrin on the amines was used for the preparation of the alcohol bases. The following table will serve as an illustration of the different steps leading from the amines to the morpholines.

Methylamine.	Aniline.	<i>o</i> -Amidophenol.	<i>o</i> -Anisidine.	Methylanisidine.
$(\text{CH}_3) \cdot \text{N} \begin{array}{l} \text{H} \\ \text{H} \end{array}$	$(\text{C}_6\text{H}_5) \cdot \text{N} \begin{array}{l} \text{H} \\ \text{H} \end{array}$			

Converted by ethylene chlorhydrin into—

Hydroxymethylamine.	Hydroxyethylaniline.	Hydroxyethyl- <i>o</i> -amidophenol.	Hydroxyethylmethylanisidine.
$(\text{CH}_3) \cdot \text{N} \begin{array}{l} \text{CH}_2 \cdot \text{CH}_2 \cdot \text{OH} \\ \text{H} \end{array}$	$(\text{C}_6\text{H}_5) \cdot \text{N} \begin{array}{l} \text{CH}_2 \cdot \text{CH}_2 \cdot \text{OH} \\ \text{H} \end{array}$		
Dihydroxyethylmethylamine.	Dihydroxyethylaniline.	Hydroxyethyl- <i>o</i> -anisidine.	
$(\text{CH}_3) \cdot \text{N} \begin{array}{l} \text{CH}_2 \cdot \text{CH}_2 \cdot \text{OH} \\ \text{CH}_2 \cdot \text{CH}_2 \cdot \text{OH} \end{array}$	$(\text{C}_6\text{H}_5) \cdot \text{N} \begin{array}{l} \text{CH}_2 \cdot \text{CH}_2 \cdot \text{OH} \\ \text{CH}_2 \cdot \text{CH}_2 \cdot \text{OH} \end{array}$		

Heating with hydrochloric acid produces

Chloro-ethylhydroxyethylmethylamine.	Chloro-ethylhydroxyethylaniline.	Chloro-ethyl- <i>o</i> -amidophenol.	Chloro-ethylmethylanidophenol.
$(\text{CH}_3) \cdot \text{N} \begin{array}{l} \text{CH}_2 \cdot \text{CH}_2 \cdot \text{Cl} \\ \text{CH}_2 \cdot \text{CH}_2 \cdot \text{OH} \end{array}$	$(\text{C}_6\text{H}_5) \cdot \text{N} \begin{array}{l} \text{CH}_2 \cdot \text{CH}_2 \cdot \text{Cl} \\ \text{CH}_2 \cdot \text{CH}_2 \cdot \text{OH} \end{array}$		

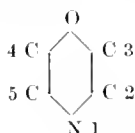
Which on boiling with caustic alkali yield—

Methylmorpholine.	Phenylmorpholine.	Phenomorpholine.	Methylphenomorpholine.
$(\text{CH}_3) \cdot \text{N} \begin{array}{l} \text{CH}_2 \cdot \text{CH}_2 \\ \text{CH}_2 \cdot \text{CH}_2 \end{array} \text{O}$	$(\text{C}_6\text{H}_5) \cdot \text{N} \begin{array}{l} \text{CH}_2 \cdot \text{CH}_2 \\ \text{CH}_2 \cdot \text{CH}_2 \end{array} \text{O}$		

Hydroxyethylmethylamine was obtained by heating equivalent quantities of methylamine and ethylene chlorhydrin in aqueous solution for 12–24 hours at 110° C. On distillation with solid caustic potash, first, methylamine, and, later, hydroxyethylmethylamine distil over. Yield about 80 per cent. The base is easily soluble in water, alcohol, and ether, and boils at 130°–140° C.

Dihydroxyethylmethylamine.—Equivalent quantities of chlorhydrin and hydroxyethylmethylamine are heated in aqueous solution for several hours at 120° C. This is a thick oil, boiling at 240°–265° C., and soluble in water. With methyl iodide it forms the *iodide of dihydroxydimethylammonium hydroxide*. On evaporation of the aqueous solution of this iodide, decomposition ensues, hydroxyethyl-dimethylamine being formed.

1-Methylmorpholine is obtained by heating dihydroxy-methylamine with fuming hydrochloric acid for 12 hours at 160° C. It is easily soluble in water, alcohol, and ether, boils at 117° C., and combines with methyl iodide, the compound, on treatment with moist silver oxide, yielding methylmorpholinemethylhydroxide. The number 1, assigned in the above formula refers to the position of the CH₂ according to Knorr's scheme—



Hydroxyethylaniline boils at 286° C., and possesses strong reducing power.

Dihydroxyethylaniline boils above 350° C.

Phenylmorpholine boils at 270° C. and melts at 53° C., is insoluble in water, easily soluble in alcohol and ether, and volatilises with steam.

Hydroxyethyl-o-amidophenol boils at 290°–310° C.

Hydroxyethyl-o-anisidine.—Boiling point 295° C. With difficulty soluble in water, with ease in ordinary solvents, is a strong reducing agent.

Phenomorpholine boils at 268° C.

Hydroxyethylmethyl-o-anisidine boils at 290° C.

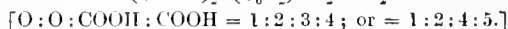
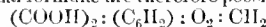
Methylphenomorpholine boils at 261° C., is volatile with steam, and is coloured intensely red by ferric chloride and nitrous acid.—A. L.

Hydrastine. M. Freund and S. Lachmann. Ber. 22, 2322–2328.

In a former paper (this Journal, 1889, 637) one of the authors ascribed to hydrastinine acid the formula C₁₁H₁₁NO₅. Further experiments with a purified sample of acid show that the formula should be altered to C₁₁H₉NO₆. On oxidation with nitric or chromic acid, hydrastinine acid is converted into a substance having the formula C₁₀H₇NO₄. It crystallises from glacial acetic acid in large white needles melting at 233° C. It is soluble in warm strong caustic potash solution, from which it is reprecipitated by acids. When boiled with potash it is first converted into a body of the formula C₁₀H₁₁NO₆, and then into an acid containing no nitrogen and having the composition C₉H₆O₆, methylamine being given off. The authors propose to name the latter body hydrastic acid. It crystallises in colourless needles, melting at 175° C. It is dibasic, and easily forms an anhydride on heating. Strong nitric acid converts it into a nitro-derivative, melting at 101°, and having the formula C₇H₄N₂O₆.

This body is identical with the methylene-ether of di-nitrocatechol, which Hesse and Jobst (Ann. Chem. Pharm. 199, 75) prepared by the action of nitric acid on piperonylic acid. Piperonylic acid differs from hydrastic acid by having one CO₂ group less. Hydrastic acid may, therefore, be considered to be derived from piperonylic acid by the substitution of a COOH group for a hydrogen atom. The two COOH groups of hydrastic acid are probably adjacent,

since the acid so readily forms an anhydride. The following two constitutional formulae are therefore possible for hydrastic acid:—

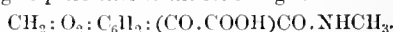


The nature of hydrastic acid being known it is easy to arrive at that of the other derivatives of hydrastine. The substance C₁₀H₇NO₄ from which hydrastic acid is derived is the methylimide of hydrastic acid—

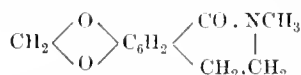


whilst the intermediate body is the acid methylamine salt of hydrastic acid, CH₂ : O₂ : C₆H₂ : (COOH)COOH, NH₂.CH₃.

For hydrastinine acid three formulae are possible, but the authors give preference to the following formula:—



Oxyhydrastinine has the formula—



Oxyhydrastinine is the first oxidation product of hydrastinine and differs from it in having two atoms of hydrogen less. Hydrastinine behaves like an aldehyde, and in another paper it is shown to be a secondary base.

Under these circumstances only one formula can be ascribed to it, viz.:—



Hydrastinine may therefore be looked upon as piperonal, in which one of the hydrogens, occupying the ortho position towards the aldehyde group, has been replaced by the group CH₂.CH₂.NH.CH₃.—H. T. P.

Hydrastine. M. Freund. Ber. 22, 2329–2339.

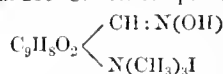
As the result of his experiments with cotarnine, Roser ascribed to it the formula—



which is analogous to that of hydrastinine determined by the author and S. Lachmann (see previous abstract) by means of quite a different line of research. In the present paper the author describes the results of his experiments with hydrastinine, conducted in a similar manner to those of Roser with cotarnine. Hydrastinine, when heated with an excess of methyl iodide, yields hydrastinine hydriodide, and another substance crystallising in pale yellow needles of the following composition, C₁₃H₁₃NO₃1. The crystals melt at 267° C. This body is evidently formed from hydrastinine by the substitution of a methyl group for a hydrogen atom, and the further addition of a molecule of methyl iodide. Hydrastinine thus appears to be a secondary base. The formation of hydrastinine acid and the reactions of the latter (see previous paper) conclusively prove the NH group to be combined with methyl. The presence of an aldehyde group in hydrastinine is shown by its behaviour with hydroxylamine (this Journal, 1889, 412), and by other considerations (this Journal, 1887, 381, 449, and 641). The constitution of the substance C₁₃H₁₃NO₃1 is therefore the following:—



If the group (C₁₀H₉O₃) be called *hydrastyl*, then the above compound would be trimethylhydrastylammonium iodide. It yields on treatment with hydroxylamine hydrochloride, an oxime crystallising in pale yellow needles, which are decomposed at 250° C. Its composition is—

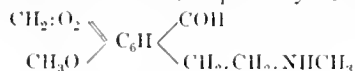


It is readily soluble in alkaline solutions, from which it is reprecipitated by acids. When warmed in aqueous alkaline solution, trimethylhydrastylammonium iodide is easily decomposed, methylamine being given off. Oily drops separate at the same time, which solidify on cooling. This new body crystallises from alcohol in yellowish rhombic plates, melting at 78°–79° C. It is insoluble in cold, slightly soluble in hot water, and readily soluble in alcohol, ether, and chloroform. When heated with water it volatilises with

the steam. Its composition is $C_{10}H_8O_3$. The author proposes to call it *hydrastal*. With phenylhydrazine it gives a crystalline body melting at $103-104^\circ$. Hydrastal oxidised in alkaline solution by potassium permanganate yields crystals melting at 158° . This substance is neutral in character. The author found the mother-liquor from the above crystals to contain a small quantity of an acid melting approximately at $170^\circ C$, but sufficient for analysis could not be obtained, yet he believes it to be identical with hydrastinic acid. The latter has the following formula: $C_7H_4O_2(COOH)_2$. The formula for hydrastinine must therefore be—

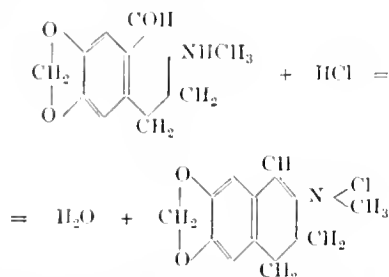


which is identical with that obtained by the author in conjunction with Lachmann. Cotarnine may be looked upon as hydrastinine in which one of the hydrogen atoms of the benzene nucleus has been replaced by methoxyl—

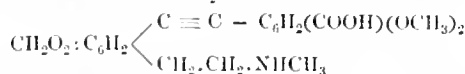


Four isomeric methoxyl derivatives of this formula are possible; which one corresponds to cotarnine has not been decided.

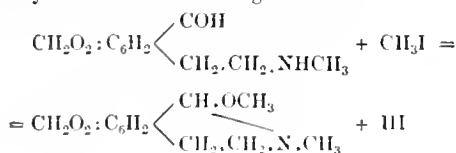
The salts of hydrastinine, like those of cotarnine, contain one molecule of water less than the free base. This can be explained by supposing that a ring formation takes place, thus:—



The salts of hydrastinine and cotarnine are therefore derivatives of isoquinoline, in which the pyridine nucleus has been reduced. This supposition explains the behaviour of hydrastinine with reducing and oxidising agents as well as with caustic alkalis. The decomposition products of hydrastine, narcotine, and papaverine, are all very closely related to isoquinoline, and therefore these substances themselves bear a close relationship to that body. It seems, therefore, that this body probably plays an important part as the root-substance of nitrogenous organic compounds found in the vegetable kingdom. Hydrastine and narcotine are formed from opianic acid, and hydrastinine and cotarnine respectively. The three last bodies all contain an aldehyde group; whilst in the alkaloids themselves an aldehyde group cannot be directly detected. This may be explained by assuming the existence of a group, $-C \equiv C-$, in the alkaloids. The formula of hydrastine would then be—



When hydrastinine dissolved in methyl alcohol is treated with methyl iodide, a crystalline body is formed, melting at $230^\circ-232^\circ$. It is isomeric with the trimethylhydrastylammonium iodide which melts at $267^\circ C$. It is not decomposed by alkalis. The author names it *hydrastinmethinnethyl iodide*. Digestion with methyl iodide does not convert it into the higher melting variety. Its constitutional formula has not yet been fully decided upon; but it is probably formed in the following manner:—



The tertiary base thus produced at once combines with a molecule of methyl iodide to form the body $C_{13}H_{13}NO_3I$, whilst the hydriodic acid liberated combines with unattacked hydrastinine.—H. T. P.

Investigations on Apiol. G. Ciamician and P. Silber. Ber. 22, 2481—2490.

In a previous communication the authors described a phenol derivative obtained by the action of alcoholic potash on apioleic acid which they regarded as the dimethylether of a tetrahydroxybenzene, $C_6H_2(OH)_2(OCH_3)_2$ (this Journal, 1888, 396 and 583). The isolation of the tetrahydroxybenzene, the mother substance of apiol, has not been effected, but there is no doubt from these investigations that the above constitution of apiol is correct.

The name of "*Apionol*" is suggested for the mother substance of apiol, whence that of dimethylapionol for the latter. The yield of apiol from apioleic acid according to the method already described (*loc cit.*) amounts to 2 grms. from 7.5 grms. of the acid. The product melts at $105^\circ-106^\circ$, and boils at 298° . In addition to the reactions previously described dimethylapionol when treated with ferrous sulphate remains unchanged at first, but after a time yields a blue colouration; lead acetate (neutral) gives a gelatinous precipitate which turns brown on standing, and silver nitrate gives a finely crystalline precipitate which blackens immediately. If a crystal of dimethylapionol be dissolved on a watch glass in sulphuric acid (conc.), the solution first becomes yellow, then red, and on warming, violet. To show the presence of four hydroxyl groups in apionol the authors have prepared tetramethylapionol, and dimethyldiacetylapionol from dimethylapionol by the usual methods. The former melts at 81° , is slightly soluble in cold water, readily in alcohol, ether, &c.; it gives a yellow colouration with nitric acid and a brown colouration with sulphuric acid (conc.) on warming. The latter can be crystallised from alcohol, and melts at 144° ; it is less soluble in water than the former, and turns first yellow, then brown when warmed with strong sulphuric acid.

Apiolealdehyde (this Journal 1888, 584) can be condensed with benzaldehyde with the formation of apionacrylic acid, according to Perkin's reaction. The resulting compound, $C_6H(O_2 \cdot CH_2 \cdot) (OCH_3)_2 (CH : CH \cdot CO \cdot OH)$ forms small yellow needles which melt at 196° ; it is only slightly soluble in water and in ether, readily soluble in alcohol. The salts of the alkalis and of magnesia are soluble, those of zinc, nickel, cobalt, iron, copper, silver, lead and mercury are insoluble. The barium and calcium salts dissolve in hot water.

By substituting benzaldehyde by propionaldehyde in the above reaction an apionerotic acid is obtained, the exact constitution of which has not yet been decided. It forms yellow needles which melt at 209° ; in water it is practically insoluble, but dissolves in hot alcohol or hot ether. Of the salts, those of magnesium, calcium, and barium dissolve in hot water, those of silver, zinc, copper, nickel, cobalt and iron are thrown down as precipitates from solutions of the alkaline salts which are readily soluble in water.

When a solution of apioleic acid in glacial acetic acid is added to well-cooled nitric acid of sp. gr. 1.40 a nitro-compound results which, crystallised from aqueous alcohol, forms yellow needles melting at $117^\circ-118^\circ$. This body, which appears to be a dinitro-apion ($C_6(NO_2)_2(OCH_3)_2(O_2CH_2)$) is insoluble in water, alkalis, and the alkaline carbonates, but dissolves in ether, alcohol, and acetic acid. It may be identical with the nitro compound obtained by Ginsberg from isapiol (this Journal, 1888, 399).

—C. A. K.

On the Natural Occurrence of Cinnamylcocaine in Coca Leaves. F. Giessel. Pharm. Zeit. 34, 516.

CINNAMYLCOCAINE, which has already been prepared synthetically, has been found by the author as a natural constituent of the coca leaves, and he has also isolated it. The properties of the natural body agree with those of the synthetically

prepared cinnamyleocaine. It melts at 121° , crystallises well, and is decomposed by permanganate with formation of oil of bitter almonds. It is quantitatively split up by hydrochloric acid into cinnamic acid and eegonine.—W. M.

On Crystallised Tanghinin Extracted from the Tanghinia Venenifera of Madagascar. Arnaud. *Compt. Rend.* 108, 1255—1258.

TANGHININ, the celebrated judicial poison used by the inhabitants of Madagascar, has been examined by the author. It was known that the toxic principle was contained in the almonds of the *Tanghinia venenifera*, belonging to the family of the Apocynaceae. The almonds contain about 75 per cent. of fatty matter which could not be got rid of by simple pressing. By treating with bisulphide of carbon, however, which does not take up the tanghinin, the fat was extracted. Subsequent boiling with strong alcohol, and evaporation, yielded a crystalline substance of powerful toxic properties. It has a strong action upon the heart, resembling strophanthin and ouabaine (this *Journal*, 1889, 211; also 1888, 765), having, however, a more general convulsive action than these bodies. Tanghinin forms colourless, rhombic, anhydrous crystals, which melt at 182° C., and are very difficultly soluble in water, but easily in strong alcohol. It is levo-rotatory, and has the following composition:—

Carbon.....	65.79	.....	65.70
Hydrogen.....	8.16	.....	8.22
Oxygen.....	26.05	.....	26.08
	100.00	.....	100.00

As it contains no nitrogen, tanghinin is neither an alkaloid nor is it a glucoside. The author intends to prepare derivatives, in order to determine its chemical constitution.

—O. J. S.

Camphor and Borneol of Rosemary. New Method of Separating Camphor and Borneol. A. Haller. *Compt. Rend.* 108, 1308—1310.

THE camphor obtained from rosemary is a mixture of dextro- and levo-rotatory camphor with dextro- and levo-rotatory borneol, separable by the following process, which is applicable to all similar mixtures:—

The crude camphor is deposited on cooling from that portion of the essential oil of rosemary which distils over above 190° C. It is pressed between filter paper, and purified by sublimation with lime, then triturated with $\frac{2}{3}$ of its weight of succinic acid, and heated in a matrass to 140° C. for 48 hours. The product separates into two layers, which both solidify on cooling and, on treatment with ether, the camphor and the acid succinate of camphor are dissolved out, leaving the excess of succinic acid undissolved. On agitating the ethereal solution with one of sodium carbonate, the acid succinate of borneol is dissolved out, leaving the camphor in solution. The carbonate of soda solution is washed by shaking with ether, then acidulated, and again agitated with ether, and on evaporating this ethereal solution, the acid succinate is obtained pure, as an unctuous mass. On saponifying this with boiling sodium hydrate, and purifying the liberated camphol by sublimation or crystallisation from petroleum spirit, hexagonal plates, resembling those of ordinary borneol, are obtained, smelling of camphor and pepper, and melting at 207.5° C. This camphol yields, on conversion, a camphor melting at 178.65° , with rotatory power $(\alpha)_D = -29.60$, and this yields two monobromo-derivatives melting at 76° and 51° , with rotatory powers of $(\alpha)_D = -124$ and $(\alpha)_D = 0$ respectively. The original camphor freed from borneol has a rotatory power of $(\alpha)_D = 21.7$, unaltered after treatment with nitric acid.

—J. M. H. M.

On the Acetates and Benzoates of Active and Racemic Camphor, and a Method of Preparing pure Dextro-Rotatory Borneol identical with Borneol of Dryobalanops. M. A. Haller. *Compt. Rend.* 109, 29—31.

VARIOUS acetates of camphor have been obtained, but all these compounds had varying rotatory powers and boiling

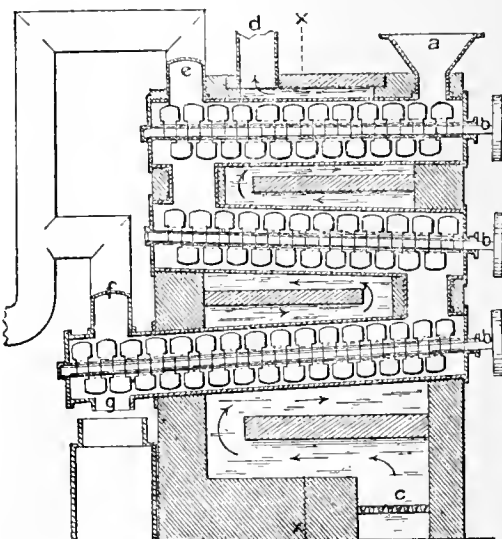
points, only the acetate prepared by de Mongolfier, from the borneol of Dryobalanops was a uniform body. This compound melted at 24° C., distilled at 226° — 227° , and had a rotatory coefficient of $(\alpha)_D = +32^{\circ}$. The author continues these investigations on dextro- and levo-rotatory camphors $(\alpha)_D = +37^{\circ} 33'$ and $+37^{\circ} 77'$. By heating borneol with an excess of glacial acetic acid to 200° , or with the anhydride at 100° , the ether was obtained, distilling between 210° — 226° C. On cooling, almost the whole of the mass crystallised, leaving a small quantity, very likely some of the inactive compound. The crystals boil at 225° — 226° C. By mixing equal parts of the levo- and dextro-rotatory acetates, the racemic acetate is obtained, which does not even crystallise at -17° . The dextro- as well as the levo-rotatory acetates have a rotatory power of $+ \text{ and } -44.5$. Camphor, on reduction, yields a mixture of the two isomeric borneols. From the above-mentioned acetyl compounds the acetate of the dextro-borneol $(\alpha)_D = +44^{\circ} 58'$ was prepared, and this, on saponification, yielded the free borneol $\alpha_D = +37^{\circ} 63'$. The author also prepared the benzoyl compounds by treating borneol with benzoyl-chloride, a colourless oil being obtained, which crystallised after standing some time during the winter months. Both the dextro- and levo-compounds melt at 25.5° C. and have a rotatory power of $\alpha_D = + \text{ and } -44^{\circ}$. The racemic melts at 20° C.—O. J. S.

On Recent Improvements in the Manufacture of Chloroform. S. P. Sadtler. *The Pharmaceutical Era*, 1889, 376—378.

THE old process of manufacture of chloroform by the action of bleaching powder upon alcohol has given way to what is now termed the "acetone" process. This method is based upon Liebig's discovery of 1832, but was not carried out practically on account of the difficulty of preparing pure acetone cheaply, and also because it was considered that only 33 per cent. of the acetone could be converted into chloroform. Now that acetone is made on a large scale, and of extreme purity, and it has been shown that it is the richest chloroform-yielding substance known (206 per cent. by theory and 200 per cent. in practice, at times), the case assumes a different aspect.

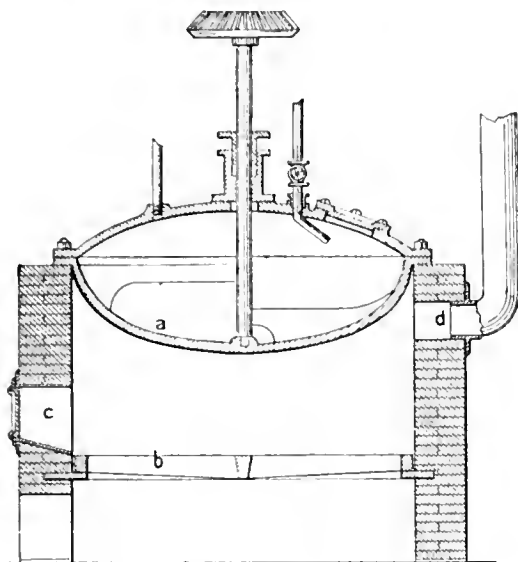
The raw material is the "gray acetate of lime" which is freed both from moisture and tarry matter by careful roasting before submitting it to distillation. The roasting forming the subject of U.S. Pat. by G. Rumpf, is carried out in a series of three slightly-inclined cylindrical retorts (Fig. 1) in which the material is continually pushed forward

Fig. 1.



by revolving blades. The acetate of lime is dropped in at *a* and leaves the furnace at *g*. At *e* and *f* are connexions with the flue through which the moisture and tarry matter can pass out. A second patent refers to the method of distilling the roasted gray acetate. Here, to secure a maximum yield of acetone, the points to be attained are uniformity of temperature throughout the whole mass and slow heating to not over 300° C.

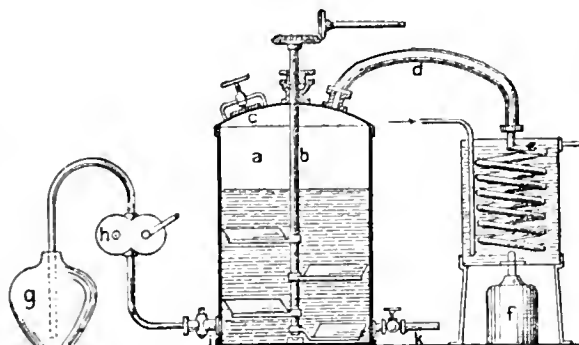
Fig. 2.



By means of stirring the mass with an agitator and admitting free steam in case of any undesirable rise of temperature, a uniformity of temperature may be secured. Fig. 2 shows form of a retort in which this is effected. It will be seen mechanical agitation is provided for by the paddles which rotate round the vertical axis. Steam is admitted by one of the openings above, while the products of distillation pass off by another outlet in the top of the still. The acetone thus obtained is redistilled and rectified till it shows 99° or 100° by alcoholometer.

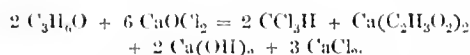
A third patent of G. Rumpf relates to the process and form of apparatus for most successfully carrying out the chloroform manufacture. In order to obtain the full yield of chloroform it is necessary to take a much larger proportion of chloride of lime than given in Watts' Dictionary of Chemistry, I., page 918, 100 lb. of bleaching powder (35 per cent.) being the necessary quantity for 58 lb. of acetone. The yield will be from 150—180 per cent. of the weight of the acetone employed instead of about 33 per cent. The construction of still and connexions are shown in Fig. 3. The still having been charged with water and the bleaching powder introduced, the manhole *c* is closed with cement.

Fig. 3.



The agitation having been started, the acetone previously diluted is pumped in at *i*. The chloroform which is thus produced distils spontaneously from the delivery tube *d*, passes through the condenser *e*, and is collected under water at *f*. When the delivery of chloroform begins to slacken, steam is injected which heats up the mixture and drives over the remainder of the chloroform. The contents of the still, which consist of very dilute calcium acetate mixed with calcium hydrate and calcium chloride are discharged through *K*.

The reaction for this production of chloroform seems to be—



Theory would require a yield of 206 parts of chloroform—in practice 180 parts are usually obtained—although 200 parts have actually been the result at times.

The chloroform thus obtained is quite free from the chlorinated side products which often accompany the chloroform made from alcohol. It is nevertheless purified by treatment with sulphuric acid and careful washing, and is then brought exactly to the U.S. Pharmacopæia standard.

—O. J. S.

PATENT.

A Portable Receiver to retain Volatile Liquids while allowing of the Escape of their Vapours. W. H. Beaeb, Bridgnorth. Eng. Pat. 18,757, December 22, 1888. 6d.

This invention consists of a metal cylinder having tubes projecting axially within it and terminating a short distance from each other. The cylinder is charged with liquid less than half its capacity, and can thus be held in any position without permitting the fluid to escape. Suitable means are provided at each end for attaching apparatus when administering a local anæsthetic. When not in use the orifices at either end are closed by screw plugs. The drawing shows the instrument as adapted to a "Paquelin thermo-cauter." A modification of the apparatus for the purpose of general anæsthesia is also shown. There are four claims.—E. S.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENTS.

Improvements in and relating to Blasting Cartridges. J. C. Butterfield and T. C. Batchelor, London. Eng. Pat. 15,160, October 22, 1888. 8d.

The object of this invention is to make a tight or waterproof cartridge. The cartridge case is made preferably of metal, and is provided at one end with a stuffing-box through which the fuse passes.—C. N. H.

Improvements in Explosive Compounds. J. Sayers, Stevenston. Eng. Pat. 17,212, November 27, 1888. 4d.

The object of this invention is to form explosive compounds which are inert under ordinary conditions. In carrying out this invention, nitrobenzene, dinitrobenzene or other nitro-derivatives of hydrocarbons are mixed with suitable proportions of nitrates and gelatinised by means of from 2 per cent. to 10 per cent. gun-cotton.—C. N. H.

An Improvement connected with Explosive Shells. W. S. Snipson, London. Eng. Pat. 17,772, December 5, 1888. 6d.

This invention relates to the employment of highly compressed gases or fluids within the chamber of a shell already charged with powder, "their combined action when ignited producing great internal pressure and the development of high explosive properties."—C. N. H.

Improvements in Explosives. G. Trench, Faversham.
Eng. Pat. 18,241, December 13, 1888. 4d.

THE object of this invention is to overcome the non-explosive character of "Roburite" and similar explosives when compressed.

In carrying out this invention nitro-cellulose is added to above class of explosives, the mixture detonating readily even when strongly compressed.—C. N. H.

Improvements relating to the Manufacture of Explosives, and to Apparatus therefor. H. S. Maxim, Westminster.
Eng. Pat. 18,663, December 20, 1888. 8d.

THIS invention relates to apparatus for the recovery of the solvents used in the production of explosive material by the treatment of gun-cotton with acetone, ether, &c. Drawings accompany the specification.—C. N. H.

Improvements in the Manufacture of Explosive Compounds.
W. E. Liardet, Balmain, New South Wales. Eng. Pat. 12,427, August 6, 1889. 4d.

THIS invention relates to a process for the manufacture of an explosive compound in which the elements of danger usually attending such manufacture are avoided, the explosive compound thus produced being absolutely safe in the hands of inexperienced persons. In carrying out this invention, picric acid is dissolved in half its weight of boiling glycerin, to this is added a certain proportion of ground cedar or other suitable wood and nitrate of potash.—C. N. H.

A New or Improved Manufacture of Matches of the Vesta type. J. G. Gomez, Navarre, and P. Franco, Saragossa, Spain. Eng. Pat. 14,362, September 11, 1889. 4d.

THIS invention relates to the substitution of specially treated cardboard for paraffined cotton as a base for vesta matches. In carrying out the invention the cardboard is cut into convenient strips and immersed in a melted mixture of 4 kilos. of "colophane," 1 kilo. stearin, to which is added 200 grms. of zinc white, until impregnated.—C. N. H.

XXIII.—ANALYTICAL CHEMISTRY.

Self-Regulating Apparatus for Generating Gases from Liquids. J. Thiele. *Annalen*, 253, 242–246.

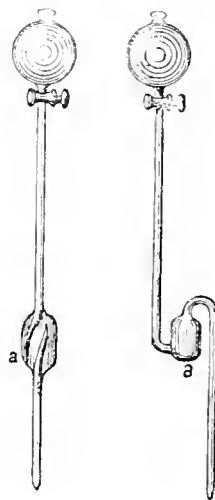
FOR the generation of gases by the reaction of two liquids on one another, the author employs the following apparatus, which in its simplest form consists of a three-necked Woulff's bottle, on the bottom of which lies a layer of mercury about 1 cm. deep.

One neck holds a funnel tube, the funnel bulb being large enough to contain a sufficient supply of one of the liquids, the other end of the tube is drawn out to a point which just dips below the mercury. The second neck holds a gas delivery tube provided with a stop-cock, and the third neck has a safety tube, closed with mercury.

If hydrochloric acid gas be wanted, the bottle is half filled with concentrated hydrochloric acid and concentrated sulphuric acid is placed in the funnel. On opening the cock of the gas delivery tube, the sulphuric acid rises through the mercury in a fine stream, and occasions a uniform evolution of gas, which can be easily regulated by the cock. When the cock is shut, mercury is forced into the funnel tube, the liquids are thus separated, and in a short time the evolution of gas ceases.

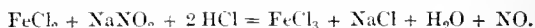
To produce sulphurous acid the bottle is filled with a concentrated solution of bisulphite of soda, and concentrated sulphuric acid is added by the funnel as before. This

apparatus has the two disadvantages that it requires a considerable quantity of mercury, and also cannot be used when the reacting liquids attack mercury.



These, however, are overcome when the mercury is contained in the funnel tube, as shown in the wood-cuts. The small bulb *a* should hold from 6–8 cc. The solution in the bottle being saturated with gas, the apparatus should not be left exposed to the sun's rays, or other source of heat, after having been used.

Nitric oxide may be readily prepared in the above apparatus by filling the bottle with a hydrochloric acid solution of chloride or sulphate of iron, and the bulb tube with a concentrated sodium nitrite solution—



If perfectly pure nitric oxide be desired, as the nitrite frequently contains carbonate, the carbonic acid may be removed by previously treating the nitrite solution with calcium chloride.—W. M.

Determination of Nitrates in Potable Waters. S. Rideal.
Chem. News, 60, 261.

THE author has compared the "phenol sulphuric acid" method with that recently described by S. C. Hooker (this *Journal*, 1889, 569) based on the green colour produced when nitric acid is added to carbazol.

The solutions required are (a) standard potassium nitrate solution containing 0.7215 gm. of the pure crystallised salt in a litre of water; 1 cc. = 0.0001 gm. of nitrogen; (b) phenol sulphuric acid solution prepared by dissolving 15 grms. of phenol in 92.5 cc. of pure sulphuric acid diluted with 7.5 cc. of water.

Pure strong redistilled sulphuric acid and dilute ammonia solution are also required.

The process adopted was as follows:—A known volume of the water is evaporated to dryness. To the dry residue 1 cc. of the phenol sulphuric acid is added, and then 1 cc. of pure water and three drops of strong sulphuric acid, and the mixture is gently warmed. The contents of the dish are then diluted to about 25 cc. and ammonia added in slight excess. The solution is poured into a narrow Nessler tube (14 in. by 1 in.), the dish washed, and the washings added to the liquid in the tube, and the whole diluted to the 100 cc. mark. The colour of the solution is roughly judged, and is then imitated by repeating the operation with the standard potassium nitrate solution.

In the carbazol method the standard potassium nitrate solution and pure sulphuric acid are also required as well as the following special reagents:—

(a). Silver sulphate solution containing 4.3945 grms. per litre or one in which 1 cc. will precipitate 1 part of chlorine per 100,000 from 100 cc. of water.

(b). Aluminium sulphate solution free from chlorides and iron, 5 grms. per litre.

(c). Carbazol solution.—0.6 grm. carbazol is dissolved in 100 cc. of glacial acetic acid. For use, 1 cc. of this solution is mixed with 15 cc. of pure redistilled sulphuric acid.

(d). A series of solutions containing 0.03, 0.05, 0.07, &c., parts of nitrogen per 100,000 from the standard nitrate solution by diluting with water. The process is as follows:—To 100 cc. of the water, the amount in which of chlorides has first been ascertained, sufficient of the silver sulphate solution is added to precipitate all the chlorides. To this solution, 2 cc. of the aluminium sulphate solution is added, and the whole made up to a convenient bulk, 110 cc. in the case of waters containing 1 to 6 parts of chlorine per 100,000. The solution is then filtered, and 2 cc. of this filtrate are then taken for the nitrate estimation. To the 2 cc. of the filtered water contained in a test-tube, 4 cc. concentrated sulphuric acid are added, and the mixture well cooled. 1 cc. of the carbazol solution in sulphuric acid is then added, and a bright green colour appears in a few moments if nitrates are present. The amount of nitrate is roughly gauged from the colour produced, and 2 cc. of the standard nitrate solution, considered to be equal to it, is placed in a second test-tube, and the operation repeated with it and a fresh 2 cc. of the water under examination at the same time. If the tints are not similar a fresh comparison must be made, and in every case it is necessary to repeat the operation with a fresh quantity of the water, so that the colours may be developed as nearly as possible simultaneously. The two processes give very concordant results.

The Application of Double Salts of Pyrophosphoric Acid to the Electrolytic Determination and Separation of Metals. A. Brand. *Zeits. Anal. Chem.* **28**, 581—605.

ALKALINE phosphates added to a neutral aqueous solution of a metallic salt yield in most cases a precipitate insoluble in excess of the precipitant, whilst pyrophosphate of sodium or of ammonium forms a precipitate more or less soluble in excess, a double pyrophosphate resulting. Acid sodium pyrophosphate behaves similarly and some freshly precipitated phosphates are dissolved by the alkaline pyrophosphates. The alkaline pyrophosphates and also the double salts have an alkaline reaction, and when these double pyrophosphates are electrolysed the heavy metal separates out and free pyrophosphoric acid is formed, the solution becoming acid; the alkaline pyrophosphate does not appear to undergo any change. Some metals can be equally readily separated by electrolysis from neutral or acid solutions of the double salts, with others the acidity of the solution resulting from the electrolysis prevents the proper deposition of the metal, but in almost all of these instances ammonia or ammonium carbonate (sesquicarbonate) can be added to the solution of the double salt without causing a precipitate to fall and thus the electrolysis can be effected in an alkaline solution. Sodium hydrate produces a precipitate in most cases. Since the solution can be kept alkaline during the electrolysis, chlorides, nitrates, and sulphates are equally applicable for the determinations. If the alkaline pyrophosphate be added to the metallic salt in quantity only sufficient to form the double pyrophosphate, but not to redissolve it, the precipitate can be dissolved in ammonia or in ammonium sesquicarbonate in all those cases in which these reagents can be added to a solution of the double salt in excess of alkaline pyrophosphate without producing a precipitate. The soluble double salts are not precipitated by the addition of ammonium oxalate. Dilute acids precipitate what appear to be acid pyrophosphates from solutions of these double salts; these precipitates dissolve in an excess of dilute mineral acid. Some of the solutions of the double pyrophosphates are precipitated on warming; for this reason it is preferable to have the solutions of the sodium pyrophosphate and of the ammonium carbonate ready made up. The solubility of sodium pyrophosphate is about 1:10 at 18°; ammonium pyrophosphate is more soluble (1:1, about), but there does not appear to be any advantage in using it and it is far more expensive. The above facts are taken advantage of for the quantitative determination

of metals by electrolysis of solutions of their double pyrophosphates. The following is an abstract of these methods as applied to the various metals. In all cases satisfactory analytical results are given. The only previous work on the electrolysis of these salts is by T. Moore (*vide Chem. News*, **53**, 209).

Nickel.—The double salt forms a white-green precipitate which dissolves in an excess of the alkaline pyrophosphate to form a yellow-green solution; this solution turns green on the addition of ammonium carbonate, and blue on the addition of ammonia. The solution of the double pyrophosphate or that containing ammonium carbonate is the best for the electrolysis. A current varying from 2—20 cc. of electrolytic gas per minute can be used. A current of 2—3 cc. precipitates 0.2—0.3 grm. of nickel in 24 hours. Heating hastens the separation. The nickel is deposited on the cathode as a grey-white film, but must be washed without breaking the current. The washing is conducted as usual; the complete precipitation of the nickel is tested for by ammonium sulphide.

Cobalt.—The double salt is pale red, the solution in excess of the precipitant violet; the colour is not changed by the addition of ammonia—ammonium carbonate turns it first brown and then violet. The electrolysis is effected as in the case of nickel; a current of 10—15 cc. is required towards the completion of the separation.

Iron.—Both ferric and ferrous salts behave normally; the precipitated double phosphates are white. The addition of ammonium carbonate (ammonia causes the separation of hydrate at the anode) is necessary. A current of 20—30 cc. is sufficient in most cases, but an increase is desirable towards the end of the precipitation to get the last traces down; the metal is iron-grey in colour and must be washed without breaking the current.

Manganese is separated as hydrated peroxide at the anode, and the separation is complete if the precipitated double phosphate is dissolved in ammonia and electrolysed with a current of 0.1 cc. for solutions containing less than 0.02 grm. of Mn per 100 cc. of solution and with a current of 0.01 cc. for solutions containing up to five times that amount. Even towards the end of the reaction the current must not exceed 0.4 cc. of electrolytic gas per minute.

Zinc.—The solution of the double pyrophosphate, to which ammonium carbonate is added, is electrolysed with a current of 5—10 cc., which should be increased to 15—20 cc. towards the end of the determination. The precipitate sticks well to the dish and can be removed by cold aqua regia without injury to the dish. An anode of platinum wire is preferable to one of platinum foil.

Cadmium.—A solution of the double pyrophosphate in a good excess of ammonia is electrolysed first for a few seconds with a current of 2—3 cc. in order to overcome the polarisation and then with a current of 0.3 to 1 cc. which should be increased to 5 cc. towards the close of the determination. The precipitated metal is silver-white and adheres well to the dish.

Copper.—The simple solution of the double pyrophosphate in excess of the alkaline pyrophosphate gives the best results with a current of 0.1 cc. which can be increased to 1 cc. towards the end of the determination. If the solution be acidified with nitric or with sulphuric acid the deposition can be effected in the usual way, since the presence of the free pyrophosphoric acid does not interfere at all.

Silver.—The double pyrophosphate of silver and sodium is treated with nitric acid or with potassium cyanide and electrolysed with a current of 0.01 to 0.20 cc. (*this Journal*, 1889, 257).

Mercury.—Mercurous salts must be first oxidised with nitric acid. The mercuric salt is converted into the double pyrophosphate, treated with ammonia and electrolysed with a current of 2 cc. which will precipitate 0.1 grm. of metal in 5—6 hours. The precipitated metal is washed as usual and then dried in an exsiccator over sulphuric acid for a short time.

Tin.—A very strong current is needed to separate tin from a solution of the double stannic pyrophosphate, but the separation is not quantitative. With stannous salts a portion of the salt separates at the anode in the stannic form which cannot be completely reduced to metal.

Chromium is oxidised to chromic acid. If the solution contain cobalt, nickel, or iron, the presence of the chromic acid interferes with their precipitation.

Lead.—The double pyrophosphate is soluble in excess and can be treated with ammonium carbonate without a precipitate separating. On electrolysis the solution the lead is partially separated at the cathode as metal and partly at the anode as peroxide. Ammonia precipitates the double pyrophosphate.

Thallium behaves like lead.

Bismuth.—The dilute slightly acid solution of the bismuth salt is treated with 4–5 times as much sodium pyrophosphate as is required for the formation of the double salt and made alkaline with ammonium sesquicarbonate; 3–5 grms. of ammonium oxalate are then added to the solution, and the electrolysis effected by a current of 0.1 to 1.0 cc., which is gradually increased to 2–3 cc. A current of 0.5 cc. will precipitate 0.25 gm. of bismuth in 12 hours; when more metal is present a weaker current must be used and 48 hours are necessary to precipitate 0.75 gm. of the metal. A coil of platinum wire is best for the anode. Towards the end of the decomposition traces of peroxide separate at the anode; these must be dissolved in oxalic acid, and it takes 4–5 hours to completely precipitate the redissolved portion. The complete precipitation is tested for by sulphuretted hydrogen. Owing to the readiness with which the metal oxidises it is advisable to dissolve it in nitric acid and convert it into the oxide by ignition, in which state it is weighed. The author finds that Moore's method (to treat the solution of the salt with tartaric acid, make it alkaline with ammonia and add a large excess of syrupy phosphoric acid, vide Chem. News, 53, 209) does not yield a very even deposit, and that the metal does not adhere well to the dish.

Antimony.—The precipitation from a solution of the double pyrophosphate treated with ammonium sesquicarbonate is not quantitative.

Separation of Metals.—Nickel, cadmium, zinc, and mercury may be separated from manganese by treating the solutions of their double pyrophosphates with 15 per cent. of ammonia (conc.) The manganese is first separated as peroxide by a weak current (v. ante) and the precipitation of the remaining metal completed in a second dish by a stronger current. Copper and manganese can be determined simultaneously, care being taken to use only a very weak current. Copper, cadmium, and mercury can be separated from manganese by acidifying the solution of the double pyrophosphates with sulphuric or nitric acid, and then separating the first-named metals.

In order to separate manganese from iron or from cobalt the solution of the double pyrophosphates (after being almost neutralised by ammonia, if acid) is electrolysed by a current of 15–20 cc. after the addition of 4–8 grms. of ammonium oxalate when the iron or cobalt is precipitated, the manganese remaining in solution. The method requires very careful working to give accurate results.

Cadmium is separated from zinc, iron, nickel and cobalt by electrolysis a sulphuric acid solution, when the cadmium alone is precipitated. To separate cadmium from manganese, sodium pyrophosphate must be first added to the solution, which is then acidified with sulphuric acid and electrolysed.

The double pyrophosphates of magnesium and uranium are precipitated by ammonia, not by ammonium sesquicarbonate; that of aluminium is not precipitated by ammonia. None of these are decomposed on electrolysis, and iron, nickel, cobalt, and zinc can thus be separated from them, but the presence of phosphoric acid in the resulting solution interferes with their subsequent determination.

—C. A. K.

Colour Reactions of Woody Cell Membranes. A. Ihl. Chem Zeit. 13, 831.

SCHIFF (Chem. Zeit. 9, 905) observed that urea and other nitrogenous compounds gave colour reactions on aldehydes. The author experimented with cinnamic aldehyde and obtained colour reactions with urea, commercial antipyrine, and an alkaloid.

Alcoholic solutions of urea and commercial antipyrine give with a mixture of concentrated hydrochloric acid and cinnamic aldehyde each a yellow colour turning reddish-yellow on boiling.

Woody matter which probably contains cinnamic aldehyde (this Journal, 1889, 640), moistened with an alcoholic solution of urea and concentrated hydrochloric acid, becomes of intense yellow colour. Human urine containing 2–3 per cent. of urea poured on wood and concentrated hydrochloric acid added, also produces the yellow stains after a short time.

Paper containing woody matter gives both of above reactions.

Commercial antipyrine in alcoholic or watery solution and concentrated hydrochloric acid poured warm on wood or paper containing woody matter produces an intense red stain, or if boiled with sawdust soon develops a red colour.

The author further notes that a dilute alcoholic solution of thymol with concentrated sulphuric acid very soon colours paper containing woody matter deep green.—D. A. S.

On the Relations between Chemical Composition and Absorption Spectra of Organic Compounds. Max Althausse and G. Krüss. Ber 22, 2065–2067.

It has been observed by exactly measuring the absorption spectra of organic compounds, that by addition of the methyl-, ethyl-, hydroxymethyl-carboxyl groups to a compound, a movement of the absorption bands from blue to red takes place; that this phenomenon is however reversed when a hydrogen atom is replaced by an amido-group or nitro-group. The author communicates some observations made on bodies of the Thionine group, which prove this hypothesis to be correct.—A. L.

On a Method of determining the Affinity Values of Organic Bases and Acids. E. Lelimmann. Ber. 22, 2101–2103.

The method is based on the fact that certain organic dye-stuffs change their colour when either treated with alkalis or acids. The quantity of the dyestuff can then be determined by a spectro-photometric apparatus. As a basic colouring matter, dimethylamidoazobenzene was used. Alcohol of 25 per cent. dissolves it to a yellow liquid, which allows all green rays to pass through. Little hydrochloric acid colours the solution intensely red, and it shows now in the green a large absorption band. The method is very simple. The hydrochloric acid salts of the bases to be examined are added to the yellow solution, and the change of colour is determined—if it be little, the base is comparatively strong, and *vice versa*. Aniline, β -naphthylamine, and α -naphthylamine were thus examined. Aniline proved the strongest base, β -naphthylamine followed, and α -naphthylamine showed the least basic properties of the three.

The affinities of acids are determined according to the same principle. If molecular quantities of phenol and the sodium salts of the three hydroxybenzoic acids be dissolved in equal quantities of water, and equal quantities of phenolphthalein be added to each solution, in the case of the salicylic acid a red colour is instantly produced by a drop of dilute caustic soda, whilst with phenol the first drops are without any effect, and then gradually a red tint is developed. From this it follows that the CO₂ONa group acts as weakening the effect of the OH in the ortho-position, as a little strengthening that of the OH in the meta-position, whilst that of the OH in the para-position is very sensibly strengthened. Further communications on this subject will follow.—A. L.

Colour Reaction of Cocaine Hydrochloride. M. Gockner.
Pharm. Zeit. **34**, 471.

This reaction is produced in the following way: a few crystals (0.1 grm.) of resorcinol are placed on a watch-glass and covered with 6–7 drops of pure concentrated sulphuric acid, and to this is added 0.02 grm. of cocaine hydrochloride. A violet reaction ensues and a beautiful cornflower blue is produced. A few drops of caustic soda solution turn the blue colour into bright red.—W. M.

On the Presence of Pectous Substances in Plants.

L. Mangin. Compt. Rend. **109**, 579–582.

A METHOD is described for detecting the presence of pectous substances in plants by a microscopic examination of their sections. It is based on the use of suitable staining reagents such as Bismarck brown, Methylene blue, &c., which do not stain cellulose, but stain pectous substances, nitrogenous matter, lignite, &c., in neutral or slightly acid solution. The colouration of the pectous substances is easily removable by treatment with alcohol, glycerol, &c., whilst that of the nitrogenous matter, &c. is permanent. The treatment with the above dyes may be followed by the application of such dyes as Induline, Nigrosine, &c., which do not colour cellulose or pectous substances, but stain nitrogenous matter, lignite, &c.—A. L. S.

Examination of Carbohc Acid and Cresolate Oil. W. W. Staveley. Chem. Zeit. **13**, 1126–1127.

THE author notes the following sources of error in various methods: Too little soda solution is apt to be used; for example, 1 grm. of NaHO is equal to 2.35 grms. of anhydrous phenol, or 2.7 grms. of anhydrous cresol, and to 3 grms. of tar acids or crude carbohc acid (taking the latter as largely composed of cresylic acid and higher homologues) with from 12 to 16 per cent. of water.

Thus, in the common method by agitation, a 10 per cent. soda solution should be used and four times (instead of only twice) the volume should be used, the alkaline solution acidified and shaken with benzene and read off.

This is preferable to reading after the agitation with alkali, as in that case any water is estimated as carbohc acid. Benzene is preferable, cresol being only soluble in petroleum containing 10 to 20 per cent. of coal-tar oil. Further distilled cresol containing 2–3 per cent. of naphtha dissolves to a clear liquid with twice its volume of 10 per cent. caustic soda solution.

The same errors occur in cases of carbohc powder testing. The author shows that unless the amount of caustic soda be increased the method of R. Williams (this Journal, 1889, 826) is inapplicable to powders containing over 20 per cent. of anhydrous cresol, or 22.5 per cent. anhydrous carbohc acid. Toth (this Journal, 1886, 618) appears to use too strong caustic potash solution as concentrated potassium, or sodium cresylate is soluble in excess of hydrocarbon oils. As to the method of Bach and also Muter and Konigsh (Analyst, **12**, 191) a better result is got by using saturated calcium chloride solution, but the author prefers agitating 50 cc. of the crude carbohc acid with 30 to 50 cc. of benzol and 30 cc. of 50 per cent. sulphuric acid. Although benzene is not absolutely necessary in case of refined or distilled acid, the author recommends its use.

With regard to Tidy's process, in which 20 cc. of NaHO (sp. gr. 1.2) are used. This solution would contain 4.23 grms. of NaHO, equivalent to 12.69 grms. of tar acids and thus becomes erroneous for larger amounts. Cases are known to the author where buyers have actually insisted on 20 per cent. of tar acids being shown to be present by Tidy's test. Tidy's method is also open to the objection that the solution of tar acids on neutralising is disregarded; 150 cc. contains at least, and often more than, 1 grm. of crude acids dissolved.

The author considers all results should be reported as anhydrous phenols.—D. A. S.

Determination of Value of Crude Cocaine. E. R. Squibb.
Pharm. Rundsch. **7**, 186.

Two grms. of an average sample of the crude cocaine is stirred with 12 cc. of ether (sp. gr. 0.725) in a tared beaker, filtered and washed with ether, and the undissolved portion determined by weighing the beaker and the dried filter with residue having a second dried filter paper as counterpoise. The ethereal solution is shaken in a separating funnel successively with 10 cc. of normal oxalic acid solution, with 10 cc. of water containing two drops of normal oxalic acid solution, and twice with about 3 cc. of water. The aqueous extracts are united and the separating funnel washed out with a mixture of 15 cc. of ether and 2 cc. of water; this is also added to the acid solution. The aqueous solution is again separated from the ether, and the latter after being twice extracted with 3 cc. of water (which is added to the cocaine oxalate solution) is mixed with the original ethereal extract. The whole of the ether is then evaporated down and the impurities of the crude cocaine soluble in ether determined. The separating funnel is washed out with a mixture of 15 cc. of ether and 2 cc. of water into the aqueous solution of cocaine oxalate contained in a second separating funnel. The whole is treated with 10 cc. and three drops of normal sodium carbonate solution in order to liberate the cocaine. The solutions are separated and the ether washed twice with 3 cc. of water; the ethereal solution is then poured into a tared beaker and the separating funnel washed out with a mixture of 10 cc. of ether and 3 cc. of water which is added to the oxalate solution. The latter is treated with one drop of normal sodium carbonate solution and well shaken; the ethereal solution is washed with a few drops of water and added to the rest of the ether. On evaporating off the ether, the cocaine separates in crystals which are dried at 90° and weighed. An analysis of crude cocaine gave:—Moisture, 3.25 per cent.; residue insoluble in ether, 5.25; soluble in ether, 0.50; pure alkaloid, 89.94; loss, 1.06 per cent. The amount of pure cocaine varies from 78 to 94 per cent.

—N. H. J. M.

Detection and Estimation of Sodium Bicarbonate in Milk.
L. Padé. Compt. Rend. **109**, 154–156.

ALTHOUGH a drop of decinormal acid is always sufficient to render acid the ash obtained by the ignition of 10 cc. of pure milk, the titration of the ash will not indicate the amount of carbonate which has been added, as during ignition it reacts on the calcium phosphate in the ash, according to the equation—



To determine the total amount of sodium bicarbonate added, the alkalinity of the soluble ash must be ascertained, and also the amount of sodium phosphate in it, as 284 parts of this corresponds to 336 of sodium bicarbonate. The phosphate is best estimated by titration with uranium solution, using cochineal as indicator.—E. E. B.

Beet Analysis. Journ. fabr. Sucre, **30**, 30–34.

IN connexion with Vivien's communication on an apparatus for the direct estimation of sugar, in which a process of aqueous extraction is carried on, Pellet says that he has also devised a similar arrangement, consisting of a tube and suitable cock by which he is enabled to completely extract the normal weight of beet juice prepared by the Pellet-Lomont rasp with 200 cc. of water. To ensure complete accuracy a second extraction is made, and both solutions are polarised, the first after the addition of 5–6 cc. of acetate of lead, the second requiring only a few drops, and the results are added. The test lasts only 12 minutes. Hot water or alcohol may also be used for the extraction.—W. M.

Beet Analyses. Zeits. f. Zuckerind. **39**, 580.

CLERC considers that the question as to whether the alcohol of polarisation should replace Pellet's aqueous extraction method or not is still undecided, while, according to Sackel, Pellet's method is only to be recommended to those who know there is no appreciable quantity of optically active non-saccharine matter present. He also considers that Pellet's fundamental assumptions are incorrect.—W. M.

Pellet's Process of Beet Analysis. Zeits. f. Zuckerind. **39**, 591.

LIPPMANN fully discusses Pellet's process and points out the numerous errors which Pellet has committed; he considers it very desirable that before being generally used the method be more completely tested. Sachs reports that Pellet's hot digestion process has given good results in Belgium, and also in his own hands, but that beets showing abnormal variations with the alcohol method were not examined; on the other hand he does not consider that the cold digestion process gives good results, and he points out that the so-called "Pellet warm digestion" originated with him, and the "cold digestion" with Van Niessen, who showed it to Pellet.—W. M.

Estimation of more than 10 Per Cent. Invert Sugar in Factory Products. Zeits. f. Zuckerind. **39**, 734.

HILLER has calculated a more complete table in extension of the figures obtained by Meissl and Herzfeld. The direct polarisation (P) of the normal weight of the sample is determined. The lead is precipitated in an aliquot portion of the filtrate by sulphate of soda, and the solution is made up to a known volume and filtered, and the invert sugar (I) estimation is carried out in 50 cc. of the filtrate, this corresponds to 200—300 mgrm. Cu.

The quantity of substance *p* contained in the 50 cc. has approximately $\frac{\text{Cu}}{2}$ grms. invert sugar; 100 grms. accordingly contain—

$$I = \frac{100 \text{ Cu}}{p} \frac{2}{2}$$

and since—

$$C \text{ (cane sugar)} + I = P + \frac{100 \text{ Cu}}{p} \frac{2}{2}$$

there is no—

$$P + \frac{100 \text{ Cu}}{p} \text{ total sugar,}$$

$$\frac{100 \text{ Cu}}{p} \text{ invert sugar,}$$

or on 100 total sugar—

$$\frac{100 \text{ Cu}}{2} \times 100 \\ p \cdot P + 100 \frac{\text{Cu}}{p} \text{ invert sugar present.}$$

Now, $C \approx 100 - I$ therefore $C : I$ is known.

Accordingly, the calculated factor *F* is taken from the following table and from the equation $I = \frac{\text{Cu}}{2} F$, the exact

percentage of invert sugar is calculated. The table is as follows:—

C : I.	I in Mgrms.						
	200	175	150	125	100	75	50
0 : 100	56.4	55.4	54.5	53.8	53.2	53.0	53.0
10 : 90	56.3	55.3	54.4	53.8	53.2	52.9	52.9
20 : 80	56.2	55.2	54.3	53.7	53.2	52.7	52.7
30 : 70	56.1	55.1	54.2	53.7	53.2	52.6	52.6
40 : 60	55.9	55.0	54.1	53.6	53.1	52.5	52.4
50 : 50	55.7	54.9	54.0	53.5	53.1	52.3	52.2
60 : 40	55.6	54.7	53.8	53.2	52.8	52.1	51.9
70 : 30	55.5	54.5	53.5	52.9	52.5	51.9	51.6
80 : 20	55.4	54.3	53.3	52.7	52.2	51.7	51.3
90 : 10	54.6	53.6	53.1	52.6	52.1	51.6	51.2
91 : 9	54.1	53.6	52.6	52.1	51.6	51.2	50.7
92 : 8	53.6	53.1	52.1	51.6	51.2	50.7	50.3
93 : 7	53.6	53.1	52.1	51.2	50.7	50.3	49.8
94 : 6	53.1	52.6	51.6	50.7	50.3	49.8	48.9
95 : 5	52.6	52.1	51.2	50.3	49.4	48.9	48.5
96 : 4	52.1	51.2	50.7	49.8	48.9	47.7	46.9
97 : 3	50.7	50.3	49.8	48.9	47.7	46.2	45.1
98 : 2	49.9	48.9	48.5	47.3	45.8	43.3	40.6
99 : 1	47.7	47.3	46.5	45.1	43.3	41.2	38.1

—W. M.

Estimation of Invert Sugar Dents. Zuckerind. **14**, 1098.

ACCORDING to Scheller a Soldaini solution of constant composition is easily prepared by dissolving 15.8 grms. of pure copper sulphate and 7.2 grms. of potash, each in 100 cc., mixing them, and pouring the whole, along with the precipitated hydroxide, into 1,700 cc. of a solution of 594 grms. of acid potassium carbonate in water. The mixture is heated for one hour on the water-bath, allowed to cool, and then made up to 2,000 cc. 1 cc. of this reagent contains 2 mgrms. of Cu. The same quantity of copper sulphate may also be added directly to the hot solution of acid potassium carbonate, and then after heating for 15 minutes the solution is allowed to cool and made up to 2,000 cc. This reagent is of constant composition, no precipitation having taken place within three months.—W. M.

Soldaini's Reagent of Constant Composition. Zeits. f. Zuckerind. **39**, 773.

ACCORDING to Striegler it is necessary to have certain fixed proportions between the components in order to have a stable solution, and especially no more bicarbonate of potassium must be used than will afterwards remain in solution at the ordinary temperature. To prepare 2 litres of the reagent, 12.77 grms. of copper sulphate are dissolved in cold water, soda is added to alkaline reaction, the precipitate is thoroughly washed with about $\frac{2}{3}$ litre of water, and then heated in a flask containing about 2 litres of water and 597.7 grms. potassium bicarbonate, on a water-bath to 40°–50° C. until the bicarbonate has dissolved, then over a naked flame to 66° until the hydroxide is completely dissolved, and finally the solution is boiled vigorously for 1–1½ hours until the excess of bicarbonate is decomposed. After cooling, the solution is made up to 2 litres and filtered, and is then quite stable, not decomposing even after half an hour's boiling. If the solution be diluted with 5 volumes

of water, greenish-blue hydroxide is precipitated which is converted into the black oxide on heating.

The solution prepared according to Soldani's original receipt and diluted with 20 vols. of water behaves in the same way, containing perhaps the copper in the form of hydroxide instead of carbonate.

This decomposition explains the irregularity of the results frequently obtained with Soldani's solution. For analysis 150 cc. of the reagent is boiled vigorously and 50 cc. of invert sugar solution is added and the solution is again boiled for five minutes. In this way the following results were obtained:—

50 cc. containing 50 mgrms. of invert sugar (I) gave 142 mgrms. of Cu, 50 mgrms. I + 5 grms. of cane sugar (C), 142.2 mgrms. Cu, 25 mgrms. of I + 5 grms. C, 71.8 mgrms. Cu, 12.5 mgrms. I + 5 grms. C, 37 mgrms. Cu, 5 mgrms. I + 5 grms. C, 17.5 mgrms. Cu, 2 mgrms. I + 5 grms. C, 7.2 mgrms. Cu. The statement of Bodenbender and Scheller that the amount of copper is proportional to the invert sugar is not quite correct, at least for small quantities of sugar.

From special experiments it was found that in the presence of 5 grms. of cane sugar the proportion of the copper to the invert sugar was as follows:—

Found, mgrms. of Cu	53,	45,	40,	35,	30,	25,	20,	15,	10,	5
Sought, mgrms. of	100,	16.3,	13.7,	11.5,	9.4,	7.5,	5.8,	3.5,	2.6,	1.1.
invert sugar ...										

—W. M.

On the Estimation of Tannin with Potassium Permanganate. F. Gantter. Zeits. f. angew. Chem. 1889, 577—580.

LÖWENTHAL'S method for estimating tannin, as improved by von Schröder, has come into very general use, and the commission for determining a uniform method of tannin estimation has accepted it, and it is known as the "cubic-centimetre" method. This method has the advantage over most others of giving fairly uniform results, and such as agree well amongst themselves, providing the method of procedure is rigorously adhered to. A slight deviation, however, from the method of procedure causes irregularities, and many chemists have therefore become prejudiced against the method. The author has therefore tried to improve the method so that uniformly accurate results might be obtainable without difficulty.

He has attempted, and as the result shows successfully, to completely oxidise the tannin with permanganate, without the presence of a special indicator, by carrying out the oxidation in a hot instead of a cold tannin solution.

As a result of his investigations, he recommends the new method of procedure given below, which he has more especially applied to the estimation of tannin in oak-bark.

The solutions necessary are:—

(a.) Potassium permanganate solution, 1,000cc. containing 3.988 grms. i.e., 1 cc. = 0.001 gm. of tannin.

(b.) Oxalic acid, 1,000 cc. = 7.951 grms. crystallised oxalic acid.

(c.) Extract of oak-bark prepared in the usual way from 10 grms. of bark = 1000 cc. of solution.

(a.) and (b.) solutions may be looked upon as equivalent, cubic centimetre for cubic centimetre, to a pure tannin solution containing 1 gm. of dry pure tannin per litre.

The permanganate solution is standardised against the oxalic acid solution.

The method of procedure is as follows:—

Ten cc. of dilute sulphuric acid are added to 10 cc. of oak-bark solution, and then nearly heated to boiling; about 1 cc. of permanganate is then added. The red colour disappears. The gradual addition of permanganate is continued until the red colour begins to disappear slowly; as soon as this is the case the solution is again heated to boiling, and the permanganate solution is now only added drop by drop. The solution must be allowed to get perfectly limpid before the addition of the next drop. Towards the end of the reaction a small quantity of a brown precipitate (manganese hydrate) is formed, which, however, always again disappears on boiling vigorously so long as the reaction is

not complete. As soon as the precipitate no longer disappears, even on vigorous boiling, about 1cc. of permanganate solution is allowed to run in in excess; the mixture is then subjected to vigorous boiling. A thick brown precipitate separates out. Oxalic acid (from a second burette) is now run into the hot solution, until the latter is perfectly limpid, and the titration is then finished off with permanganate. After deducting the number of cubic centimetres of oxalic acid solution from the number of cubic centimetres of permanganate solution used, the difference in cc. gives us the percentage of tannin directly.

It is of course necessary to carry out a second titration with a portion of the extract which has been precipitated with skin (a gelatin solution may do as well, see Sutton, Volumetric Analysis, 278) and the amount of permanganate solution used in this second titration must be deducted from the first. As a rule, however, the quantity to be deducted is so small that for technical purposes it may be neglected.

Experiments on the estimation of tannin in oak bark show that the results obtained by this method are identical with those obtained by the gravimetric method, but that the quantity of tannin found by the Löwenthal-Schröder method is about one-half of that found by the new and gravimetric methods.

The new method can also be used in determining the value of other tanning materials, since the oxidation of the tannin from various sources always requires an amount of permanganate differing only slightly from that required for pure tannin. The author is still engaged with the determination of the actual quantities of permanganate necessary in these cases.—F. W. T. K.

New Books.

FEUERUNGSANLAGEN. Für Häusliche und Gewerbliche Zwecke, von DR. FERD. FISCHER, Zugleich als 4^{te} Auflage von "Meuzel's Bau der Feuerungsanlagen" mit 299 Abbildungen. Karlsruhe: J. Bielefeld's Verlag. 1889. London: H. Grevel and Co., 33, King Street, Covent Garden.

This important work is mainly a collection of the writings of Dr. Fischer on the general subject, now arranged, with certain additions, in book form. The text covers 206 pages of an 8vo. volume, well illustrated with 299 wood engravings. The price of the book is 8s. 6d. unbound, elegantly bound 10s. The subdivision of the general subjects is effected as follows:—1. Fuels. 2. Investigations in the Application of Fuels. 3. Theory of Combustion; Smoke. 4. Grates and Stoking Arrangements. 5. Chimneys. 6. Heating and Ventilation. 7. Boiler Arrangements. 8. Blind Furnaces. 9. Boiler Furnaces. 10. Generator Gas. 11. Illuminating and Water-gas. 12. Glass Furnaces. 13. Furnaces for Porcelain and Earthenware. 14. Furnaces for Lime and Cements. 15. Furnaces for Breweries and Spirit Distilleries. 16. Other Furnace Arrangements.

DIE SYNTHETISCHEN DARSTELLUNGSMETHODEN DER KOHLENSTOFF-VERBINDUNGEN. Von KARL ELBS, Erster Band. Leipzig: Johann Ambros Barth. 1889. London: H. Grevel and Co., 33, King Street, Covent Garden.

This is an attempt to collect together all the known synthetical methods of preparation of the carbon compounds. This collection was to be completed in two volumes, of which the present is the first. It is a work of 8vo. size, containing 284 pages of subject-matter, and an alphabetical index. The price is 7s. 6d.

Chap. I. deals with syntheses by means of metallo-organic compounds. II. Syntheses of Cyanogen Compounds. III. Syntheses of Molecular Re-arrangements. IV. Syntheses

by Addition: (a) By Addition of the Anhydrides of Acids. (b) By Addition of Carbon Monoxide. (c) Synthetic Addition Processes with Aldehydes and Ketones. (d) Syntheses by Addition of Hydrogen to Aldehydes and Ketones. (e) Polymerisation of Unsaturated Hydrocarbons and their Derivatives. (f) Polymerisation of Nitrils.

HANDBOOK FOR GAS ENGINEERS AND MANAGERS. By THOMAS NEWBIGGING, Member of the Institution of Civil Engineers. Fifth Edition, Enlarged. London: Walter King, Office of the "Journal of Gas Lighting," &c., 11, Bolt Court, Fleet Street, E.C. 1889. Price, bound in cloth, 15s.; morocco, gilt, 18s.

OCTAVO volume, splendidly bound in morocco and gilt, containing Preface, Table of Contents and of Illustrations, and 524 pages of Subject-matter. All the requirements, statistics and data needed by the gas engineer are here supplied, and supplied as concisely as possible. The text is very fully illustrated with 193 engravings and tables of various data and statistics. The following is an abstract of the subjects treated of:—Coal and Cannel. The Storage of Coal. Spontaneous Ignition of Coal, &c. Testing Coal for its Producing Properties. Retort-house Benches, Retorts and Mountings. The Slaking of Hot Coke. Fuel for Carbonising. Generator Furnaces and Regeneration. The Dinsmore System of Gas Making. Charging and Drawing Retorts by Machinery. Naphthalene. Exhausters. Scrubbers. Bye-pass Mains and Valves. The Tar Well. Purification and Purifiers. Gas Holders. Main Pipes and Distribution. Service Pipes and Fittings. Consumers' Gas Meters. Testing Meters. Public Illuminations. Coloured Fires. Various Standards of Light. Relative Value of different Illuminating Agents. The Gas Industry of the United Kingdom. Coefficients of the Cost, &c. of the Buildings, Apparatus, Machinery, and Plant of a Gas Works. Alphabetical Index.

DIE CHEMIE DES STEINKOEHLENTHEERS MIT BESONDERER BERÜCKSICHTIGUNG DER KÜNSTLICHEN ORGANISCHEN FARBSTOFFE. Von GUSTAV SCHULTZ. Zweite vollständig umgearbeitete Auflage. Zweiter Band. Die Farbstoffe. Fünfte Lieferung. 1889. Brannschweig: Friedrich Vieweg und Sohn. London: H. Grevel & Co., 33, King Street, Covent Garden.

THE fourth part of the Second Volume closed with an unfinished report on the Safranines; the fifth part contained in the volume now referred to takes up and continues the subject on page 769, and it is concluded on page 802. CHAP. XL then commences with the Indulines and Nigrosins, and is completed on page 835, when the subjects Aniline black and Naphthylamine violet are considered in CHAP. XLI. The Quinoline colours are described in CHAP. XLII, viz., Flavaniline, Flavaniline S, Cyanine, Acridine colours, Phosphin, and Benzoflavin. In CHAP. XLIII the Indigo Group is the subject of study, and under this head Natural and Artificial Indigo and Indigo blue and its Derivatives are treated of. CHAP. XLIV, on the Diehroins and Allied Colouring Matters, and Colours of Unknown Constitution, extends to the final page of the volume, which, however, does not seem to be the concluding volume of the entire work. The entire text thus extends from page 769 to page 960. There are several illustrations in the form of wood engravings.

AN INTRODUCTION TO CHEMICAL SCIENCE. By R. P. WILLIAMS, A.M., Instructor in Chemistry, English High School, Boston, U.S.A. Edited and Revised by B. P. Lascelles, M.A., F.C.S., Assistant Master and Librarian, Harrow School. London and Boston, U.S.A.: Guise & Co. 1889. Price 3s. 6d.

As stated in the Editor's preface "this manual is purely introductory, and it aims only at giving an outline of the science which must be filled up in greater detail from larger works."

It is hoped that this volume will fill the gap indicated in the *Report on Chemical Teaching*, issued by a committee of the British Association in 1888, as existing between the Natural Philosophy Primer and the minute and detailed text-book.

The work takes the form of a crown 8vo. volume, is bound in cloth, and contain 209 pages of subject-matter, an Appendix covering 5 pages, and an alphabetical index. The text is embellished with 50 wood engravings.

In this little work the attempt has been made to introduce into the text (usually devoted to pure chemistry) also those elements of chemical physics which have become more and more closely allied to pure chemistry, such as Electrolysis, Electro-chemical relation of the Elements, and Photography.

CHEMISCH-TECHNISCHES REPERTORIUM. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete des technischen und industriellen Chemie mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. EMIL JACOBSEN. 1888. *Zeites Halbjahr. Zweite Hälfte.* Berlin: R. Gertner's Verlagsbuchhandlung, Hermann Heyfelder. S.W. Schönebergerstrasse, 26. London: H. Grevel and Co., 33, King Street, Covent Garden.

OCTAVO volume in paper cover; the second issue for the second half-year of 1888. It contains 178 pages of subject-matter, copiously illustrated with wood engravings. In the text the following subjects are treated of:—Food-stuffs and Confections; Paper; Photography; By-products of various kinds; Residual Matters; Manures; Disinfection and Sanitation; Soap; Explosives, &c. Preparation and Purification of Chemicals. Chemical Analysis. Apparatus, Machinery. Electro technology. Technology of Heat. Appendix: Adulterations of Trade Products, &c. New Books. Alphabetical Index.

DER PRAKTIISCHE KLEIDERFÄRBER NACH DEN ANFORDERUNGEN DER GEGENWART. Von CARL SCHULZ. Nebst einem Anhang über Kleider-Appretur. Vierte der Neuzeit entsprechend vollständig umgearbeitete Auflage. Leipzig: Verlag von Gustav Weigel. London: H. Grevel and Co., 33, King Street, Covent Garden.

SMALL 8vo. volume, in paper cover, can be had with pattern card at a price of 9s., without pattern card 3s. It contains 101 pages of text, entirely confined to the operations and requirements of the dyer and finisher. CHAP. I.—Silk Dyeing. CHAP. II.—Dyeing of Half Silks, Silk and Cotton, &c. CHAP. III.—Dyeing Woollens. CHAP. IV.—Dyeing of Half Woollens. CHAP. V.—Dyeing of Cotton Goods. CHAP. VI.—Finishing of Silk, Woollen, Half-Woollen, and Cotton Goods.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

SWEDEN.

Modifications in Customs Tariff.

The *Bollettino di Legislazione e Statistica Doganale e Commerciale* for October says that the Swedish Diet has approved, in its 1889 session, the following modifications in the Customs tariff:—

Note.—Krone = 1s. 1½d. Kilog. = 2·204 lb. avoirdupois.

No. in Tariff.	Classification of Articles.	Rates of Duty.
112	Varnishes : Spirit.....	Kron. Oro Kilog. 1·20
	Other.....	" 0·30
	<i>Note.</i> —Spirit varnishes imported in receptacles containing more than 20 kilogs., and of which the alcohol may be denaturalised in the prescribed manner, are subject to the duty of.....	" 0·40
141	Colours prepared in oil.....	" 0·15
289	Collodion.....	Litre 1·75
669	Vinegar and acetic acid : In casks containing up to 1 per cent. of acid.....	" 0·10
	Of greater acetic strength, for each degree above.....	" 0·01
679	In other receptacles, not taking account of the acetic strength.....	" 1·00

—Board of Trade Journal.

AUSTRIA-HUNGARY.

Customs Treatment of Alizarin.

The *Moniteur Belge* for the 7th November last says that an order has been issued by the Austro-Hungarian Customs authorities providing as follows:—

The alizarin subjected to the conventional rate of 1·50 florins only includes the four following categories: pure alizarin, anthra- or isopurpurin, flavopurpurin, and purpurin.

Other colours of alizarin (the derivatives of alizarin, such as orange, blue, green, yellow, alizarin, &c.) fall under the application of Article 330 of the tariff, and pay 10 florins per 100 kilog. as dyeing materials extracted from tar.

Customs Classification of "Ammonine."

According to the *Moniteur Belge* for the 27th October, the Austrian Customs authorities have decided that ammonine (substance made from soda and sulphide of ammonium) must be classified in Category 312a, and pay duty at the rate of 80 kreutzers per 100 kilogs.—*Ibid.*

SWITZERLAND.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220·4 lb. avoirdupois. Franc = 9⁴/₁₀d.

The following decisions affecting the classification of articles in the Swiss Customs tariff were given by the Swiss Customs authorities during the month of October last:—

Salicylate of soda.—Category 17. Duty, 1 franc per quintal.

Cassel-brown.—Category 30. Duty, 60 cents. per quintal. Lead-yellow (*Bleigelb, Deckgelb*).—Category 35. Duty, 3 francs per quintal.—*Ibid.*

UNITED STATES.

Recent Customs Decisions.

The following decisions affecting the classification of articles in the Customs tariff, and the application of the Customs law of the United States, have recently been given by the United States Customs authorities:—

Soap in cakes, wrapped in tinfoil, with an outside covering of paper, each cake stamped "Calvert's carbolic toilet soap," is dutiable under the provision in T. L., 8, for "soaps not otherwise provided for."

Calvert's purest carbolic medical soap is dutiable as toilet soap.

An article called toluidine is exempt from duty under provision in the free list (T. L., 559) for "aniline, crude."

Toluidine sulpho-acid is dutiable as a coal-tar colour.

Paper for use in making "ferro-prussiate paper" is dutiable as paper not otherwise provided for.

The fine copper contained in nickel matte is dutiable at the rate of 3½ cents per pound, under the provision in T. L., 186, for regulus of copper, in addition to the duty of 15 cents per pound on the nickel contained therein imposed by T. L., 191.

An impure grease, saponified by lime, which is not suitable for use as soap-stock, but which can be used as a lubricator for heavy iron bearings, such as car-axles, &c., is dutiable at the rate of 10 per cent. *ad valorem*.

Pure guaiac resin, the purity having been produced by refining, and commercially known as gum guaiac, is dutiable at the rate of 25 per cent. *ad valorem*.

Lemon juice, containing over 2½ per cent. of alcohol, is removed from the category of lemon juice, as specified in the free list, and is liable to duty at rates prescribed for alcoholic compounds in Schedule A. (T. L., 103), at 2 dols. per gallon for the alcohol contained therein and 25 per cent. *ad valorem*.

Certain so-called "saffron extracts" which do not exhibit the distinguishing characteristics of "saffron extract" and is positively a colour derived from coal-tar, are dutiable at 35 per cent. *ad valorem* under T. L., 82.—*Ibid.*

CUSTOMS TARIFF OF NICARAGUA.

The following is a statement of the rates of import duty now levied under the Customs tariff of Nicaragua. The duty in each case is leviable per Spanish *libra* or pound (100 English pounds avoirdupois are equal to 101·6 Spanish pounds).

Note.—Peso = 4s. 2d. (nominal value).

Articles.	Rates of Duty per Spanish Pound.
MEDICINES, DRUGS, &c.	
Oils, olive linseed, almond, castor, cocoa-nut, cod-liver, and any other similar oil.....	0·03
Acids, chlorhydric, muriatic, sulphuric, and nitric	0·03
Do., carbolic, acetic, and oxalic.....	0·05
Turpentine oil, gaseous mineral oil, acidulated waters.....	0·02
Aqua-fortis, orange and rose water.....	0·05
Eau de Cologne, lavender, Florida, holy, Kananga, and other similar toilette waters.....	0·07
White lead or carbonate of lead.....	0·04
Alum.....	0·02
Liquid ammonia or volatile alkali.....	0·04
Green copperas or sulphate of iron.....	0·01
Sulphur of any kind.....	0·03
Sugar candy.....	0·03
Bicarbonate of soda.....	0·01
Borax or borate of sodium.....	0·05

Articles.	Rates of Duty per Spanish Pound.
MEDICINES, DRUGS, &c.—<i>cont.</i>	
Carbonate of soda crystallised and chloride of lime	0'01
Medicinal sweetmeats or pastilles	0'15
Medicinal barks	0'15
Chalk, clay, Tripoli	0'02
Perfumed and medicinal essences	1'00
Sponges of any kind	1'00
Liquid amber	0'05
Gum arabic or gum lac	0'10
Glycerin	0'03
Lint	0'15
Senna leaves and rosemary	0'03
Soaps and syrups, medicinal	0'15
Linseed or linseed flour	0'03
Cocoa butter	0'15
Fat for ointments or pomades	0'05
Medicines in gelatin capsules, patented medicines, as well as balms and mixtures of oils in drugs, pastes, powders, in a liquid state, tragacanth, and medicines in any form and prepared in any way not specially mentioned	0'15
Medicines and drugs, in pastes, powders, liquids, tragacanth in any form, and prepared in any way, not specially mentioned	0'15
Mustard in seed or flour	0'03
Gall nuts	0'05
Oxide of zinc	0'04
Filtering paper	0'05
Pitch, resinous	0'02
Epsom and Glauber salts	0'02
Saltpetre or nitrate of potash	0'03
Sal-ammoniac	0'05
Caustic soda	0'02
Medicinal berries	0'15
Sulphate of iron	0'01
Sulphate of zinc or white vitriol	0'02
Sulphate of copper or blue vitriol	0'03
Sulphate of quinine	1'00
Persian sherbet	0'05
Turpentine	0'05
Utensils for chemists and druggists, of faience, stone, and composition, such as mortars, basins, &c.	0'03
Poisons for tanning, insects, &c.	0'10
Medicinal wines, such as quinine, extract of meat, &c.	0'15
Vaseline, easmoline, and petrolate	0'10
Bristol sarsaparilla, and other similar kinds	0'03
MISCELLANEOUS ARTICLES.	
Mineral oils such as camphine, petroleum, and naphtha	0'01
Perfumed oils	0'10
Alcohol	Prohibited.*

Articles.	Rates of Duty per Spanish Pound.
MISCELLANEOUS ARTICLES, &c.—<i>cont.</i>	
Tar, pitch, blacking	0'02
Starch or fecula of potatoes for industrial use	0'03
Manufactures of amber	0'50
Aniline and carmine	0'25
Electrical apparatus for telegraphs and telephones	Prohibited,
Varnish of any kind	0'03
Caoutchouc tissue, manufactured as shoes, capes, covers, boots, and other similar articles	0'25
Caoutchouc manufactured in articles of any kind not otherwise specified	0'30
White wax, pure or mixed, not manufactured	0'12
Articles of wax not specially mentioned	0'25
Beer	0'02
Glues of any kind	0'06
Colours and sizings of any kind not specially mentioned, in powders, pastes, or oil	0'04
Articles of celluloid of any kind	0'40
Dynamite	Prohibited,
Matches of all kinds	0'04
Fireworks of any kind	0'13
Perfumes of all kinds	0'13
Soap, common	0'02
„ superior, toilet soap, perfumed	0'10
Ochre and other coloured earths	0'40
Powder, blasting, under special authority of the Government	0'50
Powder, other	Prohibited,
Candles, tallow, wax, &c.	0'05

The following articles pay specific duties as under:—

Articles.	Rates of Duty.
Foreign spirits more than 12 degrees up to 25 degrees, inclusive by the Cartier alcoholmeter....	Pes. Cts. Bottle 0'40
Dos. more than 25 degrees by the Cartier alcoholmeter (with special authority of the Government) pay same duty as the preceding articles with an increase per degree in excess of	0'03

The following articles are free from import duty:—

Manure for agricultural use.
Still, under special authority from the Government.
Mercury for mines.
Lime and cement.
Coal and animal charcoal.
Crucibles for melting metals.

Articles not mentioned in the tariff pay the duties leviable on similar articles; those not mentioned in the composition of which there are several materials pay the duty leviable on the chief material; finally, for those not mentioned which cannot be classified there is levied 50 per cent. on the invoice value. If the original invoice is missing, a valuation of the goods will be made by experts.

The import duties are fixed on the gross weight without any deduction for cases and packages.—*Ibid.*

* Except under special permit of the Government. See below.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

RAMIE CULTIVATION IN MEXICO.

See *Board of Trade Journal* for December, p. 658.

THE PREPARATION OF RAMIE FIBRE.

Ibid., pp. 705-711.

THE WORKING OF THE STATE ALCOHOL MONOPOLY IN SWITZERLAND.

Ibid., pp. 717-718.

EXTENSION OF THE ALCOHOL DRAWBACK IN GERMANY.

An order has just been issued by which German soap-makers are allowed to use alcohol in their manufactures free of duty, provided they conform to certain regulations. These rules are very simple, and consist simply in the manufacturer giving notice on an official form of the quantity of spirit which he intends to use, and the time when the manufacturing process is to take place. The alcohol is then forwarded to the works in bond, and in officially sealed packages, and at the appointed hour an Excise officer attends at the works, breaks the seal, and watches the incorporation of the alcohol into the soap-stock until the spirit has been fully mixed with the caustic-soda lye. The concession has been made specially in the interests of the manufacturers of transparent toilet soaps. For the manufacture of perfumery with duty-free alcohol facilities are already given.—*Chemist and Druggist*.

MISCELLANEOUS TRADE NOTICES.

ENGLISH MANURES IN THE DISTRICT OF LA ROCHELLE.

In the matter of artificial manures, the English have nearly lost the market, not from the bad quality of the manures supplied, but because they have not seen fit to sell their manures with guarantees of fixed price and strength.

The French laws against the adulteration of manures are particularly stringent.* They require that particulars shall be given of the origin, whether natural or manufactured, of the manures sold, with a detailed statement of their fertilising value, expressed by the quantity of nitrogen, potash, phosphoric acid, and other elements contained in them. The price is to be based upon the quantities of the respective constituents. English manure makers have not supplied manures in exactly the form required by the French farmers. They have been consequently manipulated by retailers, and "the English article, however good it may have been when it arrived, has often reached the farmers in an adulterated condition, and has got a bad name consequently."

Owing to the failure of English makers of manures to give satisfaction, for the reasons stated, and also because the manures are a little dearer than the French, some large manufactories have been established lately in France, but it is agreed that no better manures can be made than the English, and a good business could be done if English firms were willing to meet the requirements of the farmers and keep to the letter of the laws.—*Board of Trade Journal*.

PERFUMERY MANUFACTURE IN AUSTRIA.

The Vienna Chamber of Commerce reports that, in spite of many adverse circumstances, the Vienna perfumery industry is steadily expanding. The wealthier classes in Austria, who formerly would only use French or English

soaps and perfumery, are learning to appreciate the excellence of native manufactures, and since last year an export business, mostly with the East Indies, has grown up in certain goods, especially toilet soaps of medium qualities. Viennese glycerin soaps have been enabled to compete with English, French, and German made articles lately because drawback on the denaturalised spirit used in their manufacture is now granted to the Austrian makers, but hitherto perfumers have not been able to obtain an extension of the drawback regulations to alcoholic extracts and other perfumes. The German makers, on the other hand, enjoy complete immunity from any alcohol duty on goods exported, and are consequently able to take much of the East Indian trade which, but for these advantages, the Austrian makers would monopolise.—*Chemist and Druggist*.

THE PAPER INDUSTRY IN SPAIN.

The industrial movement at Bilbao continues unchecked, and among the many schemes in view, it is now reported that a paper mill, of the largest and most perfect style, will be established in a very short time. The paper industry in the country is mostly confined to the north of Spain, in the Basque provinces and in Catalonia; but there is still room for the importation of about 5,000 tons annually, particularly from Belgium. Although Madrid is a very large market for paper, the paper industry is not either extensive or prosperous, and is far from being in proportion to the wants.—*Industries*.

THE AUSTRIAN SUGAR TRADE.

This year's manufacture of raw beet sugar was over in Austria and Hungary by December 1st. There were, altogether, 215 factories, as against 210 last season, and an output of 60 million metrical centners, compared with 47 millions. The increase has been due partially to the greater area, but chiefly to the improved quality, and therefore larger yield, of this year's beetroot crop. The area showed an increase of 90 per cent., and the yield one of 29 per cent. The manufacture of raw sugar rose from 5½ million metrical centners to over seven millions, and, as the home consumption promises to remain stationary, Austria-Hungary will be able to export nearly twice as much as last year. Most of the raw and refined sugar available for export has already been sent to Germany, in order to use the Elbe route before the winter interrupts navigation.

The large profits made during the present season form an added inducement to extend the acreage devoted to beet, especially in Hungary, where the sugar industry has been taken up energetically by the first-class firms. About 20 new factories, some of unusual capacity, will be ready at the beginning of next season to compete with the Bohemian factories, not only for the home market, but also for the export trade, for which the Hungarians prefer the sea route *via* Fiume.—*Standard*.

BUTTERINE LEGISLATION IN HOLLAND.

The new Margarine Act passed by the Dutch Legislature last session will come into operation on 1st January next. In the main it follows closely the English Margarine Act, 1887; in fact this measure led to it. But the Dutch Act offers some important modifications. It will be criminal to use the word "butterine" for margarine mixtures, and all such compounds must be labelled "margarine" before they can be "delivered" or sold in the kingdom. But on the other hand, dairy butter, if not absolutely pure, can only be sold under the name of "butter substitute." Meanwhile a new compound will be manufactured shortly at Amsterdam, where a large factory is in course of erection for the purpose. That compound is a preparation from cocoa-nuts and similar oily products of the tropics. It is styled "cocoa-nut butter," and is stated to be an excellent substitute for butter in cooking, especially as it can be manufactured at a price much lower than either butter or margarine. In Amsterdam the new factory is started by the "Dutch Vegetable Butter Company."—*Industries*.

* See this Journal, Feb. 1888, p. 143.

THE PETROLEUM SUPPLY OF THE CAUCASUS.

The price of the raw material (naphtha) during the last two years has gone up from $1\frac{1}{2}$ copecks per pood of 36 lb. to 7 copecks, the present price, and there is no denying that formerly the supply was beyond the demand, and that now the reverse is the case; but this can easily be explained without coming to the conclusion that the supply is exhausted. Bearing in mind that the Trans-Caucasian Railway can only carry a fixed quantity of the refined kerosene to Batoum, on the Black Sea, for exportation, owing to the difficulties caused by the steep gradients, by far the greater part has to find an outlet to the Russian and European markets by the steamers and sailing vessels on the Caspian Sea, which carry the kerosene in bulk to Astrakhan at the mouth of the River Volga. Two years ago there was not sufficient carrying-power on the Caspian, so that freights went up enormously, with the result that so many ordered new steamers and sailing vessels that the supply is now excessive. In one year 15 new steamers were added; taking each as carrying 1,000 tons, you get 15,000 tons a trip, and, seeing each boat makes on an average 35 trips during the season, these alone added 525,000 tons to the carrying-power, exclusive of sailing vessels. Refineries were consequently extended to such an extent that the supply of the raw material is now insufficient, although the amount raised is no less than formerly.

It must be understood that the naphtha has, up till lately, only been bored for in one place, some nine miles from here, called Balakhani, which is only about $1\frac{1}{2}$ miles long by one mile broad in extent. Lately, a new place nearer town has attracted attention, and promises to eclipse Balakhani; it is called Bailoff Mees. There are many places in the vicinity where naphtha is known to exist, but as a bore-hole costs from 5,000*l.* to 6,000*l.*, people do not care to risk their money in experiments unless some one has already done so successfully close by. Bailoff Mees would have remained untouched if it had not been for the boldness of a Persian named Tagieff, who started boring there and found naphtha; he is now one of the wealthiest men here.

The conclusion, therefore, is not that the supply is becoming exhausted, but that through the facilities of export having so suddenly increased, the present supply of the raw material is insufficient to meet the demand, which supply only requires working to bring it up to the quantity required, and this is slowly being done.—*Ironmonger.*

COCOA-NUT BUTTER IN GERMANY.

The following is an extract from the last report of the United States Consul at Mannheim on the subject of the manufacture of cocoa-nut butter in Germany:—

"German chemists discovered in the cocoa-nut a fatty substitute for butter. This discovery was made by a Dr. Schlunk, practical chemist at Ludwigshafen-on-the-Rhine. Shortly after the discovery was made a firm was established in this city under the name 'P. Müller and Söhne,' which sunk a large amount of capital in an enterprise having for its object the production of the new article, to which they gave the name of 'cocoa-nut butter.' The results achieved have more than justified their expectations. The firm is not able to meet the constant demands made upon it. Although in existence only one year, it employs 25 workmen, who get from 25 to 75 cents. a day, has a 40-horse-power engine, and produces daily 3,000 kilos. of butter, which retails at from 55 to 65 pfennigs, or from 13 to 15½ cents. per pound, or 25 to 30 cents. per kilogramme.

"The nuts are obtained from almost all lands lying in the tropics, especially from the South Sea and Coral Islands, Arabia, the coast countries of Africa, and South America. Natives in countries where the nuts grow have for a long time used the milk of these nuts instead of food oils. It contains 60 to 70 per cent. of fat, and 23 to 25 per cent. of organic substances, of which 9 to 10 per cent. is of albumen. Liebig and Fresenius had already discovered the value of the cocoa-nut oil, or fat, but did not succeed in its production

as a substitute for butter. The new butter is of a clear, whitish colour, melts at from 26° to 28° C., and contains 0·0008 per cent. water, 0·066 per cent. mineral stuffs, and 99·9932 per cent. fat.

"It hardens at 19° C. It is better adapted, however, for the kitchen than for the dining-room, that is, for cooking purposes, than for the uses to which butter is put on our tables. It is neither disagreeable to the taste nor smell. In a country where real butter runs all the way from 25 to 35 cents. per pound, and cocoa-nut butter costs but 15 cents., a great future must open up before the latter. At present it is chiefly used in hospitals and other State institutions, but is also rapidly finding its way into houses or homes where people are too poor to buy butter. The working classes are rapidly taking to it instead of the oleomargarines, against which so much had been said in the papers during the last two or three years.

"The new butter is said to be singularly free from acids and other disturbing elements so often found in butter, especially that made from milk taken from cows diseased with tuberculosis. Here it is estimated that fully 10 per cent. of the milk-giving cows are so troubled. This absence of acids and other matter renders its digestion much easier, hence the preference already shown for the new article by hospitals and such institutions. There are those who do not hesitate to declare this new substitute as healthier, and infinitely preferable to the too often bad butter brought on the markets, and not to be named in the same breath with oleomargarines made too often from the diseased fat of horse and sheep flesh.

"When it is remembered that Germany has already some 50 factories making oleomargarines and other artificial butters, and that some 180,000 centners are produced annually, it will be readily seen that regular butter will have hard work to hold its own in a hundred uses against its new rivals, and especially so since the oleomargarines and artificial butters of all kinds are placed under severe, careful, and watchful State inspectors. It is hoped, however, that no losses, but gains rather, will arise; for besides the profits resulting from the new substitutes more meat and milk, as such will come on the markets, and consequently into use. If, with König, we assume that the principal nutriment—albumen, fats, and carbon hydrates are paid for in the ratio of 5:3:1, i.e., a kilog. of albumen costs five times, and a kilog. of fat three times, as much as a kilog. of carbon hydrate, we arrive by comparison of the nutritiousness of milk with other articles of diet, at the following results:—If we pay for 1 kilog. of milk, 15 pfennigs, for a mark we get 21·33 per cent. of nutriment; for 1 kilog. lard (bacon), 172 pfennigs, 16·08 per cent.; for 1 kilog. fatty cheese, 162 pfennigs, 14·32 per cent.; for 1 kilog. pork, 131 pfennigs, 14·01 per cent.; for 1 kilog. veal, 112 pfennigs, 10·33 per cent.; for 1 kilog. beef, 128 pfennigs, 9·11 per cent.; for 1 kilog. eggs, 200 pfennigs, 4·97 per cent.

"Now, if these facts are once known, milk as an article of diet will be more in demand, and the quantities no longer needed to make butter will find their way into the families where formerly pure butter was unknown, but where its substitute, cocoa-nut butter, has taken fast hold."—*Board of Trade Journal.*

CHEMICALS AND THE LONDON COUNTY COUNCIL.

At the meeting of the London County Council, which was held on December 17th at the Guildhall, the Earl of Rosebery in the chair, a report was brought up by Mr. Arthur Arnold, as chairman of the Main Drainage Committee, in which it was stated that the committee had received from the chemist his report, and that of Mr. Shoolbred, as to the experiments carried out by Mr. W. Webster at Crossness, on the electrical treatment of sewage, and they recommended that these reports be printed and distributed to the members of the Council, which was agreed to. The committee had received a report from the chemist as to the chemicals used during the past summer, from which they took the following extract:—"The quantities used at the Barking Outfall from 23rd May to 12th October were 1,313 tons of manganate, and 391 tons of sulphuric acid. At Crossness the quantities used from 23rd May to 6th October were 1,686 tons of

manganate and 664 tons of sulphuric acid, whilst there were used at the Storm Overflows during the same period 187 tons of manganate and 40 tons of sulphuric acid, the total being 3,197 tons 1 cwt. 3 qrs. 6 lb. manganate, and 1,096 tons 17 cwt. 2 qrs. 8 lb. acid, at a cost of 25,305*l.* 7*s.*" The report was adopted.—*Chemist and Druggist*.

RUSSIAN SODA.

A large works for the manufacture of soda is being erected in the Government of Jekaterinoslav, in Southern Russia. The output is estimated at 1,000,000 poods, or about 16,000 tons per annum. The extensive salt deposits in the vicinity of the factories are now being worked by a French company, who are under contract to supply the necessary salt to the new factory.—*Ibid*.

THE MONITEUR SCIENTIFIQUE.

The *Moniteur Scientifique* is to be, after all, continued by Dr. Quesneville's son Georges, a Fellow of the College of Pharmacy, and the pharmacist-in-chief of the Sainte Anne Asylum.—*Ibid*.

SULPHATE OF COPPER FOR SPANISH VINEYARDS.

Her Majesty's Consul at Barcelona reports to the Secretary of State for Foreign Affairs that notices have been published in the *Official Gazette* of the province by the "Provincial Deputation," signed by "E. Malaguer, president," to the effect that the "deputation" have decided to obtain in foreign markets where it is manufactured, a quantity of pure sulphate of copper for distribution to vine-growers in the province whose vineyards are attacked by mildew. Manufacturers are therefore invited to send samples, with quotation of prices, to the "deputation" at Barcelona, either direct or through their agents.—*London Chamber of Commerce (Information Circular)*.

PRUSSIA.

Our Berlin correspondent telegraphs that the *Warsaw Courier* states that the import into Prussia of cowhides and goatskins, bones, hoofs, and horns is again allowed on condition that they are dry, and sent in covered railway cars, and are transported to their place of destination without being reloaded.—*Daily News*.

CONCILIATION IN LABOUR DISPUTES.

The following important report has been presented to the London Chamber of Commerce by a committee appointed by the Council to consider and report upon the settlement of labour disputes. This report of the Labour Conciliation Committee has been provisionally adopted by the Council:—
December 12th, 1889.

Your committee has given its best attention to the subject of conciliation in settling labour disputes, which was referred to it by the Council. It has held eight meetings, and has also had interviews with many persons representing both capital and labour and possessing practical information on the subject. At the first meeting of the committee the chairman (Mr. S. B. Boulton) placed before it the draft proposals which accompany this report marked "A." These have formed at each meeting the subject of consideration by the committee, who have also had the benefit of the opinions upon them of many representative gentlemen who have come before it and expressed their views. These propositions have also been brought before various bodies of working men both at representative councils and at public meetings. So far as the committee, up to the present time, are able to form an opinion, the suggestions contained in the draft marked "A" seem to commend themselves both to its own members and to those who have appeared before it, or to whom they have been in other ways submitted, and they also seem to be practically adapted to carry out the objects in view. By means of correspondence the committee has also obtained some valuable information on the subject. In the mean time two threatened strikes have arisen, and representations have been officially made to the committee that the services of the Chamber might possibly, even at

this early stage, be of practical value in preventing such occurrences, and their consequent loss and injury. The committee therefore resolved to make an interim report to the Council, namely, to the effect that they ask its provisional approval of the chairman's propositions, and also for liberty, if the opportunity arises, to put them into practical operation as above suggested. Acting on the belief that these suggestions would be approved by the Council, and urged by the duty of doing everything in its power without delay to prevent any possible strike, the committee have already, on a request which has been made to them, offered facilities for mediation, viz., by offering to place the rooms of the Chamber at the disposal of the parties, and also indicating their willingness to assist in bringing about a settlement. Upon this special point therefore the approval of the Council is asked by the committee. Under powers to add to their number, the committee has invited Mr. E. H. Carbutt to join their body, and as regards the creation of the permanent committee contemplated by the draft propositions, the committee suggest that the selection of names should be referred to them to report upon at an early stage. Having regard to the similar functions of the Mansion House Committee and the desirability of their action being combined with that of the Chamber, the committee would recommend that the Lord Mayor, Sir James Whitehead, and Cardinal Manning be asked to join your committee, either individually or as representing the Mansion House Committee.

S. B. BOULTON, Chairman.

Committee.—Sir John Lubbock, Bart., M.P., Sir Albert Rollet, M.P., Sir Vincent Kennett-Barrington, R. K. Causton, Esq., M.P., Samuel Montagu, Esq., M.P., S. B. Boulton, Esq. (chairman), H. O. Arnold-Forster, Esq., E. H. Carbutt, Esq., and Kenrie B. Murray (secretary).

His Eminence Cardinal Manning, the Right Honourable Sir Henry Isaacs (Lord Mayor of London), and Sir James Whitehead, Bart., have now joined the committee.

LABOUR CONCILIATION COMMITTEE.

Proposed Recommendations to the Council.

It is advisable that the intentions of the Chamber relative to the settlement of future labour disputes should be made public through the medium of the Press and by public meeting, and that the co-operation of employers of labour and of trades unions and other representative bodies of the working classes should be earnestly solicited. It is inevitable that from time to time readjustments of the rates of labour should take place in sympathy with the fluctuating conditions of commerce and manufacturers, and the London Chamber of Commerce fully recognises the moral, as well as the legal, right of both employers and employed to combine for the purpose of protecting their respective interests. But the Chamber, in the interests of both classes, is most anxiously desirous that such adjustments should be brought about by amicable methods, and without the wasteful and calamitous occurrence of strikes and lock-outs, which in the case of the port of London have been proved by sad experience to cause a diminution in the volume of trade, upon the continuance and increase of which the toiling masses of this metropolis depend for their daily bread.

The committee recommends:—That a permanent committee, representative of both capital and labour, be appointed to deal with questions arising out of labour disputes in the port of London and in the metropolitan district. That this committee shall be composed of members of the council of this Chamber and of gentlemen not being members of the Chamber, but who may appear to possess such influence, authority, or experience as may be useful in promoting the settlement of such disputes. That when it shall be brought to the knowledge of the committee that a dispute as to the remuneration or other conditions of labour has arisen, or is likely to arise, the committee shall deliberate as to whether the said dispute is of sufficient importance to justify their intervention in the interest of the commerce or the manufactures of London. In the event of their decision being in the affirmative they shall be empowered on behalf of the Chamber—and that either upon their own initiative

or at the request of one or both of the parties concerned—to endeavour to promote a just, fair, and reasonable settlement; and that as a general rule the following course of procedure is recommended:

(a.) That they shall in the first instance invite both parties to the dispute to a friendly conference with each other; offering the rooms of the Chamber of Commerce as a convenient place of meeting. Members of the committee can be present at this conference, or otherwise, at the pleasure of the disputants.

(b.) That in the event of the disputants not being able to arrive at a settlement between themselves they shall be invited to lay their respective cases before the committee, with a view to receiving their advice, mediation, or assistance. Or, should the disputants prefer it, the committee would assist them in selecting arbitrators, to whom the questions at issue might be submitted for decision.

(c.) That the utmost efforts of the committee shall in the meantime, and in all cases, be exerted to prevent, if possible, the occurrence or continuance of a strike or lock-out until after all attempts at conciliation shall have been exhausted.

That the committee shall endeavour to promote the formation of councils of conciliation amongst the various trades of London, to be composed of employers and workmen, and it is suggested that such councils, if formed, might be affiliated to the London Chamber of Commerce.—*London Chamber of Commerce (Information Circular).*

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

	Month ended 30th November	
	1888.	1889.
	£	£
Metals.....	1,733,833	1,898,496
Chemicals, dyestuffs, and tanning materials.....	464,691	492,902
Oils.....	619,522	664,123
Raw materials for non-textile industries.....	3,128,423	3,853,895
Total value of all imports....	35,223,935	41,303,409

SUMMARY OF EXPORTS.

	Month ended 30th November	
	1888.	1889.
	£	£
Metals (other than machinery)	2,944,978	4,032,840
Chemicals and medicines.....	679,120	709,350
Miscellaneous articles.....	2,869,976	3,082,569
Total value of all exports.....	19,799,680	22,186,255

IMPORTS OF METALS FOR MONTH ENDED 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
			£	£
Copper:—				
Ore..... Tons	15,325	9,395	129,080	73,294
Regulus and precipitate	6,894	8,861	302,618	238,861
Unwrought "	2,518	3,082	190,957	143,619
Iron and steel:—				
Iron ore	166,354	299,790	118,258	225,810
Iron bolt, bar, &c. "	10,904	14,640	99,579	137,993
Steel, unwrought ..	1,913	644	15,643	8,023
Lead, pig and sheet ..	12,911	13,555	183,840	175,046
Pyrites	46,098	37,915	94,476	66,241
Quicksilver..... Lb.	95,500	127,995	11,700	15,435
Tin	29,152	61,408	165,820	280,122
Zinc	5,042	5,272	87,383	111,858
Other articles... Value £	..	..	334,479	422,134
Total value of metals	..	..	1,733,833	1,898,496

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDED 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
			£	£
Alkali..... Cwt.	3,866	4,959	3,059	3,615
Bark (for tanners' and dyers' use) ..	29,925	20,832	8,616	6,804
Brimstone	70,025	72,224	14,660	15,446
Chemicals..... Value £	..	..	96,153	147,303
Cochineal	1,176	1,034	8,068	6,619
Catch and gambier Tons	1,983	1,745	49,258	47,553
Dyes:—				
Aniline..... Value £	..	..	22,394	34,697
Alizarine .....	..	..	27,258	13,985
Other .....	..	..	1,139	950
Indigo	1,296	1,137	22,217	13,227
Madder	1,212	836	1,558	852
Nitrate of soda....	58,432	74,603	30,167	32,393
Nitrate of potash ..	13,698	25,437	13,845	23,305
Valonia	3,013	939	43,828	14,846
Other articles... Value £	..	..	122,471	131,307
Total value of chemicals	..	..	464,691	492,902

IMPORTS OF OILS FOR MONTH ENDED 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Cocoa-nut..... Cwt.	2,516	18,334	£ 3,976	£ 22,383
Olive Tuns	831	1,546	31,218	53,949
Palm Cwt.	74,441	78,385	78,380	81,894
Petroleum Gall.	12,214,364	11,081,733	339,039	272,057
Seed Tons	1,062	1,514	38,772	41,105
Train, &c..... Tuns	1,267	1,313	24,085	29,528
Turpentine Cwt.	28,685	42,373	49,894	72,461
Other oils..... Value £	..	..	53,858	87,146
Total value of oils ...	..	..	619,522	664,123

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDED 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Bark, Peruvian .. Cwt.	14,821	8,788	£ 67,781	£ 28,506
Bristles..... Lb.	178,900	241,718	21,956	34,651
Caoutchouc..... Cwt.	21,736	17,409	268,374	188,724
Gum :—				
Arabie..... "	9,861	3,623	41,933	11,853
Lae, &c..... "	3,092	8,176	9,181	31,398
Gutta-percha "	1,565	2,320	14,024	21,652
Hides, raw :—				
Dry..... "	32,835	29,482	85,875	77,953
Wet..... "	57,384	55,874	132,527	127,835
Ivory "	638	1,114	30,937	61,724
Manures :—				
Guano..... Tons	2,134	1,832	17,530	16,248
Bones..... "	2,748	6,942	12,874	35,925
Paraffin..... Cwt.	19,944	36,486	24,601	41,068
Linen rags..... Tons	3,064	2,907	32,649	31,379
Esparto, &c. "	18,067	15,635	93,152	74,169
Pulp of wood "	10,945	8,544	65,039	53,571
Rosin..... Cwt.	45,567	114,600	9,180	24,221
Tallow and stearin "	68,236	74,471	99,784	99,785
Tar Barrels	9,229	2,660	6,331	2,026
Wood :—				
Hewn Loads	179,471	178,707	420,053	521,098
Sawn "	453,783	453,980	1,050,538	1,175,095
Staves "	19,813	11,952	74,659	55,206
Mahogany Tons	2,809	3,420	23,432	30,167
Other articles....Value £	..	..	826,013	1,109,641
Total value .....	..	..	3,428,423	3,853,895

In addition to above, drugs to the value of 65,347, were imported, as against 70,376 in November 1888.

EXPORTS OF METALS OTHER THAN MACHINERY FOR MONTH ENDED 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Brass..... Cwt.	6,210	12,762	£ 34,439	£ 50,342
Copper :—				
Unwrought "	15,170	80,416	59,577	184,078
Wrought..... "	9,464	46,491	43,715	130,681
Mixed metal "	14,418	38,941	41,585	99,408
Hardware Value £	..	..	284,111	260,995
Iron and steel..... Tons	301,380	375,199	2,138,893	2,843,248
Lead "	4,017	3,428	61,495	50,658
Plated wares... Value £	..	..	46,769	46,354
Telegraphic wires . "	..	..	18,566	113,306
Tin Cwt.	6,919	8,106	36,029	39,561
Zinc "	4,844	8,599	3,840	8,506
Other articles .. Value £	..	..	165,959	205,643
Total value .....	..	..	2,944,978	4,032,840

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDED 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Alkali..... Cwt.	553,208	594,722	£ 143,237	£ 156,795
Bleaching materials "	154,520	131,834	61,304	48,122
Chemical manures. Tons	..	24,922	151,292	159,253
Medicines..... Value £	..	..	87,927	96,045
Other articles ... "	..	..	235,000	255,135
Total value .....	..	..	679,420	709,350

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDED 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Gunpowder..... Lb.	1,015,500	1,017,800	£ 31,779	£ 28,879
Military stores.. Value £	..	..	88,136	84,336
Candles..... Lb.	1,097,500	1,283,300	20,041	23,927
Caoutchouc Value £	..	..	96,372	99,741
Cement..... Tons	52,235	49,862	101,439	99,023
Earthenware ... Value £	..	..	188,299	195,890
Stoneware ..... "	..	..	10,853	19,833
Glass :—				
Plate..... Sq. Ft.	381,817	388,212	24,156	21,239
Flint..... Cwt.	11,399	10,759	27,878	26,855
Bottles..... "	81,112	83,021	37,650	39,067
Other kinds, ... "	19,014	15,209	13,348	18,078

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH
ENDED 30TH NOVEMBER—*cont.*

Articles.	Quantities.		Values.	
	1888.	1889.	1888.	1889.
Leather:—			£	£
Unwrought	13,706	15,209	121,271	127,633
Wrought Value £	..	..	38,625	33,952
Seed oil..... Tons	5,913	5,911	126,588	133,133
Floor cloth Sq. Yds.	1,358,900	1,326,300	65,126	63,030
Painters' mate- rials Value £	..	..	137,384	135,797
Paper Cwt.	112,087	92,389	182,123	164,015
Rags..... Tons	5,781	5,213	45,220	41,948
Soap Cwt.	43,154	41,951	41,987	47,270
Total value .....	..	..	2,869,976	3,082,569

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

18,528. H. H. Lake.—From La Société Anonyme des Parfums Naturels de Cannes, France. An improved method or process of and apparatus for the lixiviation of various materials. November 19.

18,529. W. T. Walker. Stills or apparatus for submitting liquids to the action of vapours or gases. Complete Specification. November 19.

19,002. J. E. Searles, jun. Improvements in method and apparatus for extracting the liquid of soluble constituents from disintegrated vegetable materials. Complete Specification. November 26.

19,070. E. W. Jacob and L. Watson. Filter for beer, spirits, wine, milk, and all other liquids. November 27.

19,096. T. Williams. Means and appliances for the production of pure carbonic oxide gas. November 27.

19,103. G. H. Lloyd, S. S. Lloyd, jun., and W. S. Sutherland. Improvements in the distribution and mixing of the inflammable gases or vapours and air utilised in gas or blow-pipe welding or heating, and in apparatus connected therewith. November 28.

19,222. E. Theisen. Apparatus for evaporating liquids. November 29.

19,488. A. L. Roek. Charging apparatus for blast and other furnaces, gas generators, kilns, ovens, and retorts. December 4.

19,533. S. Alley. Rotating furnaces for roasting or calcining ores or other substances. December 5.

19,607. S. Ralphs. Vessels or apparatus employed in concentrating sulphuric acid, and applicable for concentrating or distilling other acids or liquids. December 6.

19,906. W. H. Lonsdale. Cement for covering boilers, steam pipes, or vessels containing steam or heated water. December 11.

19,972. A. H. Hobson. Desiccating apparatus. December 11.

19,993. T. Smith. Boilers for utilising heat and making gas from the products of combustion. December 12.

20,049. D. Herman. Apparatus for concentrating solutions, drying substances, and like purposes. December 13.

20,147. A. J. Boulton.—From S. Touyrou. Machine for agglomerating and moulding sugar, brick, coal, or the like. December 14.

20,162. A. H. Hobson. Desiccating apparatus. December 14.

COMPLETE SPECIFICATIONS ACCEPTED.*

1888.

18,948. V. Popp. Method and apparatus for utilising compressed air for production of cold. December 4.

19,057. E. Dobson. Apparatus for consuming or preventing smoke in furnaces. December 4.

1889.

83. W. Lawrence. Apparatus for distillatory and other purposes. November 27.

676. P. de Mol and A. Gerken. Filters. December 11.

1462. E. Dueret. Filtering apparatus. December 11.

1847. E. Harrison. Apparatus for softening and purifying water and prevention of incrustation in boilers. December 18.

2675. W. F. Goreham and M. Watson. Arrangement of mills for grinding cement, phosphates, &c.

10,521. G. H. Barrus. Apparatus for determining the quantity of moisture in steam. December 18.

16,583. A. Collingridge. Condensing apparatus. December 11.

17,084. V. W. Blanchard. Furnace and apparatus for generating heat. December 11.

17,432. L. Fromm. Thermometers. December 11.

17,505. J. Martinez-Ancira. Centrifugal pump. December 11.

17,686. R. Davidson and E. Emanuel. Apparatus for supplying a continuous and unvarying quantity of air to blast-furnaces, blow-pipes, &c. December 18.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

18,502. E. Fales. Improvements in and relating to the method of and apparatus for burning coal and other fuel in furnaces. Complete Specification. November 19.

18,543. J. E. Butterworth. An improvement in fire-lighters. November 20.

18,831. Kirkham, Hulett, and Chandler, Lim., and J. Chandler. Improvements in apparatus for separating or extracting tar and other impurities from gas. November 23.

18,970. J. Woodward. Improvements in apparatus, mechanism, and arrangements for the manufacture of gas from coal, cannel, or other suitable material. November 26.

19,121. W. G. Robinson. Improvements in apparatus for generating and burning gas from heavy oils or carbonaceous fluids. November 28.

19,256. G. C. Trewby. Improvements in the method of and means for charging gas retorts. November 30.

19,310. J. Watts. Improved firelighters. December 2.

19,449. G. Hargreaves, J. P. Seranton, and E. W. Porter. Improvements relating to the manufacture of gas and to apparatus therefor. Complete Specification. December 3.

19,539. W. P. Thompson.—From — Roadman. Improvements in apparatus for reducing and pulverising mineral fuel and other materials to powder, and for supplying the same mixed with air to furnaces. December 5.

19,572. W. Wood. Improvements in apparatus for the manufacture of illuminating or heating gases. December 5.

19,668. H. Brooke. Improvements in firelighters. December 7.

19,721. F. J. Jones. Improvements in the process of, and in apparatus for, the manufacture of illuminating gas. December 7.

19,763. F. Morris. An improved apparatus for charging inclined gas retorts. December 9.

19,993. T. Smith. See Class I.

20,031. W. Smith. Improvements in lighting by means of gas. December 12.

20,083. F. Siemens. Improvements in regenerative gas furnaces and gas producers. December 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

17,613. F. J. Jones and L. C. Alexander. Apparatus for manufacture of gas for illuminating, &c., and suitable for other purposes. December 4.

18,465. J. F. Cohen. Manufacture of artificial fuel. December 11.

18,682. W. J. Righton. Instantaneous water heaters. December 4.

1889.

995. W. B. Westlake. Apparatus for manufacture of perforated fuel. November 27.

1011. W. B. Westlake. Apparatus for manufacture of perforated fuel. November 27.

2964. H. Bate. Method and appliance for intensifying the light of oil, gas, &c. December 11.

15,426. M. A. Morse. Manufacture of gas, and apparatus therefor. November 27.

16,138. E. Tatham. Gases or gaseous mixtures for the production of light, heat, and power. December 4.

16,142. E. Tatham. Improvements in coal gas and like gases, and their manufacture. December 4.

16,646. D. H. Knapp. Manufacture of gas. December 4.

17,538. — Badlam. Apparatus for supplying air to carburettors and the outlet pipes thereof. December 18.

17,697. D. Irving. Hydraulic gas mains and valves connected therewith. December 11.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, &c.

APPLICATIONS.

18,599. A. J. Boulton. — From L. Zwillinger, Austria. Improved process and apparatus for the production of best hard charcoal together with the simultaneous recovery of acetic acid, wood spirit, tar, ammonia, gas. November 20.

18,823. L. Zwillinger. Improved process and apparatus for the production of best hard charcoal, together with the simultaneous recovery of acetic acid, wood spirit, tar, ammonia, and gas. November 23.

19,183. J. A. Yeadon and W. Adgie. Improvements in retorts or furnaces for the distillation of coal or other analogous purposes. November 29.

COMPLETE SPECIFICATION ACCEPTED.

1889.

2569. J. H. du Vivier. Apparatus for production of pyroligneous acid. December 18.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

18,517. B. Willeox.—From The Farbenfabriken vorm. F. Bayer and Co., Germany. Improvements in the manufacture or production of azo-colouring matters. November 19.

18,518. B. Willeox.—From The Farbenfabriken vorm. F. Bayer and Co. Improvements in the manufacture of blue colours of the rosaniline group. November 19.

18,519. B. Willeox.—From The Farbenfabriken vorm. F. Bayer and Co. Improvements in and connected with the manufacture and production of direct dyeing colouring matters for dyeing and printing. November 19.

18,901. C. Dreyfus. Improvements in the manufacture and production of colouring matters for dyeing and printing. Complete Specification. November 25.

18,927. H. H. Griffiths. An improved copying ink. November 26.

19,655. B. Willeox.—From The Farbenfabriken vorm. F. Bayer and Co., Germany. Improvements in the manufacture and production of dyestuffs for dyeing and printing. December 6.

19,729. H. H. Lake.—From A. Leonhardt and Co., Germany. Improvements in the manufacture of colouring matter. December 7.

20,020. K. E. Klimosch and F. C. Weiss. A new manufacture of colouring matter for dyeing. December 12.

20,047. S. A. Sadler and A. Wolf. Improvements in the manufacture of alizarine and the alkaline salts of alizarine sulphonic acid. December 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1889.

1803. J. Frost. Method and means for concentrating solutions for the production of dyes, &c. December 11.

2499. O. N. Witt. Production of new azo dyes. December 18.

2635. R. Gnehm. New colouring matter, and its method of manufacture. December 18.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATIONS.

18,852. T. Burrows. Improved method of treating flax yarns. November 23.

18,853. T. Burrows. A novel method of preparing flax and hemp. November 23.

18,925. A. Mitscherlich. A method of and apparatus for manufacturing threads from wood. November 25.

18,932. K. T. Sutherland and G. Esdaile. An improved method of treating vegetable fibres so that they will spin more easily, and make stronger yarn, thread, or strand. November 26.

19,733. E. T. Truman. Improvements in the treatment of hemp, flax, jute, cotton, and other substances in order to preserve the same. December 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

17,574. H. Sauvage. Conversion of jute textiles. December 4.

1889.

2570. J. H. Du Vivier. A new composition called "artificial silk," for the production of threads, and for coating threads, fabrics, &c., and apparatus for manufacturing the said composition. December 18.

2571. J. H. Du Vivier. Apparatus for manufacturing textile threads from viscous or semi-fluid matters. December 18.

13,127. W. Latimer. Fibre from the leaves of needles of *Pinus Australis* and other coniferous trees. December 4.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

18,718. P. Thomas. Improvements in machinery or apparatus for bleaching yarn. November 22.

18,719. P. Thomas. Improvements in machinery or apparatus for bleaching and washing woven fabrics. November 22.

18,859. F. B. Gouty. An improved process and means for dyeing yarns and fibrous substances. November 25.

18,973. L. Weldon. Improvements in machines for dyeing cotton and analogous materials. Complete Specification. November 26.

19,408. C. Weber-Jacquel. Improved apparatus for dyeing, cleansing, bleaching, and drying yarn in cops or in similar condition. December 3.

19,490. L. Schreiner. A new or improved method of dyeing aniline black. December 4.

19,863. C. Corron. Improved apparatus for dyeing textile fabrics. December 10.

20,026. F. A. Eggleton. The manufacture of an improved medium for staining or colouring various substances. December 12.

20,064. R. Holliday. Improvements in producing azo colours on cotton or other vegetable fibres. December 13.

20,155. P. Rhodes. Improvements in apparatus for dyeing wool, wool tops, cotton, and other fibrous substances. December 14.

COMPLETE SPECIFICATION ACCEPTED.

1888.

18,904. J. Cowan. Indigo dyeing. November 27.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

18,701. P. Naef.—Partly communicated by G. Lunge, Switzerland. Improvements in treating impure hydrochloric acid or mixtures of gases containing hydrochloric acid for the manufacture of chlorine. November 22.

18,742. L. T. Thorne, E. Luck, and Brin's Oxygen Company, Limited. Improvements in the manufacture of vinegar. November 22.

18,904. W. P. Thompson.—From E. de Lom de Berg, Belgium. Process for the manufacture of picric acid by crude phenols. Complete Specification. November 25.

19,144. R. Fullarton. Process for the separation of carbonate of lime from phosphatic minerals. November 28.

19,225. T. Wilton and G. Wilton. Improvements in or connected with the manufacture of sulphate of ammonia and apparatus therefor. November 29.

19,573. H. L. Pattinson, jun. Improvements in the manufacture of oxides of the alkaline earths, and in apparatus for the purpose. December 5.

19,592. F. Ellershansen. Improvements in the manufacture of soda. December 5.

20,078. A. Martignier. An improved process for the extraction of the tartrate of lime contained in lyes and other tartarous matters, and its transformation into cream of tartar or into tartaric acid. December 13.

20,135. J. E. J. Johnson. Improvements in the manufacture of acetic acid and soluble acetates. Complete Specification. December 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

17,528. J. Barrow. Treating gases and recovering sulphur from sulphuretted hydrogen evolved in manufacturing processes. December 4.

18,574. E. Solvay. Manufacture of chlorine and chloride of lime, and apparatus therefor. November 27.

1889.

1885. C. Roth. Manufacture of nitrate of ammonia and sulphates, chlorides, and carbonates of potassium and sodium. December 11.

2310. T. Parker and E. Robinson. Production of chlorine and sulphate of soda. December 18.

2383. T. Parker and E. Robinson. Manufacture of cyanogen compounds from sulphocyanides. December 18.

12,451. A. W. Wahlenberg and J. A. Wahlenberg. Producing ammonium nitrate. December 18.

17,348. J. E. J. Johnson. Manufacture of acetic acid, soluble acetates, and calcium sulphites. December 18.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

18,621. J. Middleton. Improvements in the mode of and apparatus for producing upon earthenware imitations of granite or the like. November 21.

18,951. W. J. Hague. Improvements in and relating to kilns for burning clay goods, furnaces and like fires, and in utilising the heat from gas producers in connexion therewith. November 26.

19,090. J. B. Shelley and P. Shelley. Improvements in the manufacture of decorated earthenware, porcelain, glass, and the like. November 27.

19,101. T. W. Gimson, W. Kent, and T. Banks. Improved means for preparing the prints used in printing potters' ware, and apparatus therefor. November 28.

19,312. J. Whitehouse. Improvements in kilns and furnaces for heating and burning bricks, pottery, and the like, and other purposes. December 2.

19,734. D. Rylands. Improvements in the manufacture by machinery of glass tubes, sheet glass, and other glass ware. December 9.

19,744. G. A. Marsden. Improvements relating to the manufacture of tiles, bricks, or the like articles, having ornamented or decorated surfaces. Complete Specification. December 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1889.

1198. A. Ramsden. Method and machinery for making earthenware pipes. November 27.

2611. T. Davidson. Manufacture of articles of pressed glass. December 11.

6446. J. E. Matthewson. — From B. C. Tilghman. Ornamentation of glass, and apparatus therefor. November 27.

16,536. H. Hall. Tiles for lining walls. November 27.

16,683. E. Leak and H. Aynsley. Apparatus for supporting pottery ware while being fired. November 27.

16,742. E. Leak and H. Aynsley. Means for supporting pottery ware while being baked or fired. November 27.

17,105. J. B. Curtis and J. W. Mackintosh. Manufacture of hollow ware from glass, &c. December 4.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

18,187. H. H. Lake. — From G. M. Fiske, United States. Improvements relating to the construction of brickwork. Complete Specification. November 19.

18,493. H. H. Lake. — From G. M. Fiske. Improvements in bricks. Complete Specification. November 19.

18,744. C. D. Abel. — From The Actien Gesellschaft für Asphaltirung und Dachbedeckung vorm. J. Jeserich, Germany. An improved manufacture of artificial stone for building and other purposes. November 22.

18,898. C. Hucker. — From F. Rulf, Germany. Process for producing artificial stone for shelling and hulling grain. November 25.

18,911. P. de Kristoffovitch. Improved manufacture of artificial granite. Complete Specification. November 25.

19,092. W. S. Akerman. Improvements in boilers for utilising the waste heat of kilns or ovens for burning cement, lime, bricks, and other materials. November 27.

19,586. C. Smith. — From P. M. Elkjær. Improvements in and in the manufacture of imitation marble, stone, and mosaic. December 5.

19,601. J. S. Palmer. Plastic wall and ceiling covering composition in ornamental relief. December 6.

19,744. G. A. Marsden. See Class VIII.

19,818. H. A. Walker, A. C. Ponton, B. L. Mosely, and C. Chambers. A process for utilising waste or artificial cryolite in the manufacture of artificial stone. December 10.

20,107. W. S. Akerman. Improvements in and relating to kilns or ovens for burning bricks, lime, cement, or other materials. December 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

17,363. J. Hargreaves, T. Robinson, and J. Hargreaves. Manufacture of cement, and apparatus therefor. November 27.

1889.

2121. G. A. Wright. An improved block, tile, or slab for building and other purposes. December 11.

14,733. D. Nicoll. Waterproof slabs and blocks. November 27.

16,941. H. D. Blake. Block paving. December 4.

17,961. J. C. Fell. — From G. Phillips. Coating exposed wooden structures or timbers. December 18.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

18,581. J. Shears. Improvements in processes for recovering tin from solutions of tin oxides. November 20.

18,660. C. Davy. Improvements in or connected with apparatus for heating and forging large masses of metal. November 21.

18,710. D. W. Cuthbert. Improvements in obtaining gold and silver from ores. November 22.

18,728. A. S. Ramage. Improvements in the manufacture or purification of steel or iron. November 22.

18,985. C. A. Piat. Improvements in metallurgical furnaces. November 26.

19,145. E. A. Herberitz. Improvements in smelting furnaces. Complete Specification. November 28.

19,148. J. C. Bull. Improvements in the manufacture of metallic alloys and compounds, and in apparatus therefor. November 28.

19,287. R. Stone. Improvements in refining metals of all kinds and other substances, such improvements also effecting the consumption of smoke. November 30.

19,306. J. E. Bennett. Improvements in the treatment of metallic chlorides for extraction of metals therefrom. December 2.

19,333. W. Sellar. Improvements in the method of, and converters or machinery for, the manufacture of iron or steel. December 2.

19,334. W. L. Wise. — From B. Natusch, Germany. Process for the production of solutions of nickel and cobalt from ores or products containing these metals. Complete Specification. December 2.

19,384. T. Twynam. Improvements in the manufacture of steel. December 3.

19,501. C. Rahache. Improvements in and connected with the extraction or reduction of zinc from ores or compounds, and in apparatus therefor. December 4.

19,588. C. A. Faure. Improvements in the manufacture of ferro-aluminium, applicable also to other purposes. December 5.

19,621. D. Dumes and T. K. Rose. An improved process or means for extracting precious metals from their ores. Complete Specification. December 6.

19,622. D. Dumes and T. K. Rose. Improvements in machinery or apparatus for extracting precious metals from their ores. Complete Specification. December 6.

19,652. T. H. Johns. Improvements in the manufacture of tin andterne plates, and in the apparatus therefor. December 6.

19,653. T. H. Johns. Improved means and apparatus for coating sheet iron (galvanising) and finishing same. December 6.

19,672. C. Gelstharp. Improvements connected with means and apparatus for separating metals from ores or compounds containing metals. December 7.

19,687. T. Teague. Improvements in the utilisation of the alloys of tin and tin oxides, and separating same. December 7.

19,759. J. T. Penny and W. H. Richardson. An improved machine for triturating and amalgamating gold and silver bearing and other ores. Complete Specification. December 9.

19,859. A. P. Rushforth. Utilisation of waste gases and superfluous heat in cupola and blast furnaces, and in apparatus employed in the manufacture of iron and steel and the smelting of metals. December 10.

19,865. E. P. Peyton. Improvements in cleaning sheets of wrought iron, iron wire, and articles of wrought iron, and in utilising the waste products obtained, and in apparatus to be employed in conducting the said cleaning and utilising processes. December 10.

19,890. H. Aiken. Casting ingots, billets, &c. Complete Specification. December 10.

19,941. J. A. H. T. Rauff. An improved process and apparatus for the continuous extraction of gold and silver from substances containing the same, by the agency of chlorine. Complete Specification. December 14.

20,017. R. E. Shill. Improvements in apparatus for separating precious metals from ores or materials containing them. December 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

17,858. D. Q. Brin and A. Brin. Extracting iron from its ore, and purifying iron. December 4.

18,004. A. Clement-Conti. Apparatus for treating auriferous sand and other matters containing free gold. December 4.

18,493. R. A. Hadfield. Cutting hollow steel and other steel shells, and apparatus therefor. November 27.

18,506. R. A. Hadfield. Manufacture of hollow steel and other steel shells. November 27.

1889.

77. E. A. Billault. Manufacture of jewellery and ornamental objects from sulphide of silver. November 27.

812. R. A. Hadfield and A. G. M. Jack. Manufacture of cast steel shells. November 27.

868. J. Hart. Method of heating plates of steel, or any other metal. November 27.

1380. J. Müller. Miners' safety lamps. November 27.

1683. C. A. Caspersson. Determining the temper of iron and steel. December 11.

1987. J. Ward. Manufacture of compound plates of iron and steel. December 11.

1989. H. Y. Castner. Production of pure double chlorides of aluminium. December 11.

2369. L. Roberts, J. Jones, and The Moor Steel and Iron Co., L^{im}. Method and apparatus for charging pig iron and scrap, &c., into steel and open-hearth furnaces. December 18.

2456. W. Hawdon. Apparatus for removing molten slag or scoria from furnaces. December 18.

5351. J. Jones, C. Vernon, E. Holden, and R. Bennett. Making box piles for the production of blooms and bars, &c., of iron or steel, or mixtures thereof. December 18.

9289. W. F. M. McCarty, W. H. Ashton, and H. D. Wallbridge. Process and apparatus for producing steel direct from the ore. December 11.

13,986. J. Hansen. Apparatus used in the smelting of cast-iron borings, turnings, and shavings. December 18.

16,396. W. P. Thompson. — From J. B. Brewster. Amalgamators for extracting precious metals from impurities combined with them. December 11.

16,474. R. F. Ludlow. Manufacture of iron and steel. December 4.

17,065. F. D. Taylor. Improvements in moulding or casting, and in moulds therefor. December 4.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

18,365. J. B. Entz and W. A. Phillips. Improvements in and connected with plates for primary and secondary batteries. Complete Specification. November 18.

18,481. C. Payen. Improvements in secondary or storage batteries. Complete Specification. November 19.

18,680. H. Hauser. Improvements in the construction of dynamo-electric machines. November 21.

18,700. T. W. Watson and A. H. Watson. Improvements in connexion with electric battery cells. November 22.

18,755. A. Reckenzum. Improvements in the manufacture of plates for use in secondary batteries or electrical accumulators. November 22.

18,953. G. Macaulay-Cruikshank. — From W. A. Johnson and J. N. Smith, Canada. An improved electrode for secondary batteries or accumulators. Complete Specification. November 26.

18,966. O. A. Enholm. Improvements in primary or galvanic batteries. Complete Specification. November 26.

18,989. W. F. Smith. Improvements in secondary or storage batteries. Complete Specification. November 26.

19,080. H. T. Cheswright. An improved construction of plates for secondary or other voltaic batteries. November 27.

19,129. C. R. Bone. — From H. Meinecke, jun., Germany. Improvements in electric dry batteries. November 28.

19,335. H. Merryweather. Improvements in voltaic batteries. December 2.

19,491. G. Philippart. Improvements in electric batteries. December 1.

19,813. H. Wernley and H. Foster. Improvements in the methods and apparatus employed in the heating, melting, and working of metals, alloys, and metalloids by the application of electric currents. December 10.

19,857. Sir C. S. Forbes, Bart. Improvements in secondary battery elements. December 10.

19,861. C. H. Logan. Improvements in secondary batteries. Complete Specification. December 10.

19,883. J. K. Pumpelly and F. D. Thomason. Improvements in electrical secondary batteries. Complete Specification. December 10.

19,892. H. E. Fowler. Improvements in machines or apparatus for welding metal by means of electricity. Complete Specification. December 10.

19,899. W. P. Thompson.—From M. W. Parrish, United States. Improvements in or relating to electric batteries. December 10.

20,106. G. L. Hille. Improvements in and connected with electric batteries. December 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

14,445. Marino. Extraction and electro deposition of aluminium and aluminium alloys. December 18.

1889.

1535. J. A. Timmis. Construction and working of dynamos. December 11.

1571. T. B. Saunders. Galvanising iron and steel. December 4.

1673. G. Philippart. Secondary batteries. December 4.

5816. W. E. Langdon. Secondary batteries. November 27.

16,036. W. E. Irish. Galvanic batteries. November 27.

16,241. H. H. Carpenter. Electric storage batteries. December 11.

19,403. C. W. Kiamins and T. Craig. Improvements in the separation of fatty or greasy matters from the washwaters of wool washing or scouring establishments. December 3.

19,615. C. R. Hingworth. Improvements in soaps. December 6.

19,922. G. T. Cannon. A compound medical animal soap. December 11.

19,948. W. Grills and M. Schroeder. An improved process for the extraction of fats and oils from substances containing the same, by means of sulphurous acid. Complete Specification. December 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

18,852. H. H. Lake.—From La Société Anonyme des Parfums Naturels de Cannes. Purification of fatty substances, and apparatus therefor. November 27.

18,857. H. H. Lake.—From La Société Anonyme des Parfums Naturels de Cannes. Purification of fatty substances, and apparatus therefor. December 1.

1889.

1142. H. Guthrie. Manufacture of oil cake, and expression of oil from oleaginous seeds or kernels. November 27.

1501. W. Mc Lay. Lubricants. November 27.

17,741. W. Hepworth-Collins and W. J. Smith. Dry soap or washing powder. December 11.

17,742. W. Hepworth-Collins and W. J. Smith. A disinfectant and detergent dry soap or washing powder, or essence. December 11.

18,046. C. H. Robinson. Thickening linseed oil. December 18.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

18,592. J. Y. Johnson.—From L. Genevois, Italy. Improvements in the treatment or preparation for consumption of soft soaps and other like materials. Complete Specification. November 20.

18,628. L. T. Thorne and Brin's Oxygen Company, Limited. Improvements in the oxidation and thickening of oils for use in the manufacture of paints, varnishes, linoleum, floor cloth, or for other purposes to which thickened or oxidised oils are applicable. November 21.

18,988. W. H. Lever, J. D. Lever, and E. G. Scott. Improvements in extracting oil or grease. November 26.

19,158. P. Heinz. A new or improved method for sweetening margarine butter, and other oils and fats. Complete Specification. November 28.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

18,429. H. Joyce and W. Skade. A polish composition for leather and other surfaces. November 18.

18,628. L. T. Thorne and Brin's Oxygen Company, Limited. See Class XII.

18,642. C. Lohusen and C. Fenerlein. Improved process for the separation of an extract "Lanoresin" or gum resin from the waste waters of wool washing and combing mills, and for the production of the same in a pure condition. November 21.

18,706. R. F. Flynn. The novel application of pitch or oil residue in the manufacture of a floor covering to be known as "Corkoline carpet." November 22.

18,921. W. Feld. Improvements in the manufacture of permanent white and alkaline carbonate or alkaline bicarbonate. November 25.

19,343. G. Bischof. A process for the manufacture of white lead. December 2.

19,910. J. E. Wood. The improvement of "sublimed" white lead. December 11.

20,010. J. H. Bath. A pure boot blacking powder. Complete Specification. December 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1889.

1578. R. Stone. Manufacture of paints and pigments. December 11.

12,844. T. H. Wright. Composition for waterproofing, &c. December 4.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

18,503. R. W. Johnson. Improvements in and relating to plastics, more especially designed for imparting to glue a permanent elasticity, and adapted to be used for various purposes. Complete Specification. November 19.

18,730. W. P. Thompson.—From C. Heepe, Prussia. New or improved flexible material applicable as a substitute for wood or leather, and process of making the same. November 22.

COMPLETE SPECIFICATION ACCEPTED.

1889.

17,436. H. J. Haddan.—From J. Landini. Process for discolouring tannic acid solutions. December 11.

XV.—AGRICULTURE AND MANURES.

APPLICATIONS.

18,677. W. B. Kemshead. Improvements in the treatment of sewage and sewage matters, and in the production of fertilising products therefrom. November 21.

18,918. E. Saxl and H. Saxl. Improvements in fertilisers. Complete Specification. November 25.

19,225. T. Wilton and G. Wilton. See Class VII.

20,076. H. Fewson. An improved method of nitrogenising suitable substances or bodies. December 13.

COMPLETE SPECIFICATION ACCEPTED.

1889.

1710. W. Riddiough. Method of treating certain refuse matter to increase its fertilising properties. December 4.

XVI.—SUGARS, STARCHES, GUMS, Etc.

APPLICATIONS.

18,516. F. M. Lyte. Improvements in extracting iron from syrups which may have become contaminated with it, and from the substances used in its treatment. November 19.

19,728. W. Thomson, J. Mylne, and J. B. Allott. Improvements in apparatus for the expression of juice from sugar cane. Complete Specification. December 7.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

18,391. H. Stockheim. New or improved process of filtering beer or other liquids and apparatus therefor. November 18.

19,003. H. T. Brown, G. H. Morris, and E. R. Moritz. An improvement in the manufacture of beer. November 26.

19,376. J. F. H. Gronwald and E. H. C. Oehlmann. Improved process for treating beer and making it keep permanently in good condition. Complete Specification. December 3.

19,772. J. Torbitt. Improvements in the manufacture of alcoholic liquids from vegetable products. December 9.

19,996. W. Spilker, H. Bendel, M. Hahn, and C. Lüewe. A new method of killing microbe-like minute living organisms, such as yeast cells, bacilli, and the like, contained in wines, alcoholic and other similar liquors. Complete Specification. December 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1889.

83. W. Lawrence. See Class I.

770. H. E. Sorel. Treatment of commercial alcohols. December 18.

962. A. Malzy. Alcoholic beverages. December 4.

1942. G. G. Cave and J. H. Howell. Apparatus for promoting circulation and aëration of brewers' wort. December 11.

16,947. A. de Méritens. Rectifying or ageing alcohol or alcoholic liquors, &c. by electricity. November 27.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

18,281. E. Edwards.—From A. Seidensticker, Germany. An improved method of and apparatus for preserving milk. November 30.

19,882. H. Barotte. An improved process and apparatus for the production of dry extract of coffee. December 10.

B.—Sanitary Chemistry.

18,677. W. B. Kemshead. Improvements in the treatment of sewage and sewage matters, and in the production of fertilising products therefrom. November 21.

18,946. J. W. Calvert and J. Chaffer. Precipitating and filtering crude sludge running away from tanneries, factories, dye works, or from any other source, and putting it portable, without the aid of mechanical power, and without adding any solids. November 26.

19,638. R. Hannam. Improvements in the sanitary treatment of drains, and in materials to be used therefor. December 6.

C.—Disinfectants.

18,460. M. Hargreaves. Improvements in disinfectants and antiseptics. November 19.

18,512. J. Price. Improvements in disinfectants and deodorisers. November 19.

19,309. G. T. Moody and F. W. Streatfield. A new method of producing and liberating aerial or gaseous disinfectants. December 2.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1888.

18,079. G. D. Wheaton. Means for the preservation of perishable substances. December 4.

19,009. J. L. Johnston. Preparation and combination of animal substances for use as food. December 11.

1889.

1033. W. G. Pursell. Treating and preserving fish. November 27.

17,380. R. Denby. Preparation of rennet powder for cheese making. December 11.

B.—Sanitary Chemistry.

1888.

17,962. J. Wilkinson and J. B. Allott. Apparatus for treating refuse. December 1.

1889.

1144. C. F. Gower. Apparatus for extracting the solid suspended matter from sewage or other liquid. December 11.

1628. J. Bradbury. Construction of destructor furnaces, and means for heating them for burning noxious vapours, refuse, &c. December 4.

C.—Disinfectants.

1889.

11,974. F. G. A. Roberts, A. Shearer, and W. B. Giles. Preparation of antiseptics. December 4.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

19,903. W. P. Thompson.—From C. Rolland, France. Improvements in the preparation or treatment of paper for producing copies of drawings or the like by the action of light. December 10.

19,587. C. F. Cross and E. J. Bevan. Some new applications of cellulose. December 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

17,779. J. Von der Poppenburg. Manufacturing papers coated with metallic foil. November 27.

18,003. F. Salomon and H. Brungger. Protecting apparatus used in the manufacture of sulphite cellulose. December 11.

1889.

1433. R. Hamilton and J. C. Hamilton. Cleansing paper-making materials and other fibrous matters. November 27.

1834. C. Ramsey. Manufacture and bleaching of wood and other pulps, and apparatus therefor. December 4.

2439. D. M. Watson and T. T. M. Lumsden. Apparatus for manufacture of paper. December 18.

17,141. D. H. Ferguson. Process for manufacturing articles from pulp. December 4.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

18,434. G. Luman. So preparing the disulphones, such as sulphonal, tetronal, trional, &c., and afterwards enclosing the powders thus prepared in gelatinous or membranous capsules capable of containing them so as to render them soluble and consequently assimilative, active and certain. November 19.

18,990. W. H. Lever, J. D. Lever, and E. G. Scott. Improvements in the manufacture of tetrachloride of carbon. November 26.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

18,547. B. Jumeaux. A new or improved compound for use in photography. November 20.

19,205. J. B. Payne.—From F. C. Binns, New Zealand. An improved process or means for giving a matt surface to albuminised silver paper photographs or prints. November 29.

19,508. W. E. Debenham. Improvements in producing magnesium flash light. December 5.

COMPLETE SPECIFICATION ACCEPTED.

1889.

741. A. F. Y. Schwartz and F. H. Mercklin. Production of films sensitive to light, and of materials for assisting or continuing the effect of light on photographic films. December 4.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

18,738. A. Martin. Improvements in percussion fuses for explosive projectiles. November 22.

19,673. L. Davies and J. Turnbull, jun. Improvements in machinery for making gunpowder pellets or compressed cartridges. December 7.

19,674. L. Davies. Improvements in treating gunpowder pellets. December 7.

19,935. A. T. Cocking. Improvements in treating and using explosives whereby the flame produced is controlled and quenched.

19,971. A. Martin. Improvements in percussion fuses for explosive projectiles. December 11.

20,013. F. E. Spiller. Improved means for igniting lucifer matches. December 12.

20,104. The Roburite Explosives Co., Lim., C. Roth, and W. J. Orman. Improvements in the treatment or preparation of nitrate of ammonium. December 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1888.

17,631. H. Ritter von Dahmen. Manufacture of nitro-glycerin and dynamite. November 27.

1889.

2078. O. Inray.—From F. C. Glaser. Granulating and glazing gelatinous explosives. December 11.

13,907. H. H. Leigh.—From La Compagnie Forat. Apparatus and process for the manufacture of nitro-glycerin. December 4.

XXIII.—ANALYTICAL CHEMISTRY.

APPLICATIONS.

18,856. A. W. Gerrard. Estimating the quantity of glucose or grape sugar in fluids. November 25.

19,470. A. T. Rapkin. Improvements in pyrometers. December 4.

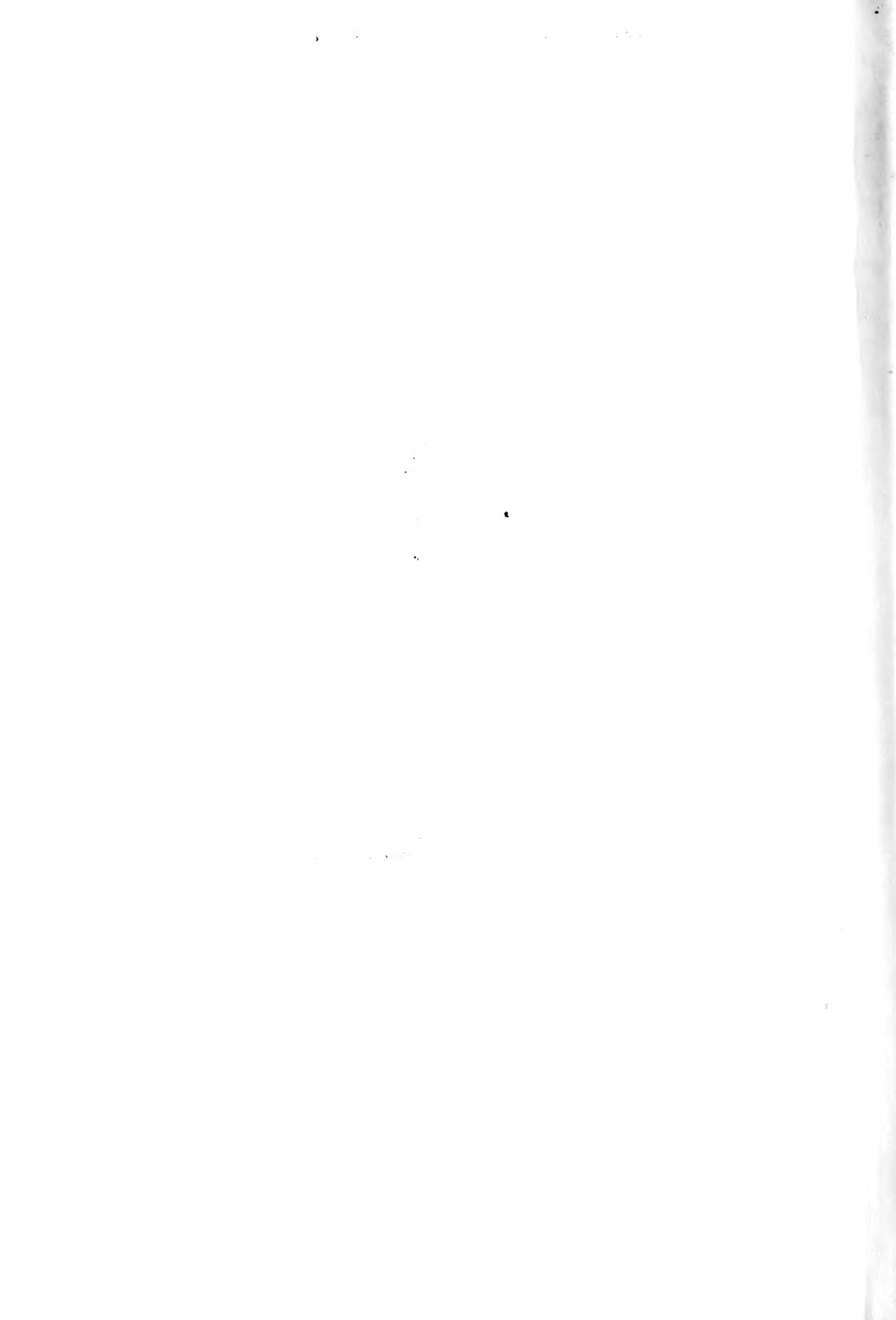
19,669. R. M. Douglas. Improvements in Sykes' hydrometer. December 7.

COMPLETE SPECIFICATION ACCEPTED.

1889.

15,800. H. Cortland. Thermostats. November 27.

*21 J.*



TP Society of Chemical Industry,
1 London
S59 Journal
v.8
cop.2

~~Physical & Applied Sci~~
~~Sciences~~

Engineering

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY

ENGINE STORAGE

